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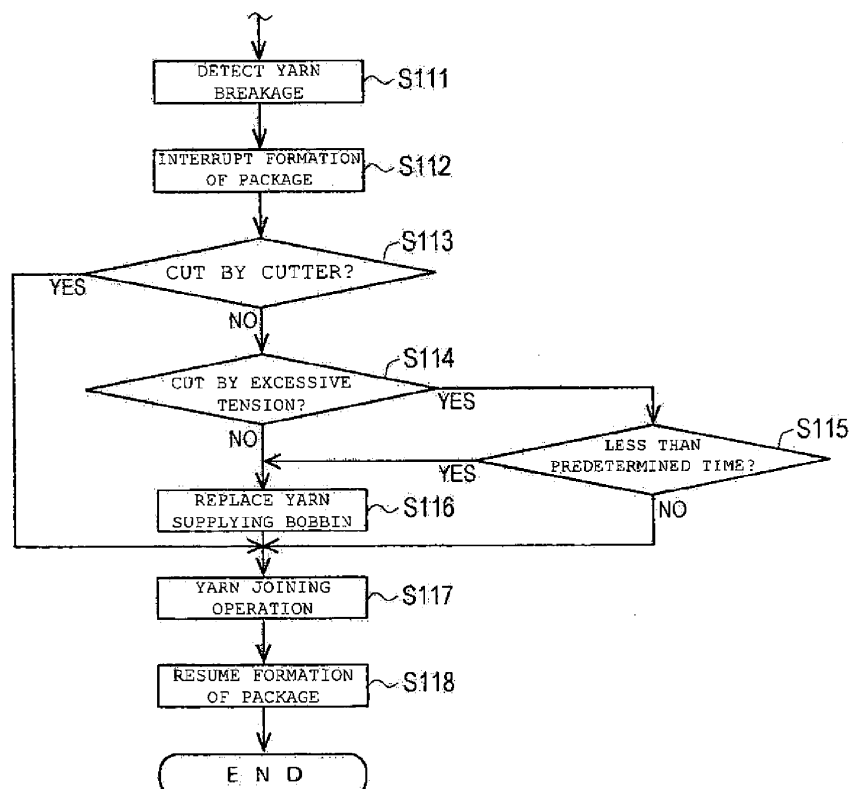
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BA ME(72) Inventor: **Tanigawa, Yasunobu****Kyoto, Kyoto 612-8686 (JP)**(74) Representative: **Beck, Alexander****Hansmann & Vogeser****Patent- und Rechtsanwälte****Maximilianstrasse 4b****82319 Starnberg (DE)**(30) Priority: **30.01.2012 JP 2012016794**(71) Applicant: **Murata Machinery, Ltd.****Kyoto-shi, Kyoto 601-8326 (JP)**(54) **Winding device**

(57) Provided is a winding device (100) including a control section (11) adapted to cause the yarn joining section (5) to join the spun yarn (Y) to resume the formation of the package (P); and a determination section (11d)

adapted to determine that the yarn supplying bobbin (SB) is abnormal when the yarn detecting section (6) detects the yarn breakage of the spun yarn (Y) and the tension detecting section (4) detects a value greater than or equal to a predetermined value.

FIG. 5**EP 2 620 533 A2**

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a technique of a winding device adapted to wind a spun yarn to form a package.

2. Description of the Related Art

[0002] Conventionally, there is known a winding device adapted to wind a spun yarn unwound from a yarn supplying bobbin to form a package (see e.g., Japanese Patent No. 3714218). The winding device includes a yarn detecting section adapted to detect presence or absence of a defective part of the spun yarn, and presence or absence of yarn breakage of the spun yarn, and a yarn joining section adapted to join ends of the spun yarn.

[0003] When the yarn detecting section detects the defective part of the spun yarn, the winding device cuts the spun yarn and interrupts the formation of the package. Then, after removing the defective part, the winding device joins the disconnected spun yarn in the yarn joining section to resume the formation of the package.

[0004] When the yarn detecting section detects the yarn breakage of the spun yarn, the winding device interrupts the formation of the package. Then, the winding device joins the disconnected spun yarn by the yarn joining section to resume the formation of the package. If the spun yarn wound around a yarn supplying bobbin is entirely unwound, the relevant spun yarn is joined with a spun yarn of a new yarn supplying bobbin to resume the formation of the package.

[0005] If the spun yarn is broken by application of an excessive tension on the spun yarn, there is a high possibility that the spun yarn may break again even if the spun yarn is joined and the formation of the package is resumed. Since the spun yarn is broken by application of an excessive tension on the spun yarn when the spun yarn is caught or entangled at the flaw of the yarn supplying bobbin, the spun yarn will be broken again by application of an excessive tension on the spun yarn even if the formation of the package is resumed.

[0006] Therefore, in the conventional winding device, a problem arises in that the yarn joining operation of the spun yarn is repeated, thereby lowering the operation rate. Furthermore, there also arises a problem in that the quality of the package lowers if the yarn joining operation is repeated. Therefore, to avoid the repetition of the yarn joining operation, there is desired a technique of promptly and accurately determining that the spun yarn wound around the yarn supplying bobbin cannot be unwound, that is, the yarn supplying bobbin is abnormal.

BRIEF SUMMARY OF THE INVENTION

[0007] An object of the present invention is to provide a technique capable of promptly and accurately determining that a yarn supplying bobbin is abnormal.

[0008] A first aspect of the invention relates to a winding device including a yarn supplying section adapted to support a yarn supplying bobbin; a winding section adapted to wind a spun yarn unwound from the yarn supplying bobbin to form a package; a tension detecting section adapted to detect a tension of the spun yarn fed from the yarn supplying section to the winding section; a yarn detecting section adapted to detect yarn breakage of the spun yarn fed from the yarn supplying section to the winding section; a yarn joining section adapted to join a spun yarn from the yarn supplying section and a spun yarn from the winding section when the yarn detecting section detects the yarn breakage of the spun yarn; a control section adapted to cause the yarn joining section to join the spun yarn to resume the formation of the package; and a determination section adapted to determine that the yarn supplying bobbin is abnormal when the yarn detecting section detects the yarn breakage of the spun yarn and the tension detecting section detects a value greater than or equal to a predetermined value.

[0009] A second aspect of the invention relates to the winding device according to the first aspect, wherein the determination section further determines that the yarn supplying bobbin is abnormal when the tension detecting section detects a value greater than or equal to a predetermined value upon yarn breakage immediately before the yarn joining section joins the spun yarn to resume the formation of the package.

