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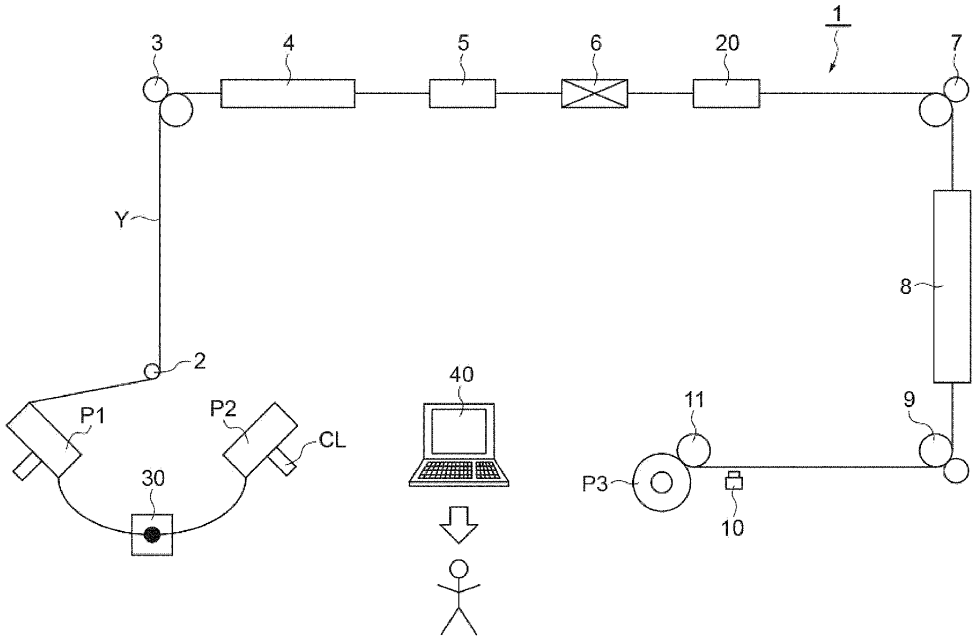
(54) FALSE-TWIST TEXTURING MACHINE

(57) A false-twist texturing machine 1 includes a tension detection device 20 which detects an untwisting tension of a yarn Y traveling between yarn feeding packages P1 and P2 and a winding package P3; a switching detection device 30 which detects that the yarn feeding package supplying the yarn Y is switched from one yarn feeding package PI to the other yarn feeding package P2; and an information processing device 40 which calculates a period of movement time at which a knot C of a yarn end Y1 of one yarn feeding package PI and a yarn end Y2 of the other yarn feeding package P2 is expected to move in the tension detection device 20 based on the detection result of the switching detection device 30 and extracts and stores tension data group corresponding to the period of movement time from the detection result of the tension detection device 20.

Fig.1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a false-twist texturing machine.

BACKGROUND

[0002] A false-twist texturing machine processes a yarn supplied from a yarn feeding package in which a raw yarn is wound and manufactures a winding package in which the processed yarn is wound. In the false-twist texturing machine, two yarn feeding packages are installed and a yarn end (tail yarn) of one yarn feeding package is connected to a yarn end (mouth yarn) of the other yarn feeding package. Accordingly, the yarns of two yarn feeding packages are connected to one. In the false-twist texturing machine, since the supply of the yarn from the other yarn feeding package starts even when the supply of the yarn from one yarn feeding package ends, the yarn is continuously supplied from the yarn feeding package to the false-twist texturing machine. A knot is formed at a position in which the yarn ends of two yarn feeding packages are connected. For example, in the false-twist texturing machine described in Patent Literature 1 (International Publication WO 2001/83348), the switching of the yarn feeding package is detected by detecting the movement of the knot.

SUMMARY

[0003] Generally, a yarn splicing operation between the yarn end of one yarn feeding package and the yarn end of the other yarn feeding package is manually performed by an operator. The result of knotting may differ depending on the skill and proficiency of the operator. Then, since the result of knotting affects the properties of the yarn after false-twist texturing when the knot is false-twist textured, the untwisting tension or the like of the false-twist textured knot may become unstable in some cases. Therefore, in general, when the knot is included in the winding package, the quality (grade) of the winding package is set low. However, not all knots affect the quality of the winding package. In some cases, it is desired to evaluate the quality of the winding package based on the condition of the false-twist textured knot. Despite the fact that the knot affects the quality of the winding package, a false-twist texturing machine capable of specifying the untwisting tension of the false-twist textured knot has never been proposed.

[0004] An object of an aspect of the present invention is to provide a false-twist texturing machine capable of specifying the untwisting tension of the false-twist textured knot.

[0005] A false-twist texturing machine according to an aspect of the present invention is a false-twist texturing machine for forming a winding package by performing false-twist texturing on a yarn supplied from a yarn feeding package, the false-twist texturing machine including a tension detection device which detects an untwisting tension of the yarn traveling between the yarn feeding package and the winding package; a switching detection device which detects that the yarn feeding package supplying the yarn has been switched from one yarn feeding package to the other yarn feeding package; and an information processing device which calculates a period of movement time at which a knot of a yarn end of the one yarn feeding package and a yarn end of the other yarn feeding package is expected to move in the tension detection device based on the detection result of the switching detection device and extracts and stores tension a tension data group corresponding to the period of movement time from the detection result of the tension detection device.

[0006] In the false-twist texturing machine according to an aspect of the present invention, the information processing device calculates the period of movement time at which the knot is expected to move in the tension detection device and extracts and stores the tension data group corresponding to the period of movement time from the detection result of the tension detection device. Accordingly, it is possible to specify the untwisting tension of the false-twist textured knot.

[0007] In an embodiment, the information processing device may determine that the untwisting tension of the yarn is abnormal when a value of the untwisting tension of the yarn exceeds a threshold value in the detection result of the tension detection device, may extract a tension data group when the abnormality is detected from the detection result of the tension detection device, and may store the tension data group related to the abnormality such that the tension data group related to the abnormality is distinguishable from a data group related to the knot. In this configuration, it is possible to store the tension data group related to the abnormality and the tension data group related to the untwisting tension of the false-twist textured knot in a distinguishable manner. Therefore, it becomes easy to compare the tension data group related to the abnormality with the tension data group related to the untwisting tension of the false-twist textured knot.

[0008] In one embodiment, the information processing device may calculate a reference movement time at which the knot is expected to move in the tension detection device based on the detection result of the tension detection device, may extract a tension data group in a predetermined time range including the reference movement time based on the reference movement time. In this configuration, the period of movement time at which the knot is expected to move in the tension detection device can be calculated based on the reference movement time. Also, since the tension data group of the period of movement time can be confirmed, the data group can be managed with the movement time as a reference.

[0009] In one embodiment, the information processing

device may calculate the reference movement time based on a switching time at which the switching detection device detects that the yarn feeding package supplying the yarn is switched from one yarn feeding package to the other yarn feeding package, a traveling speed of the yarn, and a distance of a traveling path of the yarn between the switching detection device and the tension detection device. In this configuration, it is possible to calculate the reference movement time with high accuracy.

[0010] In an embodiment, the information processing device may be provided with an output unit outputting a waveform created based on a tension value and time in the stored tension data group. In this configuration, since the waveform is visually confirmed with the output unit, the condition of the false-twist textured knot can be confirmed. In this way, the tension data group related to untwisting tension of the false-twist textured knot can be used as an index of quality evaluation Therefore, in the false-twist texturing machine, the quality of the winding package can be evaluated with details.

[0011] According to an aspect of the present invention, it is possible to specify the untwisting tension of the false-twist textured knot.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a diagram showing a configuration of a false-twist texturing machine.

FIG. 2(a) is a diagram showing a yarn end of a yarn feeding package and FIG. 2(b) is a diagram showing a knot between yarn ends of the yarn feeding package.

FIG. 3 is a block diagram showing configurations of an information processing device, a tension detection device, and a switching detection device in the false-twist texturing machine.

FIG. 4 is a flowchart showing an operation related to the extraction of a tension data group of a false-twist textured knot.

FIG. 5 is a flowchart showing an operation related to the extraction of a tension data group of tension abnormality.

FIG. 6 is a diagram showing an example of a screen displayed in the information processing device.

FIG. 7 is a diagram showing an example of a screen displayed in the information processing device.

FIG. 8 is a diagram showing an example of a screen displayed in the information processing device.

FIG. 9 is a diagram showing an example of a screen displayed in the information processing device.

DETAILED DESCRIPTION

[0013] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. In the description of the drawings, the same or equivalent elements are designated by the same reference numerals, and duplicate description will be omitted.

[0014] As shown in FIG. 1, a false-twist texturing machine 1 processes a yarn Y supplied from yarn feeding packages P1 and P2 to manufacture a winding package P3. The yarn Y is a synthetic fiber made of a thermoplastic synthetic fiber such as polyester or polyamide. The yarn feeding packages P1 and P2 are formed by winding a partially oriented yarn (POY) on a yarn feeding bobbin (not shown). The winding package P3 is formed by winding a draw textured yarn (DTY) on a winding bobbin (not shown).

[0015] As shown in FIG. 1, the false-twist texturing machine 1 includes a yarn guide 2, a first yarn feeding roller mechanism 3, a first heating device 4, a cooling device 5, a false-twisting device 6, a second yarn feeding roller mechanism 7, a second heating device 8, a third yarn feeding roller mechanism 9, a traverse device 10, and a winding roller mechanism 11. Further, the false-twist texturing machine 1 includes a tension detection device 20, a switching detection device 30, and an information processing device 40.

[0016] As shown in FIG. 1, in the false-twist texturing machine 1, the yarn guide 2, the first yarn feeding roller mechanism 3, the first heating device 4, the cooling device 5, the false-twisting device 6, the second yarn feeding roller mechanism 7, the second heating device 8, the third yarn feeding roller mechanism 9, the traverse device 10, and the winding roller mechanism 11 are provided in this order from the upstream side in the traveling direction of the yarn Y.

