



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.06.2020 Bulletin 2020/26

(51) Int Cl.:
D03D 39/22 (2006.01) **D03D 49/10 (2006.01)**
D03D 49/12 (2006.01) **D03D 49/18 (2006.01)**
D03D 51/44 (2006.01)

(21) Application number: **19211850.3**

(22) Date of filing: **27.11.2019**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Tsudakoma Kogyo Kabushiki Kaisha**
Kanazawa-shi, Ishikawa-ken 921-8650 (JP)

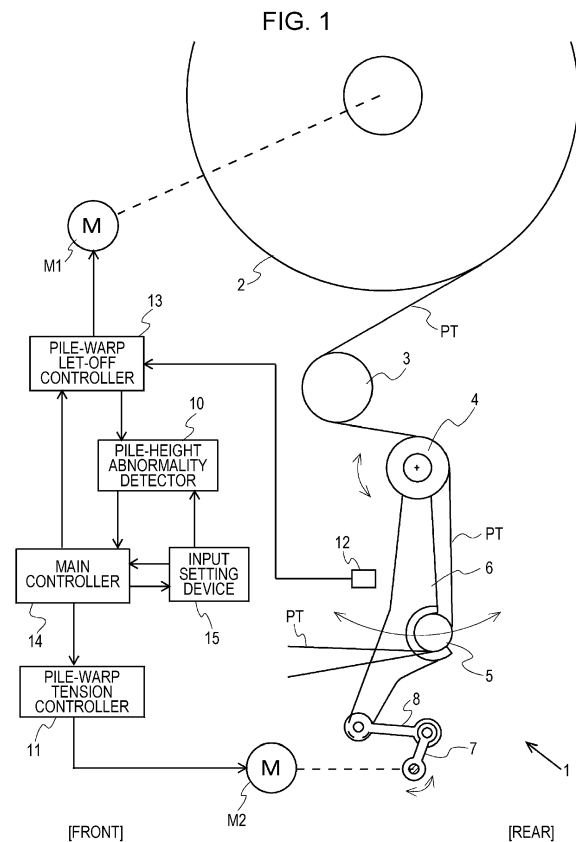
(72) Inventor: **ITO, Naoyuki**
Ishikawa-ken 921-8650 (JP)

(74) Representative: **Eisenführ Speiser**
Patentanwälte Rechtsanwälte PartGmbB
Postfach 31 02 60
80102 München (DE)

(30) Priority: **21.12.2018 JP 2018239677**

(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 swingably and displaceably with respect to a loom frame and a position detecting device that detects a 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 presence/absence of an occurrence of a pile-height abnormality in pile fabrics under weaving is preset. When an occurrence of 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.



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 configured to be displaced in accordance with tension of the pile warp to cause the tension of the pile warp to be within a desired range, the pile loom being configured to perform tension control relating to the pile warp during operation of the loom, the tension control adjusting, based on a result of detection 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 a preset allowable range, the allowable range being 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 of the reference position of the pile tension roller.

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). More 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 pivotably supported at a fixed fulcrum on the loom and is disposed so as to be swingable and displaceable in the front-rear direction of the loom. The pile loom is configured such that, when a 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 is configured to perform, when the aforementioned position of the pile tension roller becomes outside a preset allowable range due to displacement in response to the aforementioned change in the tension of the pile warp, let-off control (tension control of the pile warp) that corrects a let-off amount (let-off speed) of the pile warp. In other words, since the tension of a pile warp affects the pile height of a pile fabric to be woven, such tension con-

trol of the pile warp is performed in the pile loom in consideration of the quality of the pile fabric. Incidentally, the tension of the pile warp unavoidably changes during weaving in response to, for example, a change (decrease) in the winding diameter of the pile warp beam. The aforementioned tension control of the pile warp is performed to respond to such an unavoidable change in 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, 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 on the front side and the rear side, respectively, with respect to 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, 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, an event in which the height of a pile of a pile fabric under weaving becomes higher than a desired height may occur due to some causes. When such an event continuously occurs, a woven pile fabric is caused to have considerably degraded quality.

SUMMARY OF THE INVENTION

[0007] Accordingly, the present invention provides a method of detecting occurrence of pile-height abnormality, which is a state in which a state in which a pile height becomes higher than a desired height is continuously generated; and a pile loom including a device for detecting the pile-height abnormality.

[0008] 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

configured to be displaced in accordance with tension of the pile warp to cause the tension of the pile warp to be within a desired range, the pile loom being configured to perform tension control relating to the pile warp during operation of the loom, the tension control adjusting, based on a result of detection performed by the position detecting device, a let-off speed of the pile warp beam to cause the position of the pile tension roller to be within a preset allowable range, the allowable range being 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 of the reference position of the pile tension roller.