[0010] A third aspect of the invention relates to the winding device according to the first or second aspect, wherein the determination section further determines that the yarn supplying bobbin is abnormal when an elapsed time after the formation of the package is resumed until the yarn breakage of the spun yarn is detected is less than a predetermined time.

[0011] A fourth aspect of the invention relates to the winding device according to any one of the first to third aspects, the device further including a yarn supplying bobbin supplying section adapted to supply a new yarn supplying bobbin to the yarn supplying section, wherein when the determination section determines that the yarn supplying bobbin is abnormal, the control section discharges the yarn supplying bobbin from the yarn supplying section and instructs the yarn supplying bobbin supplying section to supply a new yarn supplying bobbin.

[0012] A fifth aspect of the invention relates to a winding method of a winding device adapted to wind a spun yarn unwound from a yarn supplying bobbin to form a package, the method including determining that the yarn supplying bobbin is in an abnormal state when the spun yarn is broken by application of an excessive tension after the spun yarn is joined to resume the formation of the package.

[0013] A sixth aspect of the invention relates to the winding method according to the fifth aspect, the method including determining that the yarn supplying bobbin is in the abnormal state when an elapsed time after the formation of the package is resumed until the yarn breakage of the spun yarn is detected is less than a predetermined time.

[0014] A seventh aspect of the invention relates to the winding method according to the fifth or sixth aspect, the method including discharging the yarn supplying bobbin and supplying a new yarn supplying bobbin when determined that the yarn supplying bobbin is in the abnormal state.

[0015] The present invention has the following effects.

[0016] According to the first aspect, determination can be made that the yarn supplying bobbin is abnormal. Accordingly, the repetition of the yarn joining operation can be avoided by replacing the yarn supplying bobbin, and the operation rate of the winding device can be improved. The lowering of the quality of the package can also be prevented.

[0017] According to the second aspect, determination can be made promptly and accurately that the yarn supplying bobbin is abnormal. Accordingly, the repetition of the yarn joining operation can be avoided by replacing the yarn supplying bobbin, and the operation rate of the winding device can be improved. The lowering of the quality of the package can also be prevented.

[0018] According to the third aspect, determination can be made promptly and accurately that the yarn supplying bobbin is abnormal. Accordingly, the repetition of the yarn joining operation can be avoided by replacing the yarn supplying bobbin, and the operation rate of the winding device can be improved. The lowering of the quality of the package can also be prevented.

[0019] According to the fourth aspect, the yarn supplying bobbin that is determined as abnormal can be discharged, and a new yarn supplying bobbin can be supplied. Accordingly, the repetition of the yarn joining operation can be avoided, and the operation rate of the winding device can be improved. The lowering of the quality of the package can also be prevented.

[0020] According to the fifth aspect, determination can be made that the yarn supplying bobbin is in an abnormal state. Accordingly, the repetition of the yarn joining operation can be avoided by replacing the yarn supplying bobbin, and the operation rate of the winding device can be improved. The lowering of the quality of the package can also be prevented.

[0021] According to the sixth aspect, determination can be made promptly and accurately that the yarn supplying bobbin is abnormal. Accordingly, the repetition of the yarn joining operation can be avoided by replacing the yarn supplying bobbin, and the operation rate of the winding device can be improved. The lowering of the quality of the package can also be prevented.

[0022] According to the seventh aspect, the yarn supplying bobbin that is determined to be in the abnormal

state can be discharged and a new yarn supplying bobbin can be supplied. Accordingly, the repetition of the yarn joining operation can be avoided, and the operation rate of the winding device can be improved. The lowering of the quality of the package can also be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Fig. 1 is a schematic view illustrating an overall configuration of a winding device according to an embodiment of the present invention;

Fig. 2 is a side view of the winding device at the beginning of a yarn joining operation when a new yarn supplying bobbin is fed;

Fig. 3 is a side view of the winding device during the yarn joining operation;

Fig. 4 is a flow chart illustrating a control mode at the time of a first yarn breakage;

Fig. 5 is a flow chart illustrating a first control mode at the time of a second yarn breakage; and

Fig. 6 is a flow chart illustrating a second control mode at the time of the second yarn breakage.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0024] First, a winding device 100 according to one embodiment of the present invention will be described.

[0025] FIG. 1 is a schematic view illustrating an overall configuration of the winding device 100. White arrows in the drawing indicate a feeding direction of a spun yarn Y. FIG. 2 and FIG. 3 are side views each illustrating a yarn joining operation of the winding device 100.

[0026] The winding device 100 includes a yarn supplying section 1. A yarn supplying bobbin SB, around which the spun yarn Y is wound, is set in the yarn supplying section 1. The winding device 100 includes a yarn unwinding assisting section 2, a tension applying section 3, a tension detecting section 4, a yarn joining section 5, a yarn detecting section 6, a traversing section 7, and a winding section 8 along the feeding direction of the spun yarn Y unwound from the yarn supplying bobbin SB. Furthermore, the winding device 100 includes an upper yarn guiding section 9, a lower yarn guiding section 10, and a control section 11.

[0027] The yarn unwinding assisting section 2 assists the unwinding of the spun yarn Y wound around the yarn supplying bobbin SB. The yarn unwinding assisting section 2 restricts the spun yarn Y unwound from the yarn supplying bobbin SB from spreading by centrifugal force.

[0028] The tension applying section 3 applies a predetermined tension on the spun yarn Y unwound from the yarn supplying bobbin SB. The tension applying section 3 enables high-speed winding of the spun yarn Y by applying a predetermined tension on the spun yarn Y. As the tension applying section 3, a disc-type tensor, and

the like may also be employed in addition to a gate-type tensor that applies the tension on the spun yarn Y by comb teeth.

[0029] The tension detecting section 4 detects the tension applied on the spun yarn Y. The tension detecting section 4 can detect the tension applied on the spun yarn Y based on a voltage value that changes according to the tension of the spun yarn Y. Specifically, a unit control section 11c analyzes a detection signal from the tension detecting section 4 to grasp the tension applied on the spun yarn Y.

[0030] The yarn joining section 5 joins ends of the spun yarn Y to each other. When the spun yarn Y is broken, for example, the yarn joining section 5 joins the ends of the disconnected spun yarn Y to each other. As the yarn joining section 5, a mechanical splicer and the like having a disc-type joining mechanism may be employed in addition to an air splicer that joins the ends of the spun yarn Y by a whirling airflow.