[0017] The yarn Y is supplied from the yarn feeding packages P1 and P2 to the false-twist texturing machine 1. The yarn feeding packages P1 and P2 are supported by a creel CL provided on a creel stand (not shown). In two yarn feeding packages P1 and P2, one yarn feeding package supplies the yarn Y to the false-twist texturing machine 1 and the other yarn feeding package waits to continuously supply the yarn Y to the false-twist texturing machine 1. In the example shown in FIG. 1, the yarn Y is supplied from the yarn feeding package P1 and the yarn feeding package P2 is in a standby state.

[0018] As shown in FIG. 1, the yarn guide 2 guides the yarn Y supplied from the yarn feeding packages P1 and P2 to the first yarn feeding roller mechanism 3. The yarn guide 2 is a tubular member and guides the yarn Y by inserting the yarn Y thereinto. The first yarn feeding roller mechanism 3 pulls out the yarn Y supplied from the yarn guide 2 by a pair of rollers (driving roller, driven roller). The first yarn feeding roller mechanism 3 conveys the yarn Y at a constant speed. The first heating device 4 performs a heating treatment on the yarn Y The cooling device 5 cools the yarn Y heated by the first heating device 4. The false-twisting device 6 performs false-twisting on the yarn Y

[0019] The second yarn feeding roller mechanism 7

pulls out the yarn Y that has moved the tension detection device 20 by a pair of rollers. A speed at which the second yarn feeding roller mechanism 7 conveys the yarn Y is different from a speed at which the first yarn feeding roller mechanism 3 conveys the yarn Y The second yarn feeding roller mechanism 7 conveys the yarn Y at a constant speed faster than that of the first yarn feeding roller mechanism 3. Accordingly, the yarn Y is stretched between the first yarn feeding roller mechanism 3 and the second yarn feeding roller mechanism 7.

[0020] The second heating device 8 performs a heating treatment on the yarn Y. The third yarn feeding roller mechanism 9 pulls out the yarn Y that has moved the second heating device 8 by a pair of rollers. A speed at which the third yarn feeding roller mechanism 9 conveys the yarn Y is different from a speed at which the second yarn feeding roller mechanism 7 conveys the yarn Y. The third yarn feeding roller mechanism 9 conveys the yarn Y at a constant speed slower than that of the second yarn feeding roller mechanism 7. Accordingly, the yarn Y is relaxed between the second yarn feeding roller mechanism 7 and the third yarn feeding roller mechanism 9.

[0021] The traverse device 10 traverses the yarn Y The winding roller mechanism 11 contacts the winding package P3 and rotationally drives the winding package P3. Accordingly, the yarn Y is wound on the winding package P3 while being traversed.

[0022] The tension detection device 20 detects the untwisting tension of the yarn Y that has been false-twisted by the false-twisting device 6. That is, the tension detection device 20 is provided between the false-twisting device 6 and the second yarn feeding roller mechanism 7. The tension detection device 20 outputs a detected tension signal to the information processing device 40. As the tension detection device 20, a known device such as a mechanical type or an optical type can be adopted. A specific method for the tension detection will be described below. A voltage value is acquired from a sensor in the tension detection device 20 at predetermined intervals (for example, 10 milliseconds). The acquired voltage is transmitted to the information processing device 40 as a tension signal.

[0023] The switching detection device 30 detects the switching of the yarn feeding packages P1 and P2. In the yarn feeding packages P1 and P2, one yarn feeding package (the yarn feeding package on one side) supplies the yarn Y to the false-twist texturing machine 1 and the other yarn feeding package (the yarn feeding package on the other side) waits to continuously supply the yarn Y to the false-twist texturing machine 1. The yarn end (tail yarn) on the inner layer side of one yarn feeding package and the yarn end (mouth yarn) on the outer layer side of the other yarn feeding package are entangled. Accordingly, since the supply of the yarn Y to the false-twist texturing machine by the other yarn feeding package starts even when the supply of the yarn Y to the false-twist texturing machine by one yarn feeding package ends, the yarn Y is continuously supplied from the yarn feeding packages P1 and P2 to the false-twist texturing machine 1.

[0024] A knot C formed by entangling the tail yarn and the mouth yarn is formed in such a manner that the tail yarn which is a yarn end Y1 on the inner layer side of the yarn feeding package P1 shown in FIG. 2(a) is entangled with the mouth yarn which is a yarn end Y2 on the outer layer side of the yarn feeding package P2 shown in FIG. 2(b). The knot C is formed at a portion in which two yarn ends Y1 and Y2 are entangled. The knot C may be formed by knotting the tail yarn with the mouth yarn, instead of entangling.

[0025] The switching detection device 30 detects the switching of the yarn feeding packages P1 and P2 by detecting the movement of the knot C at a predetermined position of the switching detection device 30. The switching detection device 30 outputs a switching signal related to the detected switching to the information processing device 40. As the switching detection device 30, a known device such as a mechanical type or an optical type can be adopted. The setting of the yarn Y (knot C) at a predetermined position of the switching detection device 30 is performed by, for example, an operator who performed a yarn splicing operation.

[0026] A specific method for the switching detection will be described below. When the knot C is set to a predetermined position of the switching detection device 30, the switching detection device 30 changes from the state without the yarn to the state with the yarn. The output signal of the switching detection device 30 changes from the low voltage state to the high voltage state due to the change in the state of the switching detection device 30. When the high voltage state continues for a predetermined time from the time at which the output signal of the switching detection device 30 changes from the low voltage state to the high voltage state, it is recognized that the knot C is set to the predetermined position of the switching detection device 30. When the yarn Y of the yarn feeding package that supplies the yarn Y to the false-twist texturing machine 1 disappears and the knot C is removed from the switching detection device 30, the state with the yarn changes to the state without the yarn.

[0027] The output signal of the switching detection device 30 changes from a high voltage state to a low voltage state due to a change in the state of the switching detection device 30. When the low voltage state continues for a predetermined time from the time at which the output signal of the switching detection device 30 changes from the high voltage state to the low voltage state, it is recognized that the yarn feeding packages P1 and P2 are switched and the knot C is set to the predetermined position of the switching detection device 30. The voltage value acquired by the switching detection device 30 is transmitted to the information processing device 40 as the switching signal. Additionally, the output signal of the switching detection device 30 when the knot C is set to the predetermined position of the switching detection device 30 changes from the low voltage state to the high

voltage state, but may change from the high voltage state to the low voltage state.

[0028] As shown in FIG. 3, the information processing device 40 is a processor having an integrated circuit mounted thereon or a computer system equipped with the processor. The information processing device 40 is a part that controls various operations in the false-twist texturing machine 1 and manages the false-twist texturing machine and includes a CPU (Central Processing Unit), a ROM (Read Only Memory), a RAM (Random Access Memory), and the like together with an input/output interface and the like. Various data or programs are stored in the ROM, and these data or the like are expanded in the RAM and processed by the CPU. As the input/output interface, for example, an input device such as a keyboard and a mouse or an output device such as a monitor and a speaker are used. Further, the information processing device is communicably connected to the tension detection device and the switching detection device via the input/output interface.

[0029] The information processing device 40 includes an input unit 41, a control unit 42, a storage unit 43, a calculation unit 44, and an output unit 45.

[0030] The input unit 41 receives a signal or data from a connected external device, and transmits the data or the like to the control unit 42. For example, the input unit 41 receives data or the like input by the operator via the input device, for example, the traveling speed (unwinding speed) of the yarn Y, the traveling path of the yarn Y between the switching detection device 30 and the tension detection device 20, and a threshold value for determining tension abnormality and transmits them to the control unit 42. These data or the like may be changed as appropriate depending on the conditions such as the used equipment and the used yarn. Further, the input unit 41 receives a tension signal output from the tension detection device 20 and a switching signal output from the switching detection device 30 and transmits them to the control unit 42.

[0031] The control unit 42 controls each unit constituting the information processing device 40. The control unit 42 controls the storage unit 43 to write and call the data or the like according to the data or the like from the input unit 41, the calculation unit 44, or the storage unit 43. The control unit 42 controls the calculation unit 44 to execute a calculation according to data or the like from the input unit 41, the calculation unit 44, or the storage unit 43. The control unit 42 controls the output unit 45 to output the data or the like according to the data or the like from the input unit 41, the calculation unit 44, or the storage unit 43.

[0032] The storage unit 43 stores data or the like based on a command from the control unit 42. Examples of the data or the like to be stored include the traveling speed (unwinding speed) of the yarn Y, the distance of the traveling path of the yarn Y between the switching detection device 30 and the tension detection device 20, the threshold value for determining tension abnormality, the tension data, and the switching data. Further examples of the data or the like to be stored include the calculation result obtained by the calculation unit 44.

[0033] The calculation unit 44 processes data or the like based on a command from the control unit 42. A specific process of the calculation unit 44 will be described below.

[0034] The output unit 45 outputs data or the like based on a command from the control unit 42. As the output unit 45, a display device such as a display can be used. A specific output of the display device will be described below.

[0035] Subsequently, an operation of the information processing device 40 will be described.

[0036] First, the processing of the tension signal transmitted from the tension detection device 20 to the information processing device 40 in the information processing device 40 will be described. The information processing device 40 receives the tension signal transmitted from the tension detection device 20. The input unit 41 converts the received tension signal into a tension value according to a predetermined correction calculation such as A/D conversion and a predetermined filter. The input unit 41 transmits the converted tension value to the control unit 42. The control unit 42 that has received the tension value transmits the tension value and the time at which the tension value is received from the input unit 41 to the calculation unit 44 and instructs the calculation unit 44 to perform a process of associating the time with the tension value. The calculation unit 44 executes a command from the control unit 42 and transmits the calculation result (tension data associated with the time) to the control unit 42. The control unit 42 receives the tension data from the calculation unit 44 and stores the tension data in the storage unit 43. Then, the tension data sequentially transmitted from the tension detection device 20 to the information processing device 40 is stored in the storage unit 43 in this way.