[0009] A method of detecting a pile-height abnormality according to the present invention includes previously determining, in the pile loom, an abnormality determination position for determining presence/absence of an occurrence of a pile-height abnormality, which is a state in which a state in which a pile height becomes higher than a desired height is continuously generated in a pile fabric under weaving, the abnormality determination position being set at the front limit position or at a position on a front side of the front limit position; and generating an abnormality signal during the operation of the loom when an occurrence of the pile-height abnormality is detected based on the pile tension roller or the swing member arriving at the abnormality determination position.

[0010] 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 less 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 presence/absence of an occurrence of the pile-height abnormality may be preset, and, when a period in which the detection value is less 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 in response to generation of the abnormality signal.

[0011] In addition, a pile loom including a device for detecting the pile-height abnormality according to the present invention includes an abnormality detecting device that generates an abnormality signal based on the pile tension roller or the swing member arriving at an abnormality determination position in the pile loom.

[0012] In the pile loom including the device for detect-

ing 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 based on the detection value being less 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 a monitor period, and the abnormality determination unit may have a function of grasping an abnormal period, the abnormal period being a period in which the detection value is less than or equal to the abnormality determination value, and may be configured to generate the abnormality signal when the abnormal period reaches the monitor period. Moreover, the abnormality signal may be a signal for stopping the loom.

[0013] According to the present invention, the abnormality determination position that is for determining presence/absence of an occurrence of the pile-height abnormality, which is a state in which a state in which a pile height becomes higher than a desired height is continuously generated, and that is set in relation to the position of the pile tension roller or the position of the swing member is previously determined. During the operation of the loom (during weaving), the pile-height abnormality is detected based on the position of the pile tension roller or the swing member in the front-rear direction detected by the position detecting device being at the abnormality determination position. In other words, the inventors of the present invention considered that the pile-height abnormality 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 based on a detected position of the pile tension roller or the swing member.

[0014] More specifically, in the pile loom, the shifting amount of a loom front position due to a terry motion is set in accordance with a pile height (desired height) of a pile fabric to be woven. In weaving, a pile is not formed by the entirety of a pile warp of a length corresponding to the shifting amount, and, in a state in which the pile warp is in a range of a proper tension, some slipping off of the pile warp occurs during pile formation by fast pick. Therefore, the shifting amount is set such that a pile warp that is slightly longer than a length of the pile warp for forming a desired pile height is present between the loom front and a beating position for a period of loose pick. The aforementioned state in which the pile warp is in a range of a proper tension is a state in which the pile tension roller is positioned, in relation with a basic pile-warp let-off amount and the like, within the aforementioned

allowable range in weaving in which some slipping off of a pile occurs as described above in each formation of the pile.

[0015] However, there is a case, although causes are unknown, in which a pile height is formed so as to be higher than the aforementioned desired height during weaving. Such a case is a result of a pile being formed with a pile warp of a length corresponding to the shifting amount when the aforementioned some slipping off of a pile, which should occur originally, does not occur due to some causes. There is a case in which such a pile having a pile height higher than a desired height is continuously formed (a state in which piles having a high pile height are formed in a portion of a range of a pile fabric is generated). In such a case, a woven fabric has degraded quality.

[0016] When the pile height is formed so as to be higher than a desired height (the some slipping off of a pile does not occur during formation of the pile) as described above, a pile warp is consumed more than usual for each formation of a pile by an amount corresponding to no occurrence of the slipping off of the pile. The basic let-off amount of the pile warp is set such that, in a state in which the pile tension roller is positioned within the aforementioned allowable range, the tension of the pile warp is in the aforementioned proper range in a state in which normal slipping off of a pile occurs. Thus, when a pile having a pile height higher than a desired height is continuously formed, the tension of the pile warp sharply increases. Consequently, in response to the increase in the tension of the pile warp, the pile tension roller is swung and displaced (more specifically, displaced toward the front side), as described above, together with the swing member.

[0017] In contrast, under the tension control, when the pile tension roller is displaced and the position thereof becomes 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 an unavoidable change in the tension of the pile warp generated in a normal state, such as a change in the tension of the pile warp due to the aforementioned change in the winding diameter of the pile warp beam. In other words, the tension control is not expected to be performed for an abnormal change in the tension of the pile warp due to an occurrence of the pile-height abnormality, which is a state in which the aforementioned state in which a pile height is formed to be higher than a desired height is continuously generated. Therefore, the tension control is insufficient for an increase in the pile warp tension due to such unexpected pile-height abnormality, which causes the pile tension roller not to return within the allowable range (to be further displaced toward the front side), even when the tension control of the pile warp by the let-off control is performed.