[0031] The yarn detecting section 6 detects a defective part of the spun yarn Y. The yarn detecting section 6 detects yarn breakage of the spun yarn Y. The yarn detecting section 6 irradiates the spun yarn Y with a light emitting diode as a light source, and detects the defective part of the spun yarn Y and the yarn breakage of the spun yarn Y based on a reflected light quantity from the spun yarn Y. Specifically, an analyzer 61 analyzes a detection signal from the yarn detecting section 6 to determine presence or absence of the defective part and presence or absence of the yarn breakage. A cutter 62 capable of cutting the spun yarn Y is provided in proximity to the yarn detecting section 6. The unit control section 11c can grasp the yarn breakage of the spun yarn Y by a cutting signal of the spun yarn Y by the cutter 62.

[0032] Herein, the defective part of the spun yarn Y includes a case where foreign substances are contained in the spun yarn Y in addition to abnormality in which a portion of the spun yarn Y is too thick (thick yarn) or too thin (thin yarn). The yarn breakage of the spun yarn Y is a concept that includes a case where the spun yarn Y is cut by the cutter 62, a case where the spun yarn Y wound around the yarn supplying bobbin SB is entirely unwound, and a case where the spun yarn Y is broken by application of an excessive tension on the spun yarn Y. As the yarn detecting section 6, a capacitance sensor and the like may be employed in addition to an optical sensor described above.

[0033] The traversing section 7 traverses the spun yarn Y guided to a package P. The traversing section 7 includes a traverse guide 71 and a traverse guide driving unit 72. The traverse guide driving unit 72 drives the traverse guide 71 based on a control signal from a traverse guide drive control section 11a. The traverse guide drive control section 11a transmits the control signal to the traverse guide driving unit 72 based on an instruction from the unit control section 11c. The unit control section 11c includes a determination section 11d adapted to determine whether or not the spun yarn Y wound

around the yarn supplying bobbin SB can be unwound, that is, whether or not the yarn supplying bobbin SB is abnormal. The control section 11 has a concept including the traverse guide drive control section 11a, the unit control section 11c, and the determination section 11d.

[0034] The traverse guide 71 is an arm member provided with a hooking section adapted to hook the spun yarn Y. The traverse guide 71 reciprocates in a rotation axis direction of a bobbin TB with the spun yarn Y hooked to the hooking section to traverse the spun yarn Y.

[0035] The traverse guide driving unit 72 is mainly configured by a servomotor. The traverse guide driving unit 72 reciprocates the traverse guide 71 by forwardly rotating or reversely rotating a rotation shaft of the servomotor.

The traverse guide driving unit 72 uses a servomotor for a power source, but for example, a stepping motor or the like may also be used, and any type of motor can be used.

[0036] The traversing section 7 thus configures a so-called arm-type traverse device adapted to traverse the spun yarn Y by the reciprocating traverse guide 71. However, a belt-type traverse device, a blade traverse device, and the like can be used in addition to the arm-type traverse device. The winding device 100 may employ a traverse drum method, i.e., a structure in which a drum that rotates while making contact with the package P is arranged to traverse the spun yarn Y by a guiding groove formed on a surface of the drum.

[0037] The winding section 8 winds the spun yarn Y by rotating the bobbin TB. The winding section 8 includes a bobbin holding unit 81, a contact roller 82, and a package driving unit 83. The package driving unit 83 rotates the bobbin TB based on a control signal from a package drive control section 11b. The package drive control section 11b transmits the control signal to the package driving unit 83 based on an instruction from the unit control section 11c. As described above, the unit control section 11c includes a determination section 11d adapted to determine whether or not the spun yarn Y wound around the yarn supplying bobbin SB can be unwound, that is, whether or not the yarn supplying bobbin SB is abnormal. The control section 11 has a concept including the package drive control section 11b, the unit control section 11c, and the determination section 11d.

[0038] The bobbin holding unit 81 includes a bearing for removably clamping the bobbin TB, and rotatably holds the bobbin TB. The bobbin holding unit 81 can swing with a swing shaft 84 as center (see arrow in FIG. 2). Therefore, even if an outer diameter of the package P becomes large accompanying winding of the spun yarn Y, the bobbin holding unit 81 enables the contact roller 82 to push the surface of the package P at a prescribed load.

[0039] The contact roller 82 rotates accompanying the rotation of the rotating package P. The contact roller 82 adjusts a shape of the package P by pressing the surface of the package P. The contact roller 82 is a substantially cylindrical rotating body, but may also be a conical rotating body, for example, and may be of any shape.

[0040] The package driving unit 83 is mainly configured by a servomotor. The package driving unit 83 drives the servomotor to rotate the bobbin TB and the package P formed on the bobbin TB. The package driving unit 83 uses a servomotor for the power source, but for example, a stepping motor or the like may also be used, and any type of motor can be used.

[0041] As described above, the winding section 8 is configured such that the package P is rotated by the package driving unit 83, and a contact roller 82 is rotated accompanying the rotation of the package P. However, the contact roller 82 may be rotated by the package driving unit 83, and the package P may be rotated accompanying the rotation of the contact roller 82.

[0042] For example, when the spun yarn Y is broken, the upper yarn guiding section 9 catches a yarn end (upper yarn) YE of the spun yarn Y wound into the package P. The upper yarn guiding section 9 is swung while sucking and holding the yarn end YE to pull out the spun yarn Y from the package P. Specifically, the upper yarn guiding section 9 is swung when the yarn joining operation is started (see arrow in FIG. 2), and catches the yarn end YE by sucking air from a suction opening 9a. The upper yarn guiding section 9 is swung while sucking and holding the yarn end YE (see arrow in FIG. 3) to pull out the spun yarn Y from the package P. In this case, the package driving unit 83 reversely rotates the bobbin TB and the package P (see arrow in FIG. 3).

[0043] For example, when the spun yarn Y is broken, the lower yarn guiding section 10 catches the yarn end (lower yarn) YE of the spun yarn Y wound around the yarn supplying bobbin SB. The lower yarn guiding section 10 is swung while sucking and holding the yarn end YE to unwind the spun yarn Y from the yarn supplying bobbin SB. Specifically, the lower yarn guiding section 10 catches the yarn end YE by sucking air from a suction opening 10a. The lower yarn guiding section 10 is swung while sucking and holding the yarn end YE (see arrow in FIG. 3) to unwind the spun yarn Y from the yarn supplying bobbin SB.

[0044] Subsequently, the spun yarn Y arranged at a predetermined position by the upper yarn guiding section 9 and the spun yarn Y arranged at a predetermined position by the lower yarn guiding section 10 are joined by the yarn joining section 5. In this manner, the winding device 100 resumes the formation of the package P.