[0037] Next, a process of the switching signal transmitted from the switching detection device 30 in the information processing device 40 in the information processing device 40 will be described. The information processing device 40 receives the switching signal transmitted from the switching detection device 30. The input unit 41 performs I/O conversion on the received switching signal to obtain a switching value. The input unit 41 transmits the converted switching value to the control unit 42. The control unit 42 that has received the switching value transmits the switching value and the time at which the switching value is received from the input unit 41 to the calculation unit 44 and instructs the calculation unit 44 to perform a process of associating the time with the switching value. The calculation unit 44 executes a command from the control unit 42 and transmits the calculation result (switching data associated with the time) to the control unit 42. The control unit 42 receives the switching data from the calculation unit 44 and stores the switching data in the storage unit 43. Then, the switching

data sequentially transmitted from the switching detection device 30 to the information processing device 40 is stored in the storage unit 43 in this way.

[0038] Next, one example of the method of extracting and storing the tension data group of the false-twist textured knot C in the information processing device 40 will be described with reference to FIG. 4.

[0039] As shown in FIG. 4, when the false-twist texturing machine 1 starts the winding of the yarn Y (DTY) (step S01), the information processing device 40 determines whether or not the yarn feeding packages P1 and P2 are switched, that is, the knot C is removed from a predetermined position of the switching detection device 30 based on the detection result of the switching detection device 30 (step S02).

[0040] When the information processing device 40 determines that the knot C is removed from a predetermined position of the switching detection device 30, that is, the yarn feeding packages P1 and P2 are switched (step S02: YES), the process of the information processing device 40 proceeds to step S03. On the other hand, when the information processing device 40 determines that the knot C is not removed from a predetermined position of the switching detection device 30, that is, the yarn feeding packages P1 and P2 are not switched (step S02: NO), the process of the information processing device 40 proceeds to step S06.

[0041] The information processing device 40 stores the switching time based on the switching signal output from the switching detection device 30 to the information processing device 40 (step S03). Subsequently, the information processing device 40 calculates the reference movement time at which the knot C is expected to move in the tension detection device 20 (step S04). The information processing device 40 extracts the tension data group in a predetermined time range including the reference movement time based also on the calculated reference movement time and store the tension data group (step S05).

[0042] Subsequently, the information processing device 40 determines whether or not the winding of the yarn Y of the false-twist texturing machine 1 ends (step S06). When the information processing device 40 determines that the false-twist texturing machine 1 ends the winding of the yarn Y (step S06: YES), the information processing device 40 ends the process. When the information processing device 40 does not determine that the false-twist texturing machine 1 ends the winding of the yarn Y (step S06: NO), the information processing device 40 returns to the process of step S02 and performs the process after step S02.

[0043] Here, one example of a specific method will be described in which the information processing device 40 calculates a reference movement time at which the knot C is expected to move in the tension detection device 20 based on the detection result of the switching detection device 30 as described in step S04.

[0044] The control unit 42 acquires the switching signal, the time at which the switching signal is acquired, the traveling speed (unwinding speed) of the yarn Y, and the distance of the traveling path of the yarn Y between the switching detection device 30 and the tension detection device 20 from the storage unit 43. Then, a command of calculating the time at which the knot C is expected to move in the tension detection device 20 based on these data or the like is transmitted to the calculation unit 44. The calculation unit 44 calculates the time at which the knot C is expected to move in the tension detection device 20 based on these data or the like and transmits the calculated time to the control unit 42 as the reference knot movement time.

[0045] Further, one example of a specific method will be described in which the information processing device 40 extracts and stores the tension data group in a predetermined time range including the reference movement time based on the reference movement time at which the knot C is expected to move in the tension detection device 20 based on the detection result of the tension detection device 20 as described in step S05.

[0046] In this embodiment, the control unit 42 extracts the tension data group of a predetermined time including the reference knot movement time from the storage unit 43 based on the calculation result. Specifically, the control unit 42 extracts the tension data in a range including a predetermined time (for example, every 5 seconds around a reference time) before and after the knot movement time which is a reference (center) as the tension data group related to the knot movement. The control unit 42 instructs the storage unit 43 to store the extracted tension data group related to the knot movement in the storage unit 43. Specifically, the control unit 42 instructs the storage unit 43 to store the tension data group related to the knot movement by setting a flag representing the tension data group of the "knot movement" to the tension data group related to the knot movement. The control unit 42 instructs the calculation unit 44 to create image data related to the display screen displayed on the display device based on the extracted tension data group.

[0047] So far described was one example in which the information processing device 40 extracts and stores the tension data group of the false-twist textured knot C with reference to Fig. 4. Specifically, the information processing device 40 calculates the reference movement time at which the knot C is expected to move in the tension detection device 20, and based on the calculated reference movement time, a tension data group in a predetermined time range including the reference movement time is extracted and stored.

[0048] The following describes a feature of the information processing device 40 extracting and storing the tension data group of a false-twist textured knot C.

[0049] That is, the information processing device 40 calculates a reference movement time at which the knot C is expected to move in the tension detection device 20, and based on the calculated reference movement time, a tension data group in a predetermined time range

including the reference movement time is extracted, which means that the information processing device 40 calculates the period of movement time based on the time at which the knot C is expected to move in the tension detection device 20. Here, the period of movement time means the period from the time when the knot C starts to move to the time when the knot C stops to move in the tension detection device 20.

[0050] Further, the information processing unit 40 extracts and stores a tension data group in a predetermined time range including a reference movement time based on the calculated reference movement time, which means that the information processing unit 40 extracts and stores a tension data group corresponding to the period of movement time based on the calculated period of time and the detection result of the tension detection device 20. Here, the tension data group corresponding to the period of movement time may include the tension data group of the movement time at which the knot C is expected to start to move and the knot C is expected to stop to move in the tension detection device 20, and also tension data groups therebefore and thereafter.

[0051] Next, a method of extracting the tension data group of tension abnormality in the information processing device 40 will be described with reference to FIG. 5.

[0052] As shown in FIG. 5, when the false-twist texturing machine 1 starts the winding of the yarn Y (DTY) (step S11), the information processing device 40 determines whether or not the tension value exceeds a threshold value, that is, tension abnormality occurs based on the detection result of the tension detection device 20 (step S12). When the information processing device 40 determines that the tension value exceeds the threshold value, that is, tension abnormality occurs (step S12: YES), the process of the information processing device 40 proceeds to step S13. On the other hand, when the information processing device 40 does not determine that the tension value exceeds the threshold value, that is, tension abnormality occurs (step S12: NO), the process of the information processing device 40 proceeds to step S15.

[0053] The information processing device 40 stores the abnormality detection time based on the tension signal output from the tension detection device 20 to the information processing device 40 (step S13). Subsequently, the information processing device 40 extracts the tension data group corresponding to the abnormality detection time and stores the tension data group (step S14).

[0054] Subsequently, the information processing device 40 determines whether or not the false-twist texturing machine 1 ends the winding of the yarn Y (step S15). When the information processing device 40 determines that the false-twist texturing machine 1 ends the winding of the yarn Y (step S15: YES), the information processing device 40 ends the process. When the information processing device 40 does not determine that the false-twist texturing machine 1 ends the winding of the yarn Y (step S15: NO), the information processing device 40 returns to the process of step S12 and performs the process after step S12.

[0055] Here, a specific method will be described in which the information processing device 40 determines that the untwisting tension of the yarn Y at a certain time is abnormal when the tension value of the yarn Y exceeds the threshold value at the certain time based on the detection result of the tension detection device 20 as described in step S12.

[0056] The control unit 42 acquires the tension data and the threshold value from the storage unit 43. Then, a command of determining whether or not tension abnormality occurs based on these data or the like is transmitted to the calculation unit 44. The calculation unit 44 determines whether or not tension abnormality occurs by performing the following calculation. When a state in which the tension value exceeds the threshold value continues for a predetermined time by comparing the tension value with the threshold value, it is determined that tension abnormality occurs. Then, the time at which the tension value exceeds the threshold value is set as the abnormality detection time. Then, as a determination result, the abnormality detection time is transmitted to the control unit 42.

[0057] Further, a specific method will be described in which the information processing device 40 extracts the tension data group corresponding to the abnormality detection time from the detection result of the tension detection device 20 as described in step S14.

[0058] The control unit 42 extracts the tension data group corresponding to the abnormality detection time from the storage unit 43 based on the determination result. The control unit 42 extracts the tension data group at a predetermined time including the abnormality detection time. In this embodiment, the control unit 42 extracts the tension data in a range including a predetermined time (for example, every 5 seconds around a reference time) before and after the abnormality detection time which is a reference (center) as the tension data group related to the tension abnormality. The control unit 42 instructs the storage unit 43 to store the extracted tension data group related to the tension abnormality in the storage unit 43 such that the tension data group related to the tension abnormality is distinguishable from the tension data group related to the knot movement. Specifically, the control unit 42 instructs the storage unit 43 to store the tension data group related to the tension abnormality by setting thereto a flag representing the tension data group of "tension abnormality." The control unit 42 instructs the calculation unit 44 to create image data related to the display screen displayed on the display device based on the extracted tension data group.

[0059] Next, a method of displaying the tension data group of tension abnormality and the tension data group of the false-twist textured knot C in the information processing device 40 will be described with reference to FIGS. 6 to 9.

[0060] As shown in FIGS. 6 to 9, the display device displays the display screen showing the tension data group of the false-twist textured yarn Y. This display screen shows an event that occurs per winding of a certain winding package P3, that is, the tension detection or tension abnormality detection of the false-twist textured knot C. The display screen is provided with a table showing events on the left side and a graph on the right side. In the table, "number", "grade", "date and time of occurrence", and "type" are provided from the right. The "number" represents a serial number in which the event occurred. The "grade" represents the quality of the winding package at the time at which the event occurred. The "grade" is expressed in ascending alphabetical order, of A, B, and C, etc. as the quality decreases. The "grade" has a correlation with tension abnormality detection, and once tension abnormality detection occurs, the quality deteriorates and the alphabet display changes each time. The "date and time of occurrence" represents the date and time when the event occurred. The "type" represents the type of event, the "knot movement" represents the tension data group of the false-twist textured knot C, and the "tension abnormality" represents the tension data group in the tension abnormality.