[0018] Accordingly, in the present invention, the abnormality determination position for determining pres-

ence/absence of an occurrence of the pile-height abnormality is determined at the front limit position or at a position on the front side of the front limit position in the allowable range. In addition, it becomes possible to detect an occurrence of the pile-height abnormality, which is not detected in 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 originally, and on the basis of the determination, an occurrence of the pile-height abnormality is detected.

[0019] Incidentally, in existing pile looms, an occurrence of the pile-height abnormality is not basically expected, and therefore, even an idea for detecting, in some form or another, an occurrence of the pile-height abnormality has been present. Thus, even when the aforementioned state in which the state in which a pile height becomes higher than a desired height is continuously generated is generated in an existing pile loom, weaving is continued in the state as it is unless the continuous generation of the state is noticed by an operator. Moreover, it is necessary to directly observe and check pile fabrics during weaving to notice the continuous generation of the state, and it is thus not possible to perform checking at a position away from the loom, which may result in delay in noticing the continuous generation of the state. As a result, the quality of a woven pile fabric is considerably degraded.

[0020] In contrast, according to the present invention, occurrence of the pile-height abnormality is detected as described above, and the abnormality signal is generated in response thereto. In this case, for example, by causing, based on generation of the abnormality signal, an alarm lamp of the loom to flash and a display of the loom to display a message indicating an occurrence of the pile-height abnormality, it is possible to grasp an occurrence of the pile-height abnormality during weaving in the loom through the alarm lamp and the like. Consequently, it is possible to notice the occurrence of the pile-height abnormality in an early stage, which enables weaving to be avoided from being continued in a state in which the state in which a pile height is higher than a desired height is continuously generated. Moreover, by causing the loom to stop based on the abnormality signal, it is possible to avoid weaving from being continued in the state in which the state in which a pile height is higher than a desired height is continuously generated, even when, for example, no operator is stationed in a weaving factory and it is thus not possible to immediately grasp an occurrence of the 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 in the state in which the state in which

a pile height is higher than a desired height is continuously generated; 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 more simple configuration by configuring the present invention 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, to perform the aforementioned determination, a detector is needed because of the necessity of grasping the position of the pile tension roller or the swing member; however, when the position detecting device for the tension control of the pile warp originally provided in the pile loom on which the present invention is based is also used as the detector thereof, 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 an occurrence of the pile-height abnormality in an earlier stage. Specifically, in the pile loom, there is a state in which the aforementioned unavoidable tension change also causes the pile tension roller to be displaced to a position in the vicinity of the front limit position, and weaving is continued in the state. In this state, when the pile tension roller is displaced in response to pile formation, inertia generated due to the displacement may cause the pile tension roller to be temporarily displaced to a position beyond the front limit position. Therefore, when such a circumstance is expected, the abnormality determination position needs to be set at a position sufficiently separated from the front 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 at a time point when the pile tension roller or the swing member is swung and displaced to the thus 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 front 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 an occurrence of the pile-height abnormality at an earlier stage.

[0025] In addition, by configuring the loom, as described above, so as to stop in response to generation of the abnormality signal, it is possible to minimize a por-

tion (range) that is woven in a state in which the pile-height abnormality occurs, because the pile-height abnormality does not continue after the stoppage.

5 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 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 that is constituted by a drive lever 7 attached to an output shaft of the torque motor M2, and a link rod 8 that 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. As a result of the drive of the torque motor M2 being thus controlled, the pile tension roller 5 applies 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 arranged at a predetermined position (reference position) in the front-rear direction of the loom. The urging force is a force having a certain magnitude in accordance with the predetermined set tension value, and the arrangement of the pile tension roller 5 is determined by 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 change in the tension of the pile warp PT is generated in the pile loom during weaving. As a result, the pile tension roller 5 is swung and displaced in accordance with the change in the tension 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, and thus, the pile tension roller 5 is 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 in response to that, the tension of the pile warp PT increases. The swing and displacement of the pile tension roller 5 stop 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, in response to that, the tension of the pile warp PT decreases, and thus, the swing and displacement of the pile tension roller 5 stop 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 tension in accordance with the set tension value because, even when the tension of the pile warp PT changes, the change in the tension is offset by the aforementioned change in the path length in response to 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 loom RPM and a setting value of weft density that are previously stored in the main controller 14 and the winding diameter of the pile warp PT obtained as described above. The pile-warp let-off controller 13 controls the drive of the let-off motor M1 in accordance with 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, the front-rear position changing as described above in accordance with 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 with respect to the reference position and a limit position (front limit position) set on the front side with respect to the reference position. Each of the rear and front limit positions is a position that is set such that when the pile tension roller 5 is positioned beyond the limit position in relation 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) there-

of 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, the setting value of each of the rear threshold and the front threshold is also set as a distance from the position detector 12.