[0045] As illustrated in FIG. 2 and FIG. 3, the winding device 100 includes a yarn supplying bobbin supplying section 12. The yarn supplying bobbin supplying section 12 can supply a new yarn supplying bobbin SB to the yarn supplying section 1 based on an instruction from the control section 11. Furthermore, the winding device 100 includes a yarn supplying bobbin collecting section 13. The yarn supplying bobbin collecting section 13 can collect the yarn supplying bobbin SB discharged from the winding device 100.

[0046] Next, a technique capable of promptly and accurately determining that the spun yarn Y wound around

the yarn supplying bobbin SB cannot be unwound will be described.

[0047] FIG. 4 to FIG. 6 are flowcharts illustrating a control mode of the winding device 100. FIG. 4 illustrates a control mode at the time of a first yarn breakage. FIG. 5 illustrates a first control mode at the time of a second yarn breakage. FIG. 6 illustrates a second control mode at the time of the second yarn breakage.

[0048] First, the control mode at the time of the first yarn breakage and the first control mode at the time of the second yarn breakage will be described with reference to FIG. 4 and FIG. 5.

[0049] Assume that the yarn detecting section 6 detects the yarn breakage of the spun yarn Y in step S101. Specifically, assume that the control section 11 grasps that the spun yarn Y is broken based on an analysis result of the analyzer 61. In this case, the determination section 11d stores a tension value of when the spun yarn Y is broken based on a detection signal from the tension detecting section 4.

[0050] In step S102, the control section 11 interrupts the formation (winding) of the package P. Specifically, the control section 11 stops the rotation of the package P by transmitting a control signal to the package driving unit 83. The control section 11 thus interrupts the formation of the package P by stopping the rotation of the package P.

[0051] In step S103, the control section 11 considers whether or not the spun yarn Y is cut by the cutter 62. Specifically, the control section 11 grasps whether or not the spun yarn Y is cut by the cutter 62 based on the presence or absence of a cutting signal. If the spun yarn Y is cut by the cutter 62, the process proceeds to step S106, and if the spun yarn Y is not cut by the cutter 62, the process proceeds to step S104.

[0052] A case where the spun yarn Y is cut by the cutter 62 is assumed to be a state in which the spun yarn Y is cut to remove the defective part. A case where the spun yarn Y is not cut by the cutter 62 is assumed to be a state in which the spun yarn Y wound around the yarn supplying bobbin SB is entirely unwound or a state in which the spun yarn Y is broken by application of an excessive tension on the spun yarn Y.

[0053] In step S104, the determination section 11d considers whether or not the spun yarn Y is broken by application of an excessive tension on the spun yarn Y. Specifically, the determination section 11d grasps whether or not the spun yarn Y is broken by application of an excessive tension based on the tension value stored in step S101. When the tension value stored in step S101 is greater than or equal to a predetermined value, the determination section 11d determines that the spun yarn Y is broken by application of an excessive tension on the spun yarn Y. If the spun yarn Y is broken by application of an excessive tension on the spun yarn Y, the process proceeds to step S106, and if the spun yarn Y is broken without application of an excessive tension on the spun yarn Y, the process proceeds to step S105.

[0054] A case where the spun yarn Y is broken by application of an excessive tension on the spun yarn Y is assumed, for example, to be a state in which the spun yarn Y is caught or entangled at the flaw of the yarn supplying bobbin SB. A case where the spun yarn Y is broken without application of an excessive tension on the spun yarn Y is assumed to be a state in which the spun yarn Y wound around the yarn supplying bobbin SB is entirely unwound.

[0055] In step S105, the control section 11 replaces the yarn supplying bobbin SB. Specifically, the control section 11 instructs the discharge of the yarn supplying bobbin SB to the yarn supplying section 1 and instructs the supply of a new yarn supplying bobbin SB to the yarn supplying bobbin supplying section 12 (see black arrows in FIG. 2 and FIG. 3).

[0056] In step S106, the control section 11 joins the spun yarn Y from the yarn supplying section 1 and the spun yarn Y from the winding section 8. That is, the control section 11 joins the spun yarn Y wound around the yarn supplying bobbin SB and the spun yarn Y wound around the package P. The operation of joining the spun yarns Y, that is, the yarn joining operation is an operation of arranging the spun yarns Y by the upper yarn guiding section 9 and the lower yarn guiding section 10, and joining the spun yarns Y by the yarn joining section 5.

[0057] In step S107, the control section 11 resumes the formation of the package P. Specifically, the control section 11 rotates the package P by transmitting a control signal to the package driving unit 83. The control section 11 thus resumes the formation of the package P by rotating the package P.

[0058] According to such a control mode, the winding device 100 enables the formation of the package P to continue. However, if the spun yarn Y is broken by application of an excessive tension on the spun yarn Y, there is a high possibility that the spun yarn Y may break again even if the spun yarns Y are joined and the formation of the package P is resumed. Since the spun yarn Y is broken by application of an excessive tension on the spun yarn Y when the spun yarn Y is caught or entangled at the flaw of the yarn supplying bobbin SB, even if the formation of the package P is resumed, the spun yarn Y may break again by application of an abnormal tension (in the second yarn breakage, this is referred to as "abnormal tension" for simplification. The "excessive tension" and the "abnormal tension" are synonymous).

[0059] In step S111, the control section 11 grasps that the spun yarn Y is again broken based on the analysis result of the analyzer 61. In this case, the determination section 11d stores the tension value of when the spun yarn Y is broken, similarly to the case of the first yarn breakage.

[0060] In step S112, the control section 11 interrupts the formation of the package P. As described above, the control section 11 interrupts the formation of the package P by stopping the rotation of the package P.

[0061] In step S113, the control section 11 considers

whether or not the spun yarn Y is cut by the cutter 62. Specifically, the control section 11 grasps whether or not the spun yarn Y is cut by the cutter 62 based on presence or absence of the cutting signal. If the spun yarn Y is cut by the cutter 62, the process proceeds to step S117, and if the spun yarn Y is not cut by the cutter 62, the process proceeds to step S114.

[0062] A case where the spun yarn Y is cut by the cutter 62 is assumed to be a state in which the spun yarn Y is cut to remove the defective part. A case where the spun yarn Y is not cut by the cutter 62 is assumed to be a state in which the spun yarn Y wound around the yarn supplying bobbin SB is entirely unwound or a state in which the spun yarn Y is broken by application of an abnormal tension on the spun yarn Y.