[0061] The graph displays the tension data group corresponding to the event selected in the table as waveform. The vertical axis of the graph represents the tension value, and the horizontal axis of the graph represents the time. The display unit and display range can be changed as appropriate for both the tension value and the time. The display contents of the table and the display contents of the graph are associated with each other in the display table, and when the "number" of the table is selected, the waveform associated with the "number" is displayed in the graph. The display table is stored in the storage unit 43 in advance, and when displaying the display screen on the display device, the display table is expanded in the control unit 42 and the calculation unit 44 and image data is created as the calculation result. The created image data is transmitted to the display device via the output unit 45, and is displayed on the display device as the display screen.

[0062] Next, the creation of the image data displayed on the display screen in the information processing device 40 will be described.

[0063] The control unit 42 extracts the knot movement time, the tension data group related to the knot movement, the abnormality detection time, the tension data group related to the abnormality detection, and the display table from the storage unit 43. The control unit 42 transmits a command of creating the image data to the calculation unit 44 based on the knot movement time, the tension data group related to the knot movement, the abnormality detection time, the tension data group related to the abnormality detection, and the display table extracted as described above. The calculation unit 44 calculates and creates image data to be displayed on a table and a graph of the display screen from the knot movement time, the tension data group related to the knot movement, the abnormality detection time, the tension data group related to the abnormality detection, and the display table. Specifically, the following procedure is followed.

[0064] The waveform related to the knot movement and the waveform related to the abnormality detection are respectively created from the tension data group related to the knot movement and the tension data group related to the abnormality detection. The knot movement time and the abnormality detection time are entered in the field of the "date and time of occurrence" of the display table. The "date and time of occurrence" are sorted in the order of earliest, and they are allocated in ascending order of the "number" in the display table. In the case of the knot movement time, a tag is put in the "type" of the display table to display the "knot movement" in the field of the "type" of the display screen. In the case of the knot movement time, a tag is put in the field of the "type" of the display table to display the "abnormality detection" in the field of the "type" of the display screen in the case of the abnormality detection time associated with the waveform created from the tension data group related to the knot movement time in the display table. In the case of the abnormality detection time, a tag is put in the "grade" of the display table so that the display of the "grade" of the display screen becomes the display having a lower quality than before. In the case of the abnormality detection time, the abnormality detection time is associated with the waveform created from the tension data group related to the abnormality detection time in the display table.

[0065] Subsequently, the operation of the display screen displayed on the display device in the information processing device 40 will be described.

[0066] When the number to be displayed on the display screen is selected, the column of the number is changed to a gray background. The waveform related to the number is displayed on the graph. FIGS. 6 and 7 show a winding package P3-1 on August 1, 20XX.

[0067] FIG. 6 shows a state in which the "number" 2 has been selected. Since the user has selected the "number" 2, the column related to the "number" 2 has been changed to a gray background. The "number" 2 has a "date and time of occurrence" of 11:15:05 on August 1, 20XX. In the "number" 2, the "type" is the tension abnormality. Since the tension abnormality is shown in the "number" 2, the quality evaluation is lowered from the "number" 1 and the "grade" is changed from A to B. In the graph, the waveform corresponding to the "number" 2 is displayed. The dotted horizontal line in the graph represents a threshold value. A point in time at which the tension value exceeds the threshold value is the abnormality detection time, which corresponds to the "date and time of occurrence" of 11:15:05 on August 1, 20XX indicated by the intersection of the dotted vertical line and the dotted horizontal line.

[0068] FIG. 7 shows a state in which the "number" 3

has been selected. Since the user has selected the "number" 3, the column related to the "number" 3 has been changed to a gray background. The "number" 3 has a "date and time of occurrence" of 13:30:35 on August 1, 20XX. In the "number" 3, the "type" is the knot movement. Since the knot movement is shown in the "number" 3, the "grade" is blank regardless of the quality evaluation of the winding package. In the graph, the waveform corresponding to the "number" 3 is displayed. Here, the reference movement time at which the knot is expected to move in the tension detection device corresponds to the "date and time of occurrence" of 13:30:35 on August 1, 20XX, indicated by the intersection of the dotted vertical line and the dotted horizontal line. The dotted horizontal line in Fig. 7 represents the threshold value as in Fig. 6, while in the graph of Fig. 7, the dotted horizontal line representing the threshold value is closer to the upper part compared with Fig. 6 because a value of one increment of the tension value in the vertical axis in Fig. 7 is set to be greater than that in Fig. 6. That is, since the display range of the tension value is set to be broad, and the tension value of the waveform is lower than the threshold value in the graph of Fig. 7, the dotted horizontal line representing the threshold value is closer to the upper part of the graph. The waveform in the graph of Fig. 7 does not surpass the dotted horizontal line representing the threshold value related to tension abnormality, and the threshold value and the tension value are distanced, which means that the portion related to the false-twist textured knotted C maintains a low tension value. Thus, it is considered that the false-twist texturing of this knot C does not have much influence on the untwisting tension.

[0069] FIGS. 8 and 9 show a winding package P3-2 on August 2, 20XX.

[0070] FIG. 8 shows a state in which the "number" 1 is selected. Since the user has selected the "number" 1, the column related to the "number" 1 has been changed to a gray background. The "number" 1 has a "date and time of occurrence" of 10:30:15 on August 2, 20XX. In the "number" 1, the "type" is the tension abnormality. Since the tension abnormality is shown in the "number" 1, the quality evaluation is lowered from the "number" 1 and the "grade" is changed to A. In the graph, the waveform corresponding to the "number" 1 is displayed. In the graph of Fig. 8, a value of one increment of the tension value of the vertical axis is equal to that of Fig. 6. The dotted horizontal line in the graph represents a threshold value as in Fig. 6. A point in time at which the tension value exceeds the threshold value is the abnormality detection time, which corresponds to "date and time of occurrence" of 10:30:15 on August 2, 20XX, indicated by the intersection of the dotted vertical line and the dotted horizontal line.

[0071] FIG. 9 shows a state in which the "number" 2 is selected. Since the user has selected the "number" 2, the column related to the "number" 2 has been changed to a gray background. The "number" 2 has a "date and time of occurrence" of 10:30:15 on August 2, 20XX. In the "number" 2, the "type" is knot movement. Since the knot movement is shown in the "number" 2, the "grade" is blank regardless of the quality evaluation of the winding package. In the graph, the waveform corresponding to the "number" 2 is displayed. Here, the reference movement time at which the knot is expected to move in the tension detection device corresponds to the "date and time of occurrence" of 10:30:15 on August 2, 20XX indicated by the intersection of the dotted vertical line and the dotted horizontal line. In the graph of Fig. 9, a value of one increment of the tension value of the vertical axis is equal to that of Fig. 8. The dotted horizontal line in the graph represents a threshold value as in Fig. 8. Since the waveform surpasses the dotted horizontal line representing the threshold value related to tension abnormality in the graph of Fig. 9, that is, the threshold value is surpassed by the tension value, it is considered that the tension abnormality has occurred by false-twist texturing the knot C.

[0072] As described above, in the false-twist texturing machine 1 according to this embodiment, the information processing device 40 calculates the period of movement time at which the knot C is expected to move in the tension detection device 20 and extracts and stores the tension data group corresponding to the period of movement time from the detection result of the tension detection device 20. Accordingly, it is possible to specify the untwisting tension of the false-twist textured knot C.

[0073] In the false-twist texturing machine 1 according to this embodiment, the information processing device 40 determines that the tension of the yarn Y is abnormal when the value of the untwisting tension of the yarn Y in the detection result of the tension detection device 20 exceeds a threshold value. Then, the information processing device 40 extracts the tension data group when the tension abnormality is detected, and stores the extracted tension data group related to tension abnormality such that the tension data group related to tension abnormality is distinguishable from the tension data group related to the knot C. In this configuration, it is possible to distinguish the tension data group related to tension abnormality from the tension data group related to untwisting tension of the false-twist textured knot C. In this way, the tension data group related to tension abnormality and the tension data group related to untwisting tension of the false-twist textured knot C can be associated each other and stored. Therefore, it becomes easy to compare the tension data group related to tension abnormality with the tension data group related to untwisting tension of the false-twist textured knot C.

[0074] In the false-twist texturing machine 1 according to this embodiment, the information processing device 40 calculates a reference knot movement time at which the knot moves in the tension detection device 20 based on the detection result of the switching detection device 30, and extracts and stores the tension data group in a predetermined time range including the reference knot

movement time based on the reference knot movement time. In such a configuration, the period of movement time at which the knot is expected move in the tension detection device can be calculated based on the reference movement time. Further, since the tension data group of the period of movement time can be confirmed based on the reference movement time, the data group can be managed with the knot movement time as a reference. Therefore, it becomes easy to manage data.

[0075] In the false-twist texturing machine 1 according to this embodiment, the information processing device 40 extracts and stores the tension data group in a predetermined time range including the abnormality detection time based on the abnormality detection time at which the information processing device 40 determines that the untwisting tension of the yarn Y is abnormal as a reference. In such a configuration, the tension data group can be confirmed based on the abnormality detection time, and the data group can be managed with the abnormality detection time as a reference. Therefore, it becomes easy to manage data.

[0076] In the false-twist texturing machine 1 according to this embodiment, the information processing device 40 includes the output unit 45 which outputs a waveform created based on the tension value and time in the stored tension data group. In this configuration, it is possible to visually confirm the waveform with the display device. Therefore, it is possible to confirm the state of the false-twist textured knot C. In this way, the waveform related to the untwisting tension of the false-twist textured knot C can be used as an index for quality evaluation. For example, it is possible to evaluate the quality of the winding package P3 step by step based on the tendency of the waveform related to the untwisting tension of the false-twist textured knot C. Thus, it is possible to evaluate the quality of the winding package P3 in the false-twist texturing machine 1.