[0043] During weaving, 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 tension levers 6 are displaced toward the rear side beyond the rear limit position, the pile-warp let-off controller 13 adjusts the let-off speed of the pile warp PT to be decreased. Consequently, the tension of the pile warp PT balancing with the urging force changes in a direction of increasing 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 the let-off speed of the pile warp PT to be increased. Consequently, the tension of the pile warp PT changes in a direction of decreasing 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 an occurrence of the pile-height abnormality, which is a state in which a state in which a pile height becomes higher than a desired height is continuously generated. 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 presence/absence of an occurrence of the pile-height abnormality (hereinafter also referred to as the "abnormality determination") and that is set at the front limit position or at a position on the front side of the front 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 grasping 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, for the tension control of the pile warp PT, the front-rear position of the tension levers 6. In the present embodiment, the distance detecting device is also used as the detector, and the determination of the arrival is performed 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 a distance from the position detector 12 to the abnormality determination position. The abnormality determination is performed on the basis of the detection value being less 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 less 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 cycles of the loom. Thus, the abnormal period to be compared with the monitor period is also obtained in units of the number of 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 in response to generation of the abnormality signal.

[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 (the 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 includes, for example, a touch-panel display screen, and various setting values can be input and set with a setting screen and the like displayed on the display screen. The abnormality determination value and the monitor period are input and set in the input setting device 15, and the abnormality determination value and the monitor period are sent to the storage 21 in response to the inputting and setting and are 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 front side of the aforementioned front limit position and in the vicinity of the front 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 temporary displacement of the pile tension roller 5 toward the front side from being detected as an occurrence of a pile-height abnormality.

[0054] More 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) is 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, there is a state in which the tension levers 6 are present 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 thus operates in a state in which the tension levers 6 are present, 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 front limit position, and therefore, the detection value may become less than or equal to the abnormality determination value depending on the displacement.

[0055] The temporary displacement is, however, not the displacement of the pile tension roller 5 in response to an occurrence of a state in which a pile height becomes higher than a desired height (hereinafter also referred to as the "high-pile state"), and thus, the temporary displacement needs to be avoided from being detected as the displacement of the pile tension roller 5 due to a continuous generation of the high-pile state.

[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 front limit position is caused as a result of generation of the high-pile state in the pile loom and continuous generation of the high-pile state. However, when the generation of the high-pile state is temporary (for a short period), the displacement of the pile tension roller 5 due to the high-pile state is cancelled when the pile-height returns to a desired height. 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, when continuous generation of the high-pile state is temporary and ends after a short period, the front-rear position of the tension levers 6 returns again to a position not at or beyond the abnormality determination position, even when the front-rear position of the tension levers 6 is temporarily at or beyond the abnormality determination position. In other words, even when the detection value of the tension levers 6 is temporarily less than or equal to the abnormality determination value, the detection value becomes more than the abnormality determination value again.

[0058] Even when being in a state in which the high-pile state is continuously generated, pile fabrics of some types allow the state, from the point of view of quality, depending on the size of the range of the generation for a reason that, for example, a pile height higher than a desired height is less noticeable depending on the patterns of the pile fabrics. In other words, in pile fabrics of some types, the state in which continuous high-pile state is generated during weaving is not necessarily considered abnormal and may not be considered abnormal depending on the size of the range of generation.

[0059] Thus, in the present embodiment, the aforementioned monitor period is set to avoid generation of the continuous high-pile state within a range 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 less 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

becomes less than or equal to the abnormality determination value as described above, generation of the continuous high-pile state is not detected as abnormality unless the period in which the detection value is less than or equal to the abnormality determination value reaches the monitor period. In other words, in the present embodiment, a pile-height abnormality is detected based on the period in which the detection value is less than or equal to the abnormality determination value reaching the monitor period.

[0060] Thus, in the present embodiment, the monitor period is set as a period in consideration of a degree (size of the range of generation) of generation of the high-pile state allowable from the point of view of quality in a pile fabric to be woven. As described above, in the present embodiment, the monitor period is set in units of the number of 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 (pile formation cycle $\times$ the number of piles) of the loom required to form one pile is set as the setting value for 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 abnormality 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, for each calculation, the calculated average value to the comparator 22. 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 corresponding to 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 the 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 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 less 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 less than or equal to the abnormality determination value. When determining that the detection value is more than the abnormality determination value, the abnormality determination unit 23 resets the count value.

[0064] Thus, according to the above configuration, at a time point when the detection value first becomes less than or equal to the abnormality determination value (at a time point when the deviation becomes less than or equal to zero), counting of the number of 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 less than or equal to the abnormality determination value (while the deviation is less than or equal to zero). Even after the counting of the number of cycles in the counter 24 is started, when the detection value becomes more than the abnormality determination value (when the deviation becomes more than zero), the count value of the counter 24 is reset, and until before the detection value first becomes less than or equal to the abnormality determination value again, 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 thereof, 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 it is detected that a pile-height abnormality with the abnormal period reaching the monitor period is generated), the abnormality determination unit 23 outputs the loom stop signal as the abnormality signal to the main controller 14.