[0063] In step S114, the determination section 11d considers whether or not the spun yarn Y is broken by application of an abnormal tension on the spun yarn Y. Specifically, the determination section 11d grasps whether or not the spun yarn Y is broken by application of an abnormal tension based on the tension value stored in step S111. If the spun yarn Y is broken by application of an abnormal tension on the spun yarn Y, the process proceeds to step S115, and if the spun yarn Y is broken without application of an abnormal tension on the spun yarn Y, the process proceeds to step S116.

[0064] A case where the spun yarn Y is broken by application of an abnormal tension on the spun yarn Y is assumed, for example, to be a state in which the spun yarn Y is caught or entangled at the flaw of the yarn supplying bobbin SB. A case where the spun yarn Y is broken without application of an abnormal tension on the spun yarn Y is assumed to be a state in which the spun yarn Y wound around the yarn supplying bobbin SB is entirely unwound.

[0065] In step S115, the determination section 11d considers whether or not an elapsed time after the formation of the package P is resumed until the yarn breakage of the spun yarn Y is detected is less than a predetermined time. Specifically, the determination section 11d grasps whether or not the elapsed time is less than the predetermined time by measuring the elapsed time after the formation of the package P is resumed until the yarn breakage of the spun yarn Y is detected. If the elapsed time is less than the predetermined time, the process proceeds to step S116, and if the elapsed time is not less than the predetermined time, the process proceeds to step S117. This makes the control mode different from the control mode at the time of the first yarn breakage.

[0066] In a case where the first yarn breakage is caused by application of an excessive tension on the spun yarn Y and the elapsed time after the formation of the package P is resumed until the second yarn breakage is detected is less than the predetermined time, it is assumed that the spun yarn Y is caught or entangled at the flaw of the yarn supplying bobbin SB.

[0067] In step S116, the control section 11 replaces

the yarn supplying bobbin SB. As described above, the control section 11 instructs the discharge of the yarn supplying bobbin SB to the yarn supplying section 1 and instructs the supply of a new yarn supplying bobbin SB to the yarn supplying bobbin supplying section 12 (see black arrows in FIG. 2 and FIG. 3).

[0068] In step S117, the control section 11 joins the spun yarn Y from the yarn supplying section 1 and the spun yarn Y from the winding section 8. The operation of joining the spun yarns Y, that is, the yarn joining operation is as described above.

[0069] In step S118, the control section 11 resumes the formation of the package P. The control section 11 resumes the formation of the package P by rotating the package P.

[0070] As described above, in the first control mode, when the yarn detecting section 6 again detects the yarn breakage of the spun yarn Y after resuming the formation of the package P and the tension detection section 4 detects a value greater than or equal to a predetermined value, and the elapsed time after the formation of the package P is resumed until the yarn breakage of the spun yarn Y is detected is less than the predetermined time, determination is made that the spun yarn Y wound around the yarn supplying bobbin SB cannot be unwound (see step S114 and step S115). Therefore, the winding device 100 promptly and accurately determines that the spun yarn Y wound around the yarn supplying bobbin SB cannot be unwound, that is, the yarn supplying bobbin SB is abnormal. In this control mode, determination is made as to whether or not the yarn supplying bobbin SB is abnormal when the second yarn breakage is detected, but the number of times the yarn breakage is detected is not limited thereto.

[0071] According to such a control mode, the winding device 100 can promptly and accurately determine that the yarn supplying bobbin SB is abnormal. Accordingly, the repetition of the yarn joining operation can be avoided by replacing the yarn supplying bobbin SB, and the operation rate of the winding device 100 can be improved. The lowering of the quality of the package P can also be prevented.

[0072] Next, the second control mode at the time of the second yarn breakage will be described with reference to FIG. 6.

[0073] In the second control mode as well, the control mode at the time of the first yarn breakage is similar to the control mode described above. In other words, the configuration from step S101 to step S107 is similar in the second control mode as well. Therefore, description will be made herein from step S211.

[0074] In step S211, the control section 11 grasps that the spun yarn Y is broken again based on the analysis result of the analyzer 61. In this case, the determination section 11d stores the tension value of when the spun yarn Y is broken, similarly to the first yarn breakage.

[0075] In step S212, the control section 11 interrupts the formation of the package P. As described above, the

control section 11 interrupts the formation of the package P by stopping the rotation of the package P.

[0076] In step S213, the control section 11 considers whether or not the spun yarn Y is cut by the cutter 62. Specifically, the control section 11 grasps whether or not the spun yarn Y is cut by the cutter 62 based on the presence or absence of the cutting signal. If the spun yarn Y is cut by the cutter 62, the process proceeds to step S218, and if the spun yarn Y is not cut by the cutter 62, the process proceeds to step S214.

[0077] A case where the spun yarn Y is cut by the cutter 62 is assumed to be a state in which the spun yarn Y is cut to remove the defective part. A case where the spun yarn Y is not cut by the cutter 62 is assumed to be a state in which the spun yarn Y wound around the yarn supplying bobbin SB is entirely unwound or a state in which the spun yarn Y is broken by application of an abnormal tension on the spun yarn Y.

[0078] In step S214, the determination section 11d considers whether or not the spun yarn Y is broken by application of an abnormal tension on the spun yarn Y. Specifically, the determination section 11d grasps whether or not the spun yarn Y is broken by application of an abnormal tension based on the tension value stored in step S211. If the spun yarn Y is broken by application of an abnormal tension on the spun yarn Y, the process proceeds to step S215, and if the spun yarn Y is broken without application of an abnormal tension on the spun yarn Y, the process proceeds to step S217.

[0079] A case where the spun yarn Y is broken by application of an abnormal tension on the spun yarn Y is assumed, for example, to be a state in which the spun yarn Y is caught or entangled at the flaw of the yarn supplying bobbin SB. A case where the spun yarn Y is broken without application of an abnormal tension on the spun yarn Y is assumed to be a state in which the spun yarn Y wound around the yarn supplying bobbin SB is entirely unwound.

[0080] In step S215, as the cause of the first yarn breakage, the determination section 11d considers whether or not the spun yarn Y is broken by application of an excessive tension on the spun yarn Y. Specifically, the determination section 11d grasps whether or not the spun yarn Y is broken by application of an excessive tension based on the tension value stored in step S201 (corresponding to step S101). If the spun yarn Y is broken by application of an excessive tension on the spun yarn Y, the process proceeds to step S216, and if the spun yarn Y is broken without application of an excessive tension on the spun yarn Y, the process proceeds to step S218. This aspect makes the control mode different from the first control mode at the time of the second yarn breakage.

[0081] In a case where the first and second yarn breakages are caused by application of an excessive (abnormal) tension on the spun yarn Y, it is reliably assumed that the spun yarn Y is caught or entangled at the flaw of the yarn supplying bobbin SB.