[0077] Here, a method of storing the tension data related to all untwisting tension can be considered in order to evaluate the quality of the winding package P3. However, since the length of the yarn Y wound around the winding package P3 is very long, a huge storage capacity is required to store all tension data. In the false-twist texturing machine 1 according to this embodiment, since the tension data group related to the untwisting tension of the false-twist textured knot C having a high possibility of affecting the quality is extracted and stored, it is possible to perform an effective quality evaluation while suppressing an increase in storage capacity.

[0078] In the false-twist texturing machine 1 according to this embodiment, it is possible to confirm the relationship between the tension abnormality and the false-twist textured knot C by comparing the waveform corresponding to the abnormality detection time at which the abnormality is detected and the waveform related to the untwisting tension of the false-twist textured knot C. For example, the operator can confirm that the false-twist textured knot C has tension abnormality, that is, there is a relationship between the false-twist textured knot C and the tension abnormality when the waveform data corresponding to the abnormality detection time at which the abnormality is detected is extracted at the time that matches or approximates the knot movement time at which the waveform related to the untwisting tension of the false-twist textured knot C is extracted by displaying the display screen shown in FIGS. 6 to 9 on the display device.

[0079] In the false-twist texturing machine 1 according to this embodiment, the information processing device 40 may calculate the reference knot movement time based on the switching time at which the switching detection device 30 detects the movement of the knot C, the traveling speed of the yarn Y, and the distance between the switching detection device and the tension detection device. In this configuration, it is possible to calculate the reference knot movement time with high accuracy.

[0080] Although the embodiment of the present invention has been described above, the present invention is not essentially limited to the above-described embodiment and can be modified into various forms in the scope not departing from the spirit thereof.

[0081] In the above-described embodiment, an example of a mode in which the tension detection device 20 outputs the tension signal has been described. However, the tension detection device 20 may output the tension data. In the tension data, the tension signal and the detection time are correlated with each other. Similarly, the switching detection device 30 may output the switching data.

[0082] In the above-described embodiment, an example of a mode in which the operator confirms that there is a relationship between the false-twist textured knot C and the tension abnormality by displaying the display screen on the display device has been described. However, the information processing device 40 may set a flag representing that tension abnormality has occurred in the false-twist textured knot C in the tension data group related to the abnormality detection when the tension date group corresponding to the abnormality detection time at which the abnormality is detected is extracted at the time that matches or approximates the knot movement time at which the tension data group related to the untwisting tension of the false-twist textured knot C is extracted. Accordingly, the operator can confirm the relationship between the false-twist textured knot C and the tension abnormality by confirming the tension data group in which the flag is set.

[0083] In the above-described embodiment, an example of a mode in which the knot C is set to a predetermined position of the switching detection device 30 and the movement of the knot C is detected has been described. However, the switching detection device 30 does not necessarily have to set the knot C at a predetermined position to detect the movement of the knot C, but may detect the switching of the yarn feeding packages P1 and P2. For

example, the switching detection device of another embodiment has the following configuration. The switching detection device is provided at a position of the yarn guide 2. When the yarn Y is supplied from the direction in which the yarn feeding package P1 is installed, the switching detection device recognizes that the yarn Y is supplied from the yarn feeding package P1. When the yarn Y is supplied from the direction in which the yarn feeding package P2 is installed, the switching detection device recognizes that the yarn Y is supplied from the yarn feeding package P2. When the recognition of the supply of the yarn Y is changed from the yarn feeding package P1 to the yarn feeding package P2, the switching detection device recognizes that the yarn feeding packages P1 and P2 have been switched. Similarly, when the recognition of the supply of the yarn Y is changed from the yarn feeding package P2 to the yarn feeding package P1, the switching detection device recognizes that the yarn feeding packages P1 and P2 have been switched.

[0084] In the above-described embodiment, an example of a mode in which the control unit 42 extracts the tension data in a range including a predetermined time before and after the knot movement time which is a reference (center) as the tension data group related to the movement of the knot has been described. However, the control unit 42 may extract the tension data group in a predetermined time range including the knot movement time. For example, the control unit 42 may extract the tension data group with the knot movement time as a predetermined start time or may extract the tension data group with the knot movement time as a predetermined end time. The point is that the knot movement time is included in a predetermined time. The same applies to the extraction of the tension data group in a predetermined time range including the abnormality detection time.

[0085] In the above-described embodiment, as a method of extracting the tension data group related to the knot C, an example of a mode in which the information processing unit 40 calculates the reference knot movement time based on the detection result of the switching detection device 30, and extracts the tension data group corresponding to the reference knot movement time has been described. However, the information processing device 40 may use another method to extract the tension data group related to knot C. For example, the information processing device 40 may calculate the period of movement time at which the knot C is expected to move in the tension detection device 20 based on the detection result of the switching detection device 30, and extract the tension data group between the time at which the knot C is expected to start to move and the knot C is expected to stop to move in the tension detection device 20.

[0086] In the above-described embodiment, as a method of extracting the tension data group when the untwisting tension of the yarn Y is determined to be abnormal, an example of a mode in which the information processing unit 40 extracts the tension data group corresponding the abnormality detection time at which the information processing device 40 determines that the untwisting tension of the yarn Y is abnormal has been described. However, the information processing device 40 may use another method of extracting the tension data group when abnormality is determined. For example, the information processing device 40 may extract the tension data group by calculating (setting) the start point and the end point between which the time at which the abnormality is determined and extracting the tension data group between the start and end points.

[0087] In the above-described embodiment, an example of a mode in which the false-twist texturing machine 1 has a configuration shown in FIGS. 1 and 3 has been described. However, the false-twist texturing machine 1 may not include a part of the device and may further include another device.

[0088] In the above-described embodiment, an example of a mode in which the information processing device 40 displays the tension data group (waveform) on the display device has been described. However, the tension data group may be displayed on another device. In this case, the output unit 45 of the information processing device 40 outputs the tension data group to another device.

REFERENCE SIGNS LIST

[0089] 1: false-twist texturing machine, 6: false-twisting device, 20: tension detection device, 30: switching detection device, 40: information processing device, 45: output unit, C: knot, P1, P2: yarn feeding package, P3: winding package, Y: yarn, Y1, Y2: yarn end.

Claims

1. A false-twist texturing machine (1) for forming a winding package (P3) by performing false-twist texturing on a yarn (Y) supplied from a yarn feeding package (PI, P2), the false-twist texturing machine (1) comprising:

   a tension detection device (20) which detects an untwisting tension of the yarn (Y) traveling between the yarn feeding package (PI, P2) and the winding package (P3);
   a switching detection device (30) which detects that the yarn feeding package (PI, P2) supplying the yarn (Y) has been switched from one yarn feeding package (PI, P2) to the other yarn feeding package (PI, P2); and
   an information processing device (40) which calculates a period of movement time at which a knot (C) of a yarn end (Y1, Y2) of the one yarn feeding package (PI, P2) and a yarn end (Y1, Y2) of the other yarn feeding package (PI, P2) is expected to move in the tension detection de-

vice(20) based on the detection result of the switching detection device (30) and extracts and stores a tension data group corresponding to the period of movement time from the detection result of the tension detection device (20).

2. The false-twist texturing machine (1) according to claim 1,
wherein the information processing device (40) determines that the untwisting tension of the yarn (Y) is abnormal when a value of the untwisting tension of the yarn exceeds a threshold value in the detection result of the tension detection device (20), extracts a tension data group corresponding to a detection time at which the abnormality is detected from the detection result of the tension detection device (20), and stores a tension data group related to abnormality distinguishably from a data group related to the knot (C).

3. The false-twist texturing machine (1) according to claim 1 or 2,
wherein the information processing device (40) calculates a reference movement time at which the knot (C) is expected to move in the tension detection device (20) based on a detection result of the switching detection device (30), extracts and stores a tension data group in a predetermined time range including the reference movement time based on the reference movement time.

4. The false-twist texturing machine (1) according to claim 3,
wherein the information processing device (40) calculates the reference movement time based on a switching time at which the switching detection device (30) detects that the yarn feeding package (PI, P2) supplying the yarn (Y) is switched from one yarn feeding package (PI, P2) to the other yarn feeding package (PI, P2), a traveling speed of the yarn (Y), and a distance of the traveling path of the yarn (Y) between the switching detection device (30) and the tension detection device (20).

5. The false-twist texturing machine (1) according to any one of claims 1 to 4,
wherein the information processing device (40) includes an output unit (45) which outputs a waveform created based on a tension value and time in the stored tension data group.