[0066] Operation of the pile-height abnormality detector 10 in the present embodiment described above is as follows.

[0067] When the high-pile state is generated due to some causes during weaving, the pile warp is consumed more than usual for each formation of a pile by an amount corresponding to no occurrence of the some slipping off of a pile during formation of the pile. When the high-pile state is continuously generated, the tension of the pile warp PT sharply increases, and, in response thereto, the pile tension roller 5 is displaced toward the front side. At this time, when the continuous generation of the high-pile state does not end, the displacement of the pile tension roller 5 toward the front side is continuously generated.

[0068] When the front-rear position of the tension levers 6 is beyond the aforementioned front limit position in response to the displacement, the pile-warp let-off con-

troller 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 change in the tension of the pile warp PT in response to the change (decrease) in the winding diameter of the pile warp beam 2 and is not expected to be performed for an abnormal change in the tension of the pile warp PT due to generation of the continuous high-pile state. In other words, the adjustment of the let-off speed performed by the pile-warp let-off controller 13 is insufficient for displacement of the pile tension roller 5 due to the aforementioned continuous high-pile state. Therefore, even when the let-off speed is thus adjusted, the front-rear position of the pile tension roller 5 (tension levers 6) is not returned, and the displacement of the pile tension roller 5 toward the front side continues in the state in which generation of the high-pile state continues.

[0069] During weaving, an output of the detection value to the comparator 22 of the pile-height abnormality detector 10 by the pile-warp let-off controller 13 is performed for each cycle of the loom. The comparator 22 compares the detection value with the abnormality determination value, for each input of the detection value, to obtain the deviation and outputs the deviation signal that indicates the magnitude of the deviation to the abnormality determination 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 a result of the displacement of the pile tension roller 5 continuing as described above, the detection value becomes less than or equal to the abnormality determination value. Thus, the deviation signal output by the comparator 22 becomes a signal indicating that the deviation ≤ 0 .

[0071] When the deviation signal indicating that the deviation ≤ 0 is input into the abnormality determination unit 23, the abnormality determination unit 23 increments (+1) the count value of the counter 24 (the count value is initially set to zero and thus is incremented to 1). In other words, while the deviation signal indicating that the deviation ≤ 0 is continuously input, the abnormality determination unit 23 counts the number of input with 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 cycles of the loom.

[0072] Then, the detection value continues to be less than or equal to the abnormality determination value when continuous generation of the high-pile state does not end and when the displacement of the pile tension roller 5 due to the high-pile state continues. Thus, the deviation signal output for each cycle of the loom by the comparator 22 becomes a signal indicating that the deviation ≤ 0 throughout a period in which the detection value is less than or equal to the abnormality determination value. In response to that, the abnormality determination unit 23 increments the count value of the counter

24 for each input of the deviation signal.

[0073] As described above, however, the high-pile state may end after a short period because the cause of the generation of the high-pile state is temporary. In this case, the displacement of the pile tension roller 5 toward the front side due to the high-pile state stops. At a time point when the displacement stops, the detection value is more than the front threshold. Thus, when the let-off speed of the pile warp PT is adjusted by the pile-warp let-off controller 13, the pile tension roller 5 is displaced toward the rear side. As a result, the detection value becomes more than the abnormality determination value. In response to that, the deviation signal output by the comparator 22 becomes a signal indicating that the 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, in response to an input of the abnormality signal, the main controller 14 performs control for stopping the loom. Consequently, weaving is stopped in the pile loom, which avoids weaving from being continued in a state in which the high-pile state is continuously generated as described above. Therefore, according to the pile-height abnormality detector 10 described above, it is possible to minimize a portion (range) to be woven in a state in which the pile height is formed to be higher than a desired height, and it is thus possible to avoid 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 in response to an input of the abnormality signal and outputs a signal indicating a cause (continuous generation of the high-pile state) 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 continuous generation of the high-pile state.

[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 high-pile state is continuously generated, if the range of the generation 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

front limit position, even when continuous generation of the high-pile state does not occur. Moreover, even when the high-pile state is continuously generated, the high-pile state may be allowed from the point of view of quality depending on the size of the range of the generation thereof. Taking these circumstances into consideration, it is conceivable to set the abnormality determination position at a position away from the front limit position and to perform determination of whether to generate the abnormality signal only by comparing the abnormality determination value corresponding to the abnormality determination position with the detection value. However, the pile height in the high-pile state is not necessarily constant, and it is thus difficult to grasp the range of the generation on a woven pile fabric in strict association with the amount of the displacement (front-rear position) of the pile tension roller 5. Thus, when the determination is thus performed only with the abnormality determination position, it is necessary to set the abnormality determination position by considering that slight slipping off of piles occurs during formation of each pile even in a state in which the high-pile state is continuously generated. In this case, the abnormality signal may be output, even when the range of generation is within the allowable range.