[0082] In step S216, the determination section 11d considers whether or not an elapsed time after the formation of the package P is resumed until the yarn breakage of the spun yarn Y is detected is less than a predetermined time. Specifically, the determination section 11d grasps whether or not the elapsed time is less than the predetermined time by measuring the elapsed time after the formation of the package P is resumed until the yarn breakage of the spun yarn Y is detected. If the relevant elapsed time is less than the predetermined time, the process proceeds to step S217, and if the relevant elapsed time is not less than the predetermined time, the process proceeds to step S218.

[0083] In a case where the first yarn breakage is caused by application of an excessive tension on the spun yarn Y and the elapsed time after the formation of the package P is resumed until the second yarn breakage is detected is less than the predetermined time, it is reliably assumed that the spun yarn Y is caught or entangled at the flaw of the yarn supplying bobbin SB.

[0084] In step S217, the control section 11 replaces the yarn supplying bobbin SB. As described above, the control section 11 instructs the discharge of the yarn supplying bobbin SB to the yarn supplying section 1, and instructs the supply of a new yarn supplying bobbin SB to the yarn supplying bobbin supplying section 12 (see black arrows in FIG. 2 and FIG. 3).

[0085] In step S218, the control section 11 joins the spun yarn Y from the yarn supplying section 1 and the spun yarn Y from the winding section 8. The operation of joining the spun yarns Y, that is, the yarn joining operation is as described above.

[0086] In step S219, the control section 11 resumes the formation of the package P. The control section 11 resumes the formation of the package P by rotating the package P.

[0087] As described above, in the second control mode, when the yarn detecting section 6 again detects the yarn breakage of the spun yarn Y after resuming the formation of the package P and the tension detection section 4 detects a value greater than or equal to a predetermined value, and when the tension detection section 4 detects a value greater than or equal to a predetermined value before resuming the formation of the package P and the elapsed time after the formation of the package P is resumed until the yarn breakage of the spun yarn Y is detected is less than the predetermined time, determination is made that the spun yarn Y wound around the yarn supplying bobbin SB cannot be unwound (see step S214, step S215, and step S216). Therefore, the winding device 100 promptly and accurately determines that the spun yarn Y wound around the yarn supplying bobbin SB cannot be unwound, that is, the yarn supplying bobbin SB is abnormal. In this control mode, determination is made as to whether or not the yarn supplying bobbin SB is abnormal when the second yarn breakage is detected, but the number of times the yarn breakage is detected is not limited thereto.

[0088] According to such a control mode, the winding device 100 can promptly and accurately determine that the yarn supplying bobbin SB is abnormal. Accordingly, the repetition of the yarn joining operation can be avoided by replacing the yarn supplying bobbin SB, and the operation rate of the winding device 100 can be improved. The lowering of the quality of the package P can also be prevented.

[0089] As described above, the winding device 100 can replace the yarn supplying bobbin SB by the instruction of the control section 11. This can be realized by including the yarn supplying bobbin supplying section 12 and the yarn supplying bobbin collecting section 13.

[0090] According to such a configuration, the winding device 100 can discharge the yarn supplying bobbin SB, from which the spun yarn Y cannot be unwound, and can receive the supply of a new yarn supplying bobbin SB. Accordingly, the repetition of the yarn joining operation can be avoided, and the operation rate of the winding device 100 can be improved. Furthermore, the lowering of the quality of the package P can also be prevented.

Claims

1. A winding device (100) **characterized by** comprising:

a yarn supplying section (1) adapted to support a yarn supplying bobbin (SB);
 a winding section (8) adapted to wind a spun yarn (Y) unwound from the yarn supplying bobbin (SB) to form a package (P);
 a tension detecting section (4) adapted to detect a tension of the spun yarn (Y) fed from the yarn supplying section (1) to the winding section (8);
 a yarn detecting section (6) adapted to detect yarn breakage of the spun yarn (Y) fed from the yarn supplying section (1) to the winding section (8);
 a yarn joining section (5) adapted to join a spun yarn (Y) from the yarn supplying section (1) and a spun yarn from the winding section (8) when the yarn detecting section (6) detects the yarn breakage of the spun yarn (Y);
 a control section (11) adapted to cause the yarn joining section (5) to join the spun yarn (Y) to resume the formation of the package (P); and
 a determination section (11d) adapted to determine that the yarn supplying bobbin (SB) is abnormal when the yarn detecting section (6) detects the yarn breakage of the spun yarn (Y) and the tension detecting section (4) detects a value greater than or equal to a predetermined value.

2. The winding device (100) according to claim 1, **characterized in that** the determination section (11d) determines that the yarn supplying bobbin (SB) is ab-

normal when the tension detecting section (4) detects a value greater than or equal to a predetermined value upon yarn breakage immediately before the yarn joining section (5) joins the spun yarn (Y) to resume the formation of the package.

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3. The winding device (100) according to claim 1 or 2, **characterized in that** the determination section (11d) determines that the yarn supplying bobbin (SB) is abnormal
- when an elapsed time after the formation of the package (P) is resumed until the yarn breakage of the spun yarn is detected is less than a predetermined time.

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4. The winding device (100) according to any one of claims 1 to 3, further **characterized by** comprising a yarn supplying bobbin supplying section (12) adapted to supply a new yarn supplying bobbin (SB) to the yarn supplying section (1), wherein
- when the determination section (11d) determines that the yarn supplying bobbin (SB) is abnormal, the control section (11) discharges the yarn supplying bobbin (SB) from the yarn supplying section (1) and instructs the yarn supplying bobbin supplying section (12) to supply a new yarn supplying bobbin (SB).

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5. A winding method for a winding device (100) adapted to wind a spun yarn (Y) unwound from a yarn supplying bobbin (SB) to form a package (P), the method **characterized by** comprising:

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determining that the yarn supplying bobbin (SB) is in an abnormal state when the spun yarn (Y) is broken by application of an excessive tension after the spun yarn (Y) is joined to resume the formation of the package (P).

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6. The winding method according to claim 5, **characterized by** comprising:

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determining that the yarn supplying bobbin (SB) is in the abnormal state when an elapsed time after the formation of the package (P) is resumed until the yarn breakage of the spun yarn (Y) is detected is less than a predetermined time.

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7. The winding method according to claim 5 or 6, **characterized by** comprising:

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discharging the yarn supplying bobbin (SB) and supplying a new yarn supplying bobbin (SB) when it is determined that the yarn supplying bobbin (SB) is in the abnormal state.