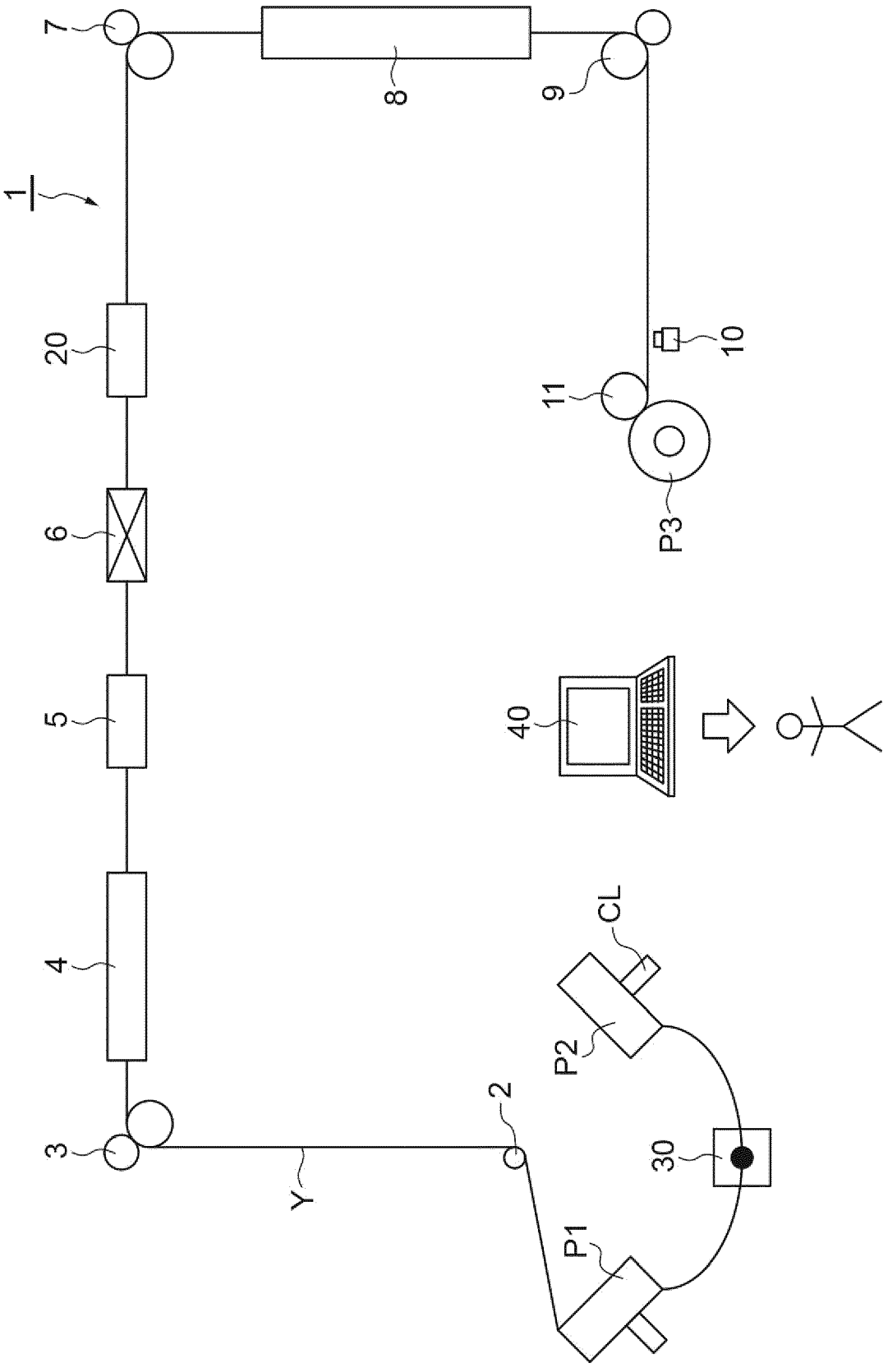


Fig.1

Fig.2

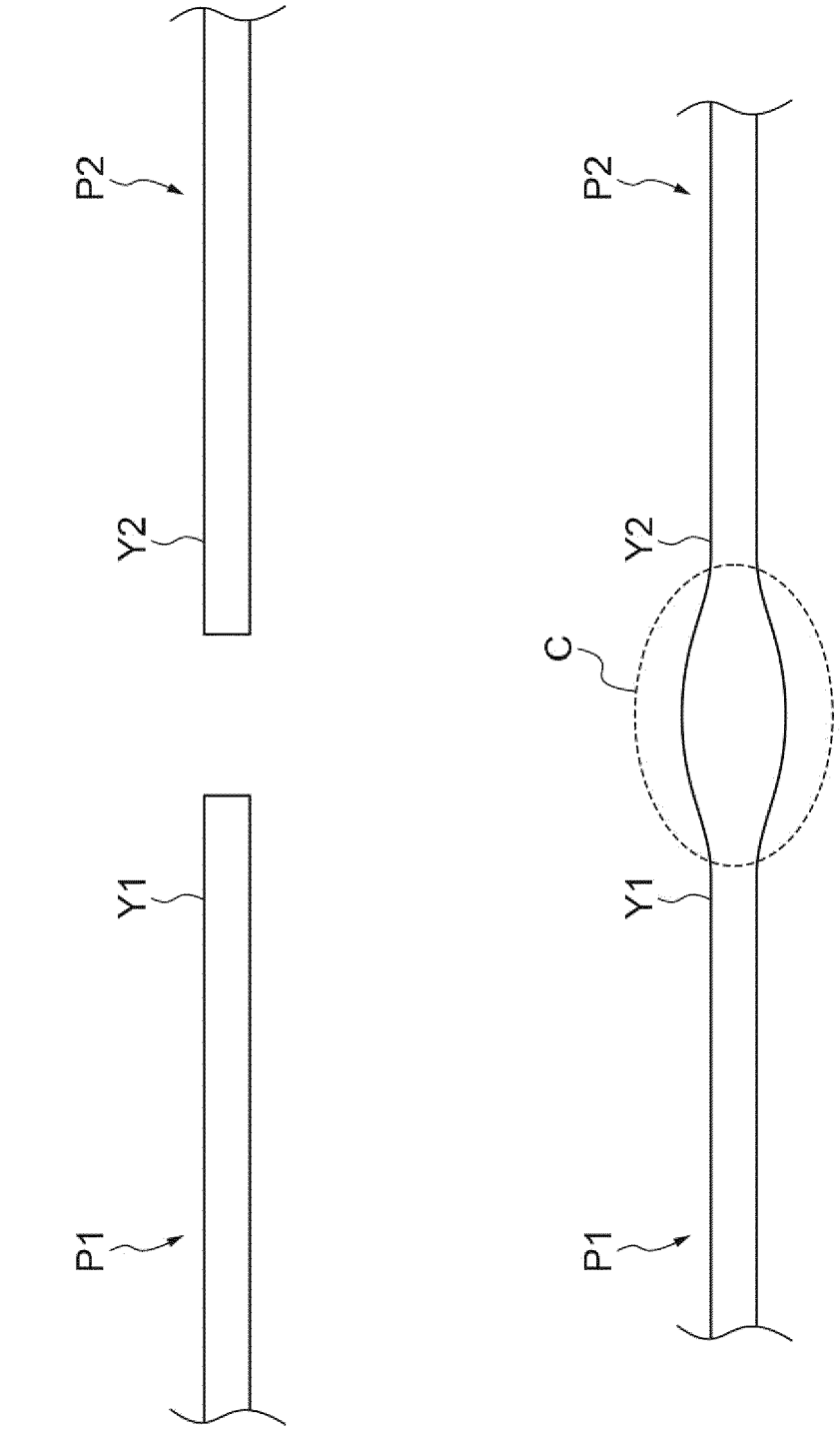


Fig.3

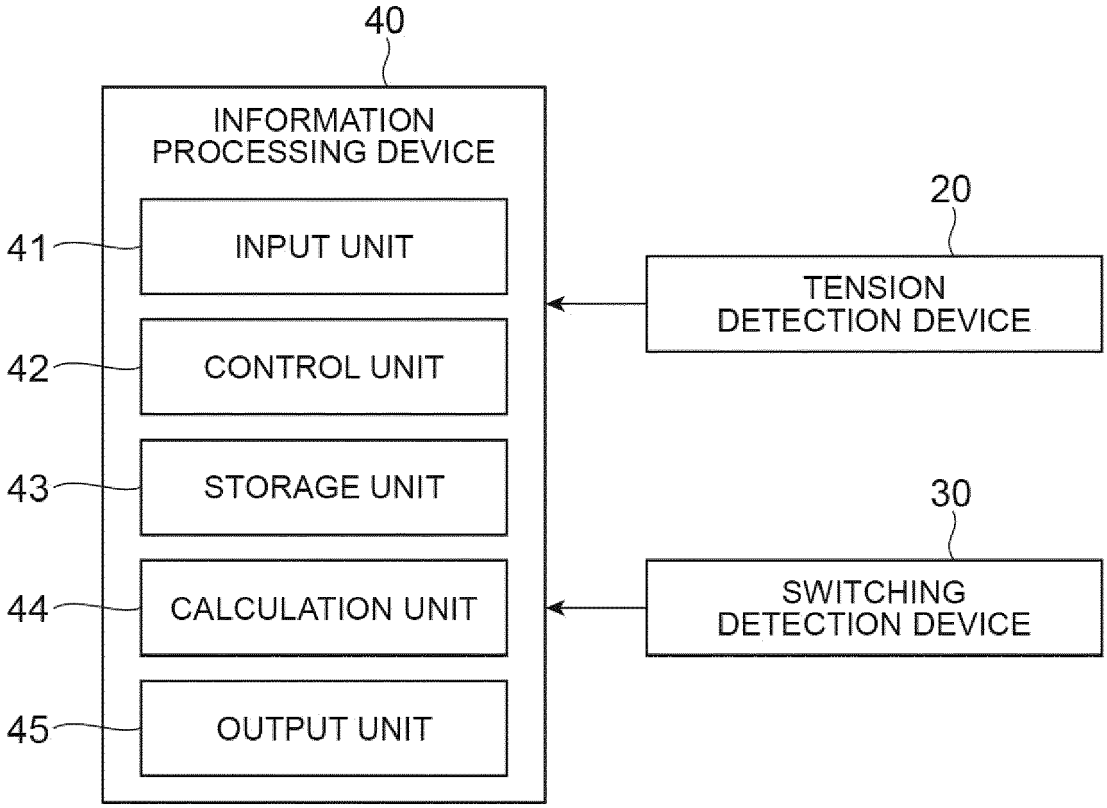

40
INFORMATION PROCESSING DEVICE
41
INPUT UNIT
42
CONTROL UNIT
43
STORAGE UNIT
44
CALCULATION UNIT
45
OUTPUT UNIT
20
TENSION DETECTION DEVICE
30
SWITCHING DETECTION DEVICE