[0079] To address the above, 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 front limit position, and the monitor period corresponding to the allowable range of generation is set. Consequently, while avoiding the abnormality signal from being output in response to the aforementioned temporary displacement of the pile tension roller 5, it is possible to avoid generation of a state in which the abnormality signal is 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 cycles of the loom. Meanwhile, the range of generation corresponds to the number of piles formed in a period of the generation, and the number of the cycles of the loom (pile formation cycle) required for forming one pile is previously grasped. Accordingly, when the monitor period is thus set in units of the number of 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 the following modified embodiment.

(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 also 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 a 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 at a time point 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 at a time point when being determined to be beyond) the abnormality determination position. In this case, the abnormality determination position is preferably set at a position away from the front limit position in consideration of the aforementioned temporary displacement of the pile tension roller 5.

(3) As described above, the detector for grasping 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) that is for tension control of the pile warp and that is originally provided at 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). 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 every multiple 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 of a case in which the detector is also used as the let-off device 1 and a case 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 be another device that has a different

detection configuration. For example, the detector may be a device that detects an inclination (swing angle) of the detected member that changes in response to 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.

In addition, the detector is not limited to a device configured to, similarly to the distance detecting device and the angle sensor described above, continuously 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.

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 thereof. The detection signal may be the abnormality signal or, similarly to the aforementioned embodiment, the abnormality signal may be generated after a lapse of a preset monitor period after a time point when the detected member arrives at the abnormality detection position.

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 front side beyond the abnormality determination position. In addition, similarly to the aforementioned embodiment, counting of the abnormal period may be started at a time point when the proximity body is detected by the proximity switch (at a time point 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 front side of the front 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 position of the front limit position. In other words, the front threshold in

the aforementioned embodiment may be also used as the abnormality determination value. However, as described above, the front limit position is a position that causes the tension control to be performed and thus is a position at which the detected member arrives even in a normal weaving state in which the continuous high-pile state is not generated. Accordingly, when the front 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 such that the abnormality signal is generated after a lapse of the monitor period after the detected member arrives at the abnormality determination position, in order to avoid the abnormality detection from being performed even when the continuous high-pile state is not generated.

(6) The aforementioned embodiment is an example in which the abnormality signal is used as the loom stop signal, and the pile loom is configured to perform, in response to generation of the abnormality signal, stop operation to stop the pile loom and to perform 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 in response to generation of the abnormality signal are not limited to these three operations; one or two of the operations may be performed. In other words, in response to generation of the abnormality signal of the present invention, the pile loom may perform at least one of the stop operation, the alarm operation, and the display operation described above.

[0082] Note that the present invention is not limited to the examples described above and can be modified, as appropriate, within a 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 (6) that is swung and displaced together with the pile tension roller (5), the pile tension roller (5) being configured to be displaced in accordance with tension of the pile warp (PT) to cause the tension of the pile warp (PT) to be within a desired range, the pile loom being configured to perform tension control relating to the pile

warp (PT) during operation of the loom, the tension control adjusting, based on a result of detection performed by the position detecting device, a let-off speed of the pile warp beam (2) to cause the position of the pile tension roller (5) to be within a preset allowable range, the allowable range being 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 of the reference position of the pile tension roller (5), the method comprising:

previously determining an abnormality determination position for determining presence/absence of an occurrence of a pile-height abnormality, which is a state in which a pile height becomes higher than a desired height is continuously generated in a pile fabric under weaving, the abnormality determination position being set at the front limit position or at a position on a front side of the front limit position; and

generating an abnormality signal during the operation of the loom when an occurrence of the pile-height abnormality is detected based on the pile tension roller (5) or the swing member (6) 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 (6), 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 less than or equal to the abnormality determination value, an arrival of the pile tension roller (5) or the swing member (6) 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 presence/absence of an occurrence of the pile-height abnormality is preset, and wherein, when a period in which the detection value is less 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 in response to generation of the abnormality signal.