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FIG. 1

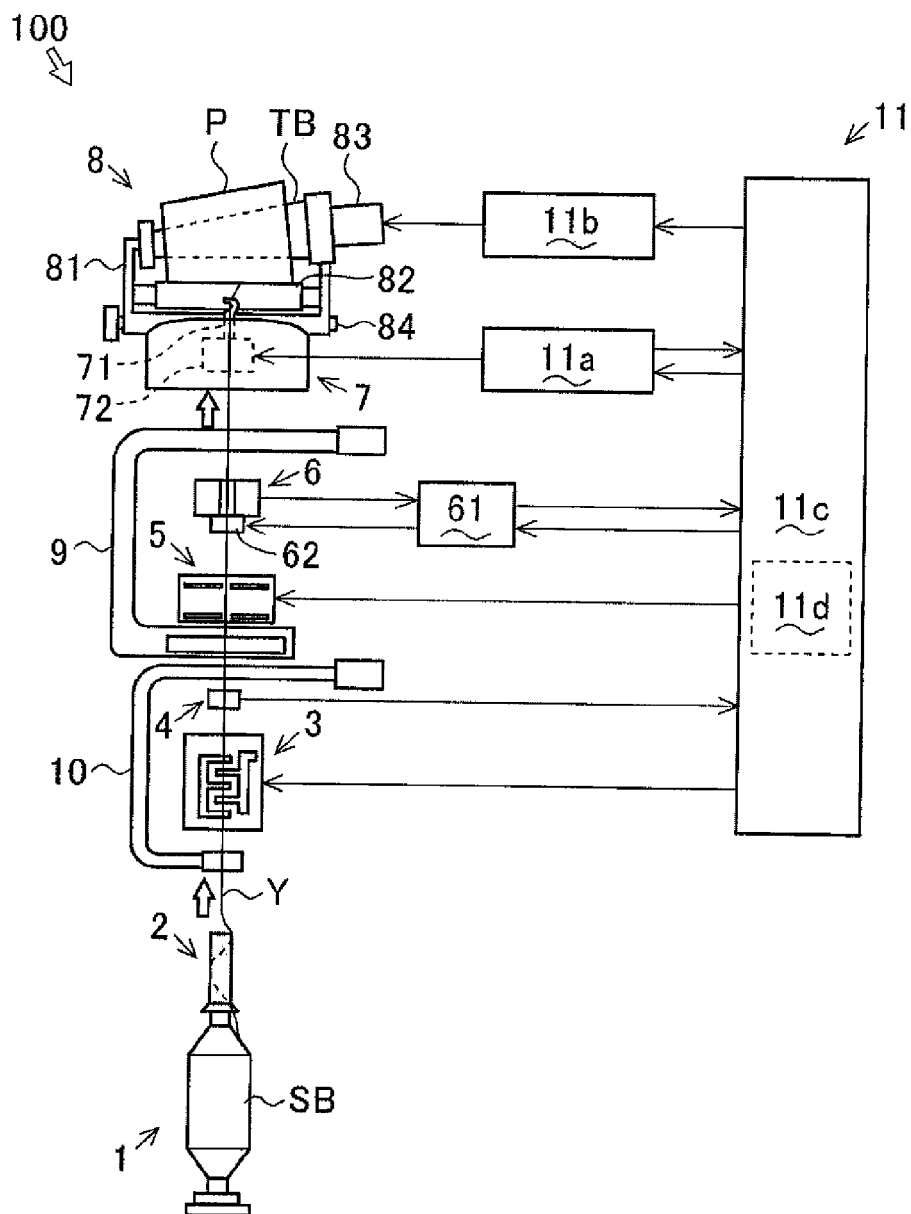


FIG. 2