Fig.4

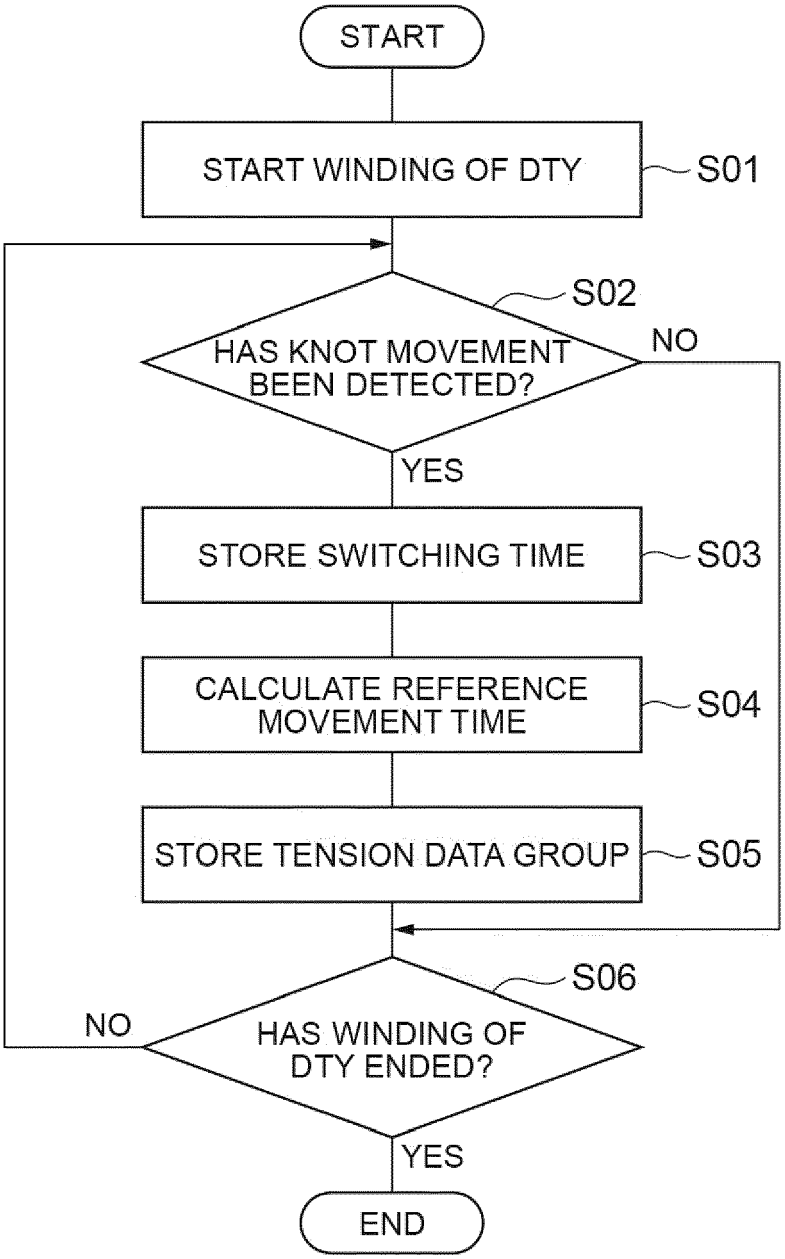

START
START WINDING OF DTY
S01
S02
HAS KNOT MOVEMENT BEEN DETECTED?
NO
YES
STORE SWITCHING TIME
S03
CALCULATE REFERENCE MOVEMENT TIME
S04
STORE TENSION DATA GROUP
S05
S06
NO
HAS WINDING OF DTY ENDED?
YES
END

Fig.5

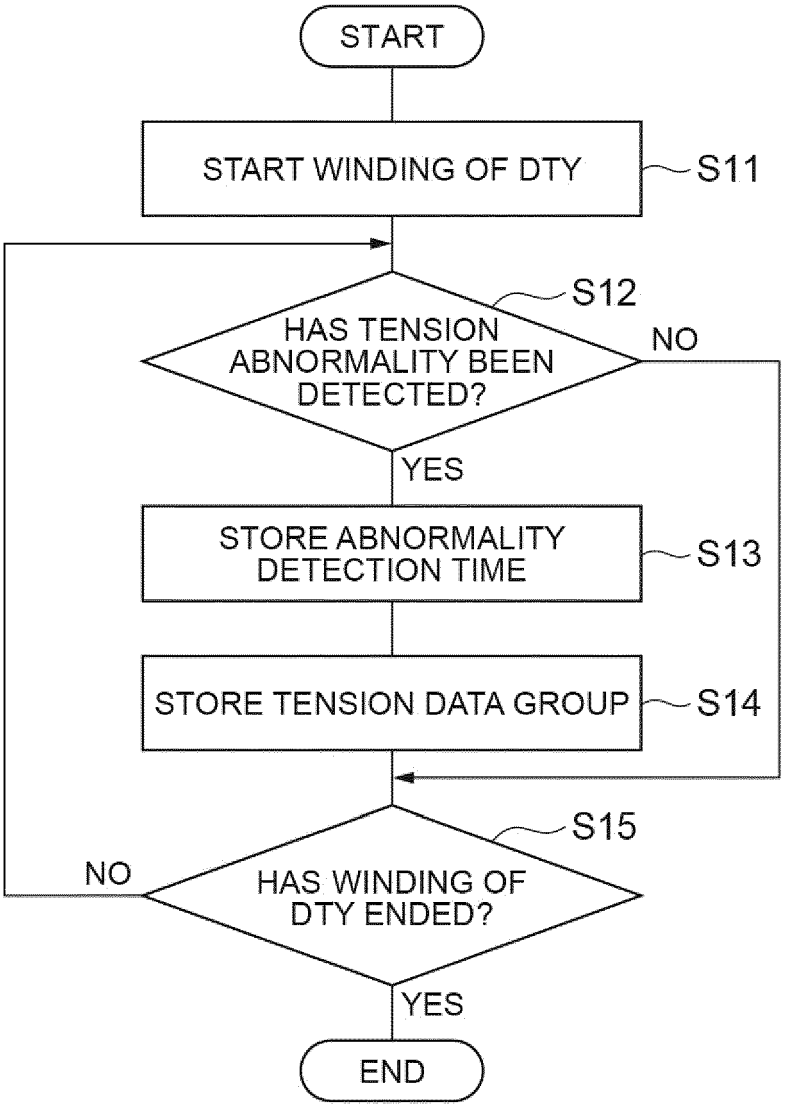

START
START WINDING OF DTY
S11
S12
HAS TENSION ABNORMALITY BEEN DETECTED?
NO
YES
STORE ABNORMALITY DETECTION TIME
S13
STORE TENSION DATA GROUP
S14
S15
NO
HAS WINDING OF DTY ENDED?
YES
END

Fig.6

NUMBER	GRADE	DATE AND TIME OF OCCURRENCE	TYPE
1	A	20XX/08/01 10:30:15	TENSION ABNORMALITY
2	B	20XX/08/01 11:15:05	TENSION ABNORMALITY
3		20XX/08/01 13:30:35	KNOT MOVEMENT
4	C	20XX/08/01 15:35:25	TENSION ABNORMALITY
5	D	20XX/08/01 15:55:45	TENSION ABNORMALITY
6			
7			
8			

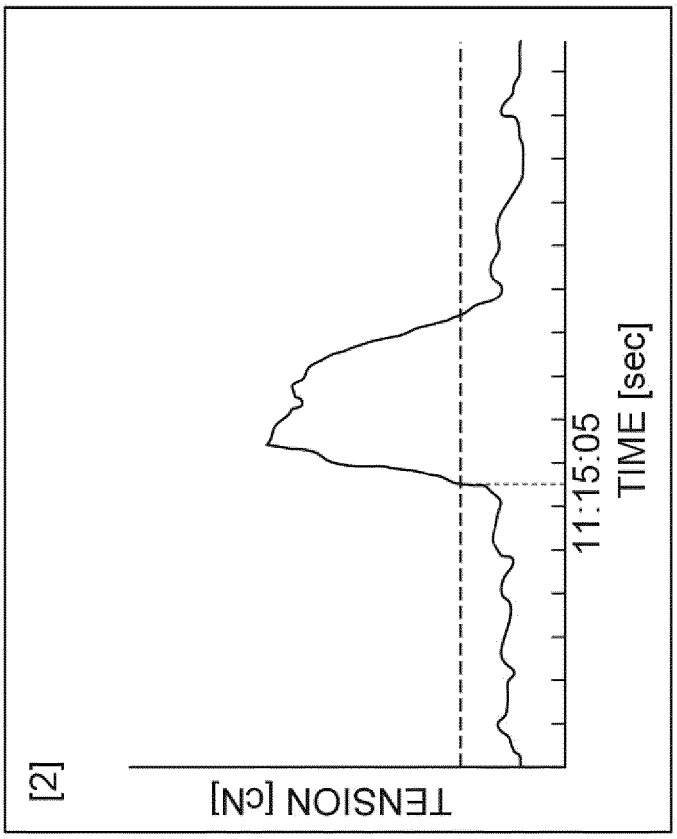


Fig.7

NUMBER	GRADE	DATE AND TIME OF OCCURRENCE	TYPE
1	A	20XX/08/01 10:30:15	TENSION ABNORMALITY
2	B	20XX/08/01 11:15:05	TENSION ABNORMALITY
3		20XX/08/01 13:30:35	KNOT MOVEMENT
4	C	20XX/08/01 15:35:25	TENSION ABNORMALITY
5	D	20XX/08/01 15:55:45	TENSION ABNORMALITY
6			
7			
8			