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 (6) that is swung and displaced together with the pile tension roller (5), the pile tension roller (5) being configured to be displaced in accordance with tension of the pile warp (PT) to cause the tension of the pile warp (PT) to be within a desired range, the pile loom being configured to perform tension control relating to the pile warp (PT) during operation of the loom, the tension control adjusting, based on a result of detection performed by the position detecting device, a let-off speed of the pile warp beam (2) to cause the position of the pile tension roller (5) to be within a preset allowable range, the allowable range being 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 of the reference position of the pile tension roller (5), the pile loom comprising: an abnormality detecting device that generates an abnormality signal based on the pile tension roller (5) or the swing member (6) arriving at an abnormality determination position for determining presence/absence of an occurrence of a pile-height abnormality, which is a state in which a pile height becomes higher than a desired height is continuously generated in a pile fabric under weaving, the abnormality determination position being set at the front limit position or at a position on a front side of the front 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 (6), 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 based on the detection value being less 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 presence/absence of an occurrence of the pile-height abnormality, and wherein the abnormality determination unit (23) has a function of grasping an abnormal period, the abnormal period being a period in which the detection value is less than or equal to the abnormality determination value, the abnormality determination unit (23) being configured to generate 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.

20

25

30

35

40

45

50

55

FIG. 1

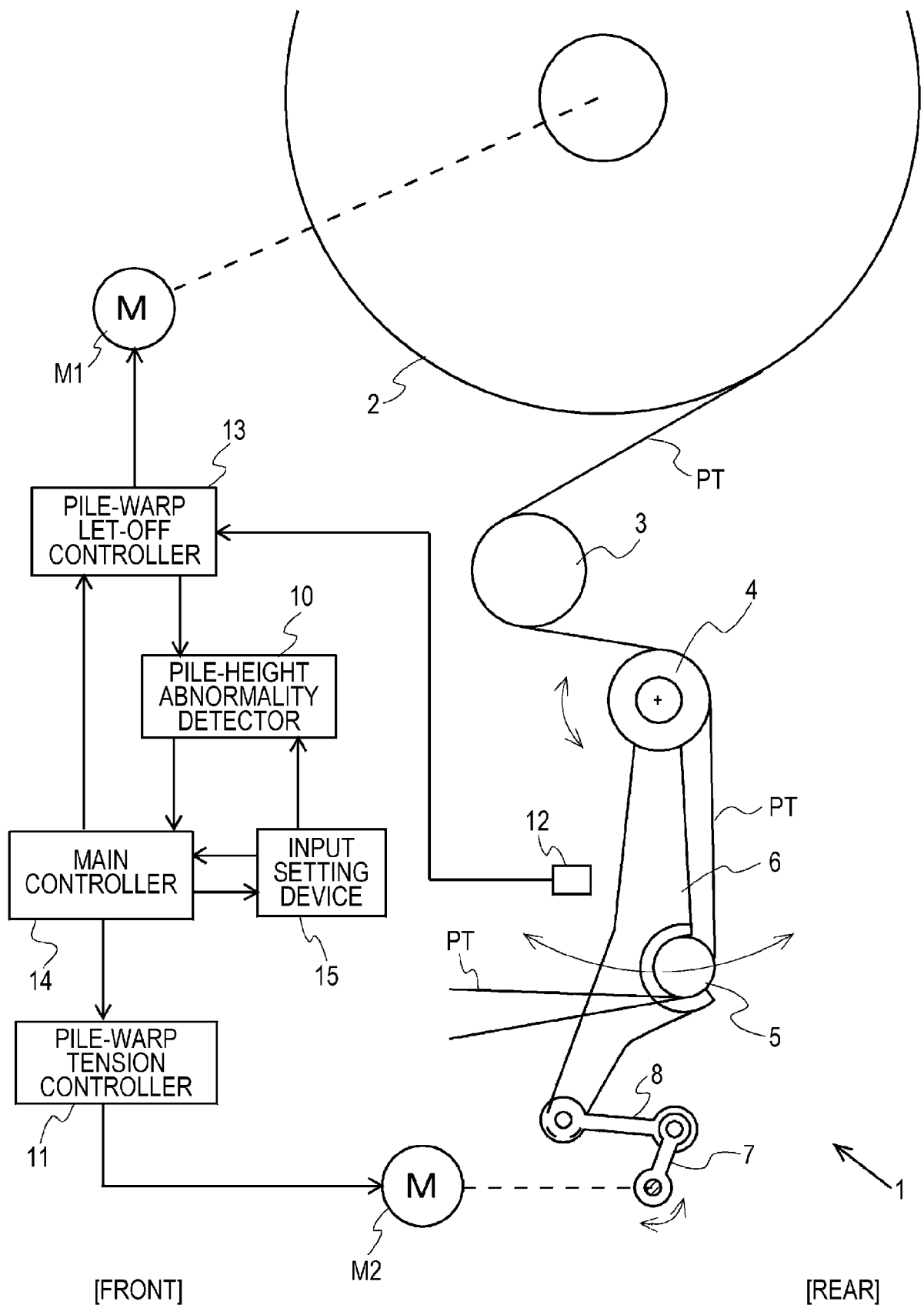
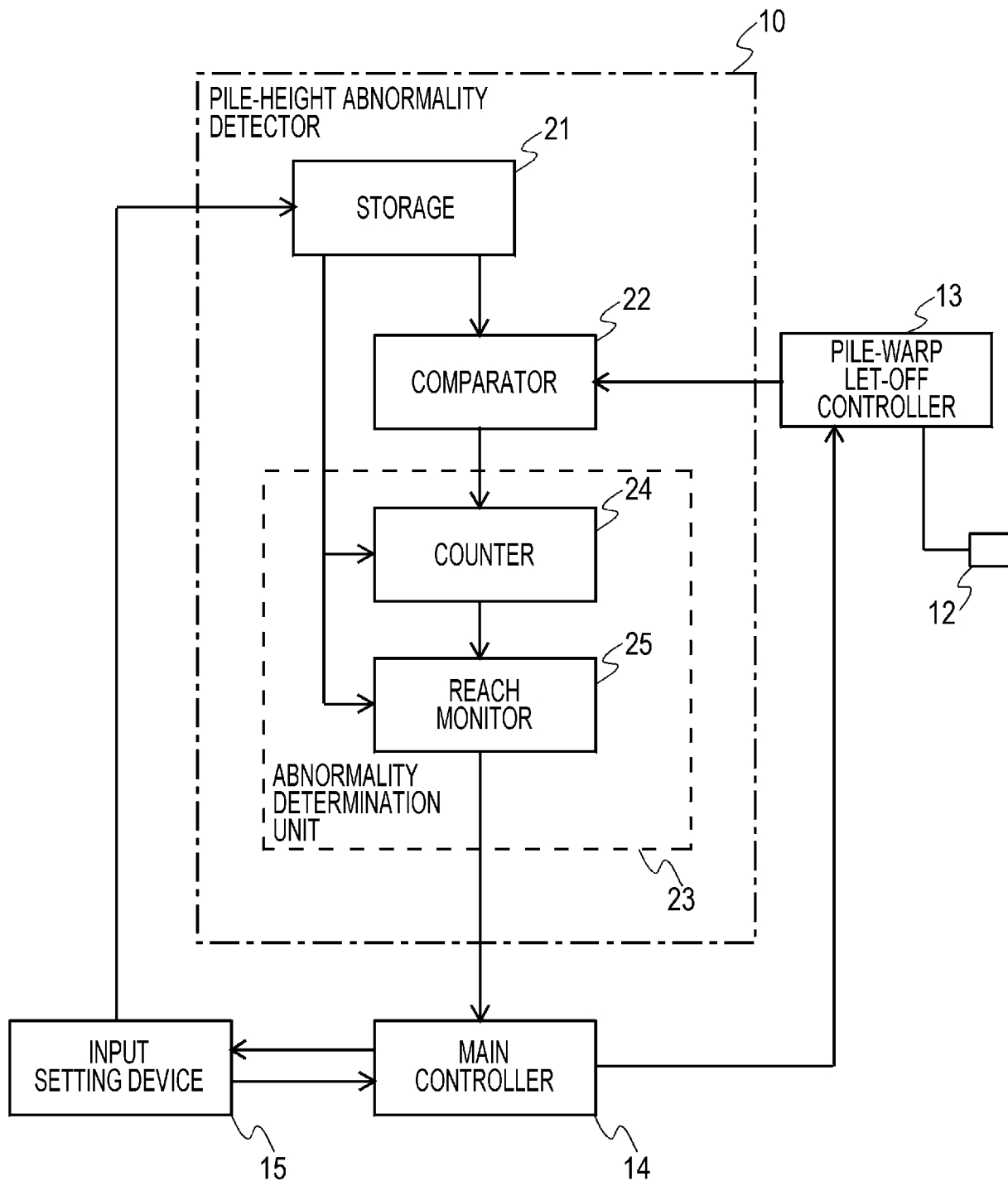


FIG. 2





EUROPEAN SEARCH REPORT

Application Number
EP 19 21 1850

5

10

15

20

25

30

35

40

45

50

55

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)	1,2,4-6, 8	INV. D03D39/22
A	* the whole document *	3,7	D03D49/10 D03D49/12
A	JP H04 289242 A (TSUDAKOMA IND CO LTD) 14 October 1992 (1992-10-14) * paragraph [0011] - paragraph [0019] * * paragraph [0031] * * figures 1-10 *	1-8	D03D49/18 D03D51/44
			TECHNICAL FIELDS SEARCHED (IPC)
			D03D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 14 May 2020	Examiner Hausding, Jan
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

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

EP 19 21 1850

5

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-05-2020

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP S63145450 A	17-06-1988	JP H0213055 B2 JP S63145450 A	03-04-1990 17-06-1988
JP H04289242 A	14-10-1992	NONE	

15

20

25

30

35

40

45

50

55

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 57005945 A [0002]
- JP 63275751 A [0005]