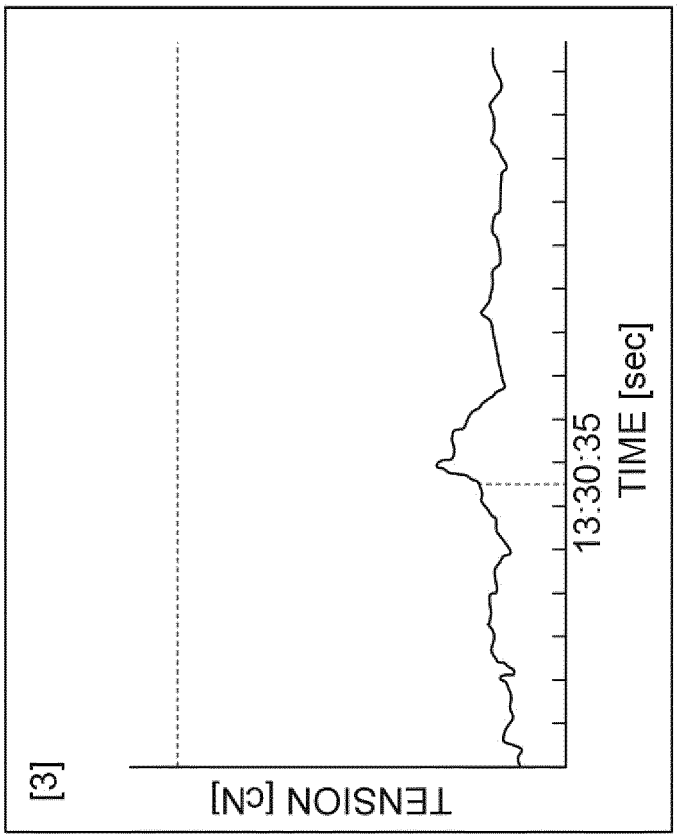
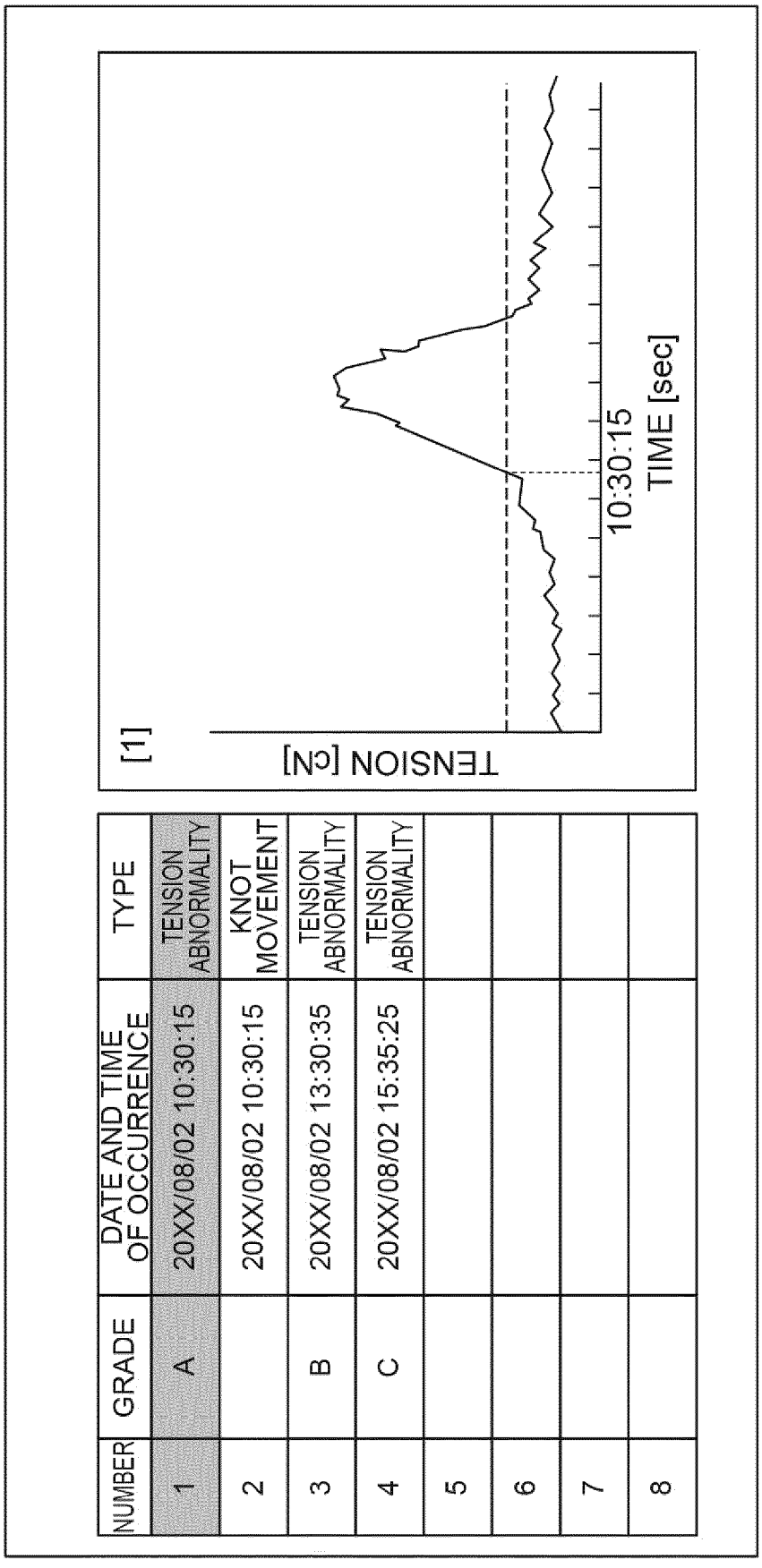
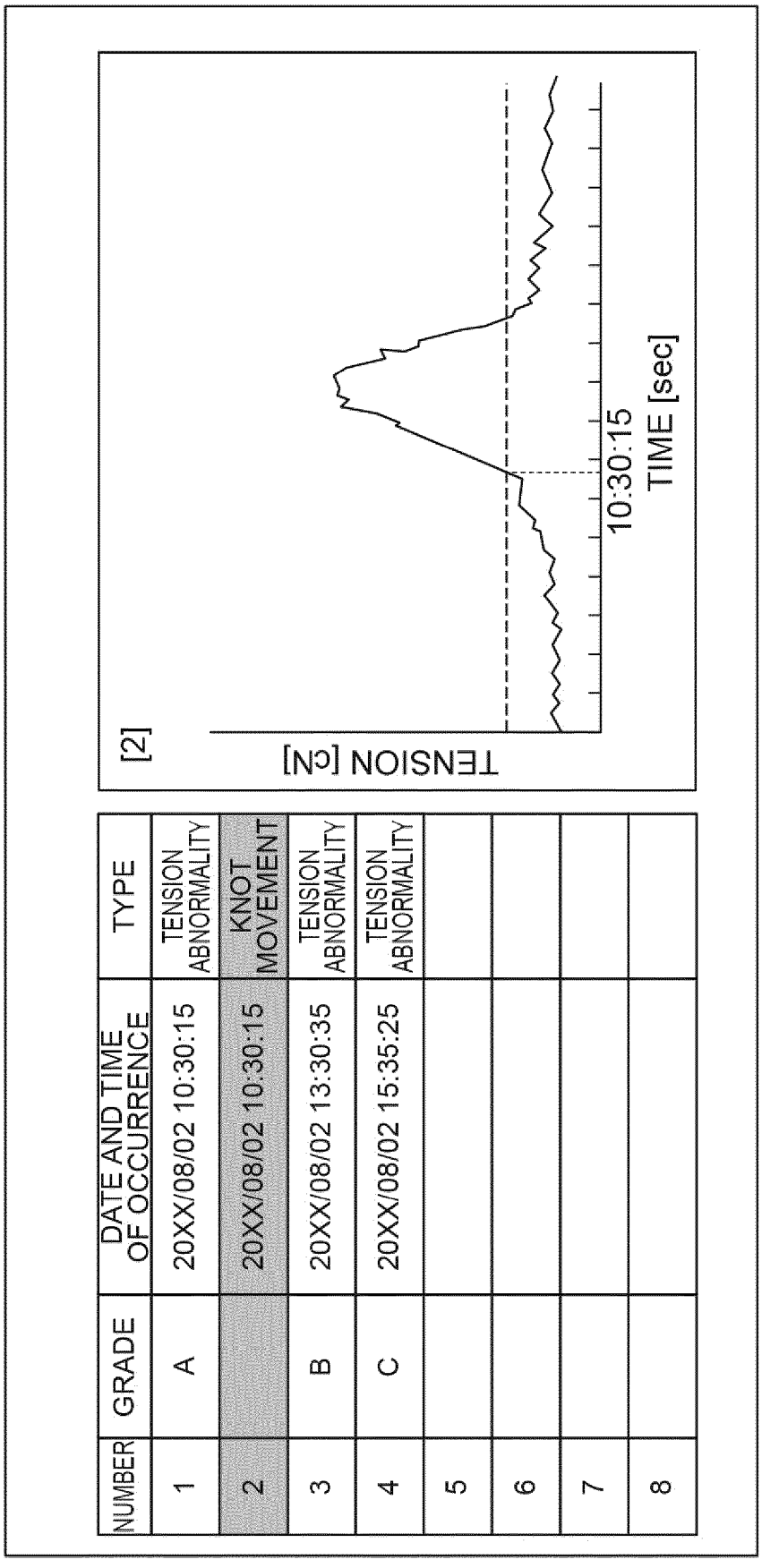


Fig.8



NUMBER	GRADE	DATE AND TIME OF OCCURRENCE	TYPE
1	A	20XX/08/02 10:30:15	TENSION ABNORMALITY
2		20XX/08/02 10:30:15	KNOT MOVEMENT
3	B	20XX/08/02 13:30:35	TENSION ABNORMALITY
4	C	20XX/08/02 15:35:25	TENSION ABNORMALITY
5			
6			
7			
8			

Fig.9



NUMBER	GRADE	DATE AND TIME OF OCCURRENCE	TYPE
1	A	20XX/08/02 10:30:15	TENSION ABNORMALITY
2		20XX/08/02 10:30:15	KNOT MOVEMENT
3	B	20XX/08/02 13:30:35	TENSION ABNORMALITY
4	C	20XX/08/02 15:35:25	TENSION ABNORMALITY
5			
6			
7			
8			

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European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 21 19 8498

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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