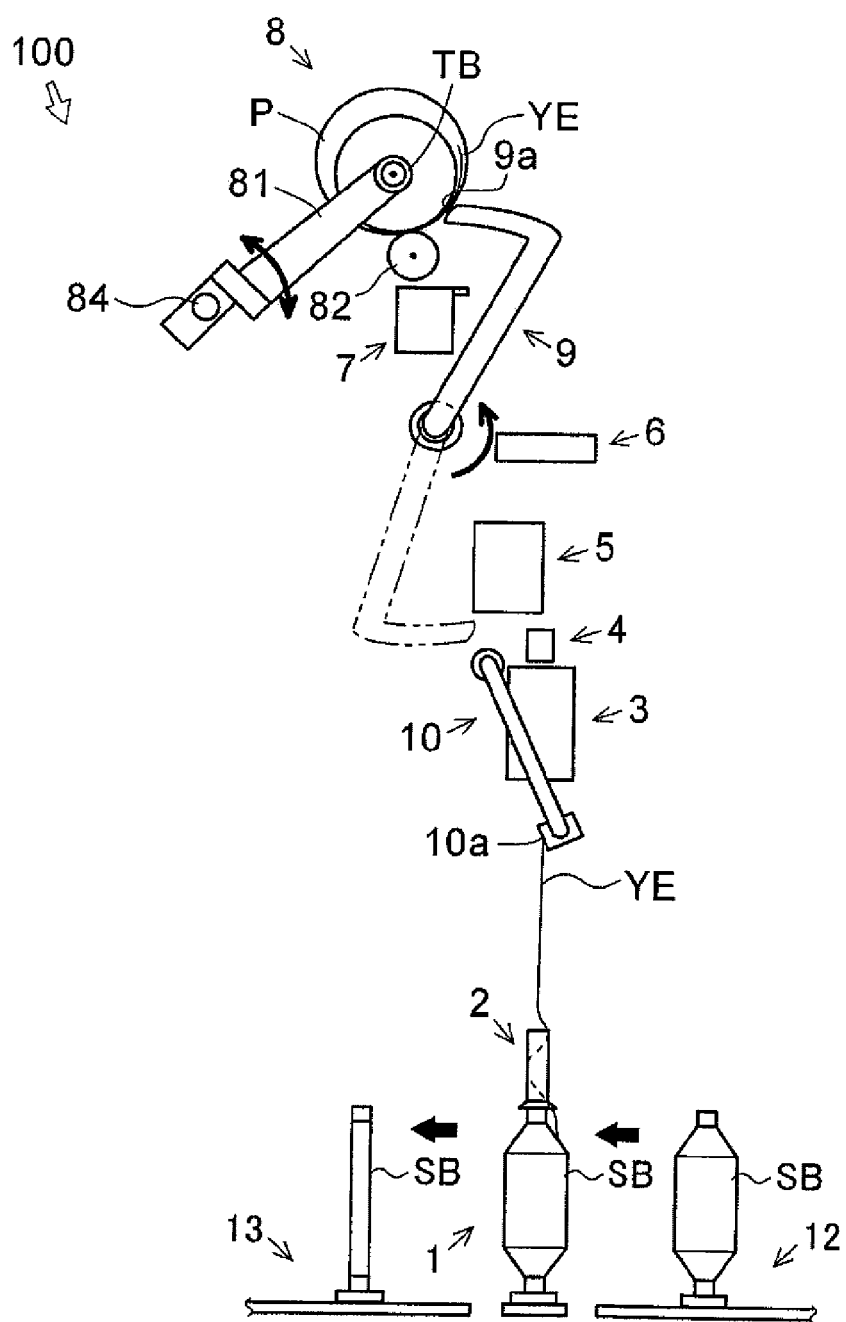


FIG. 3

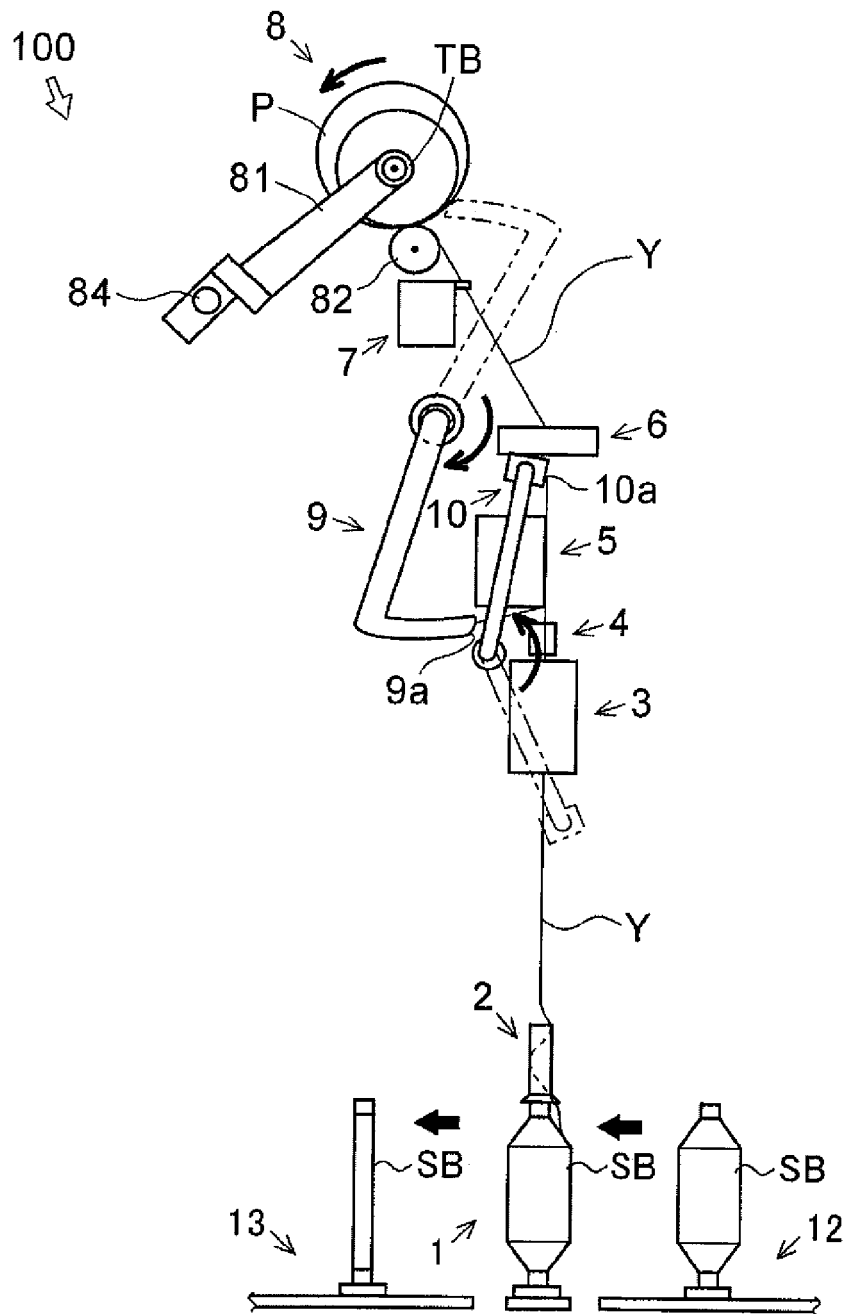


FIG. 4

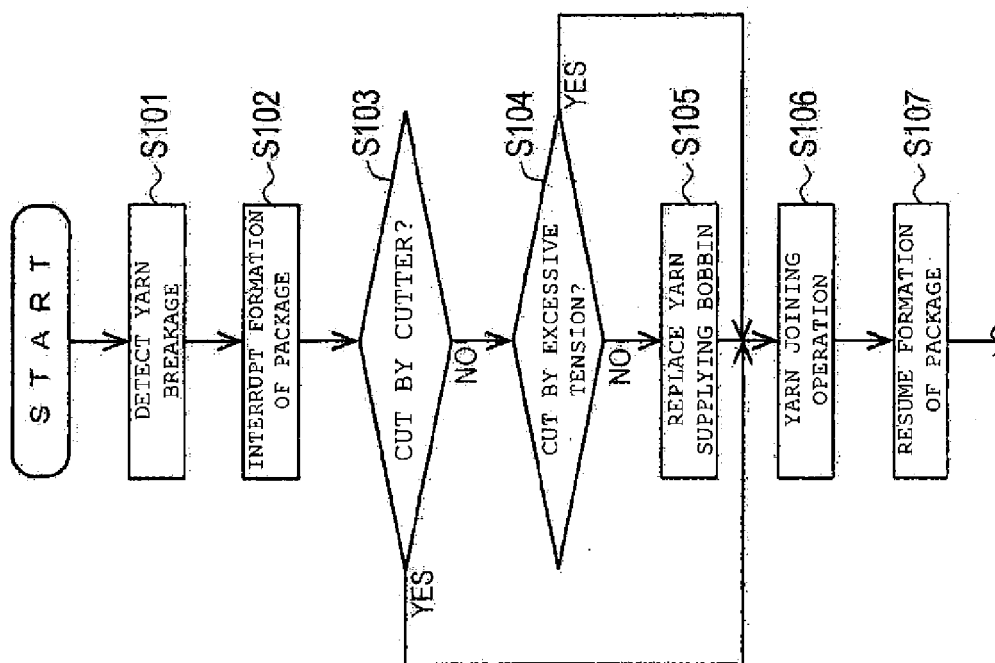


FIG. 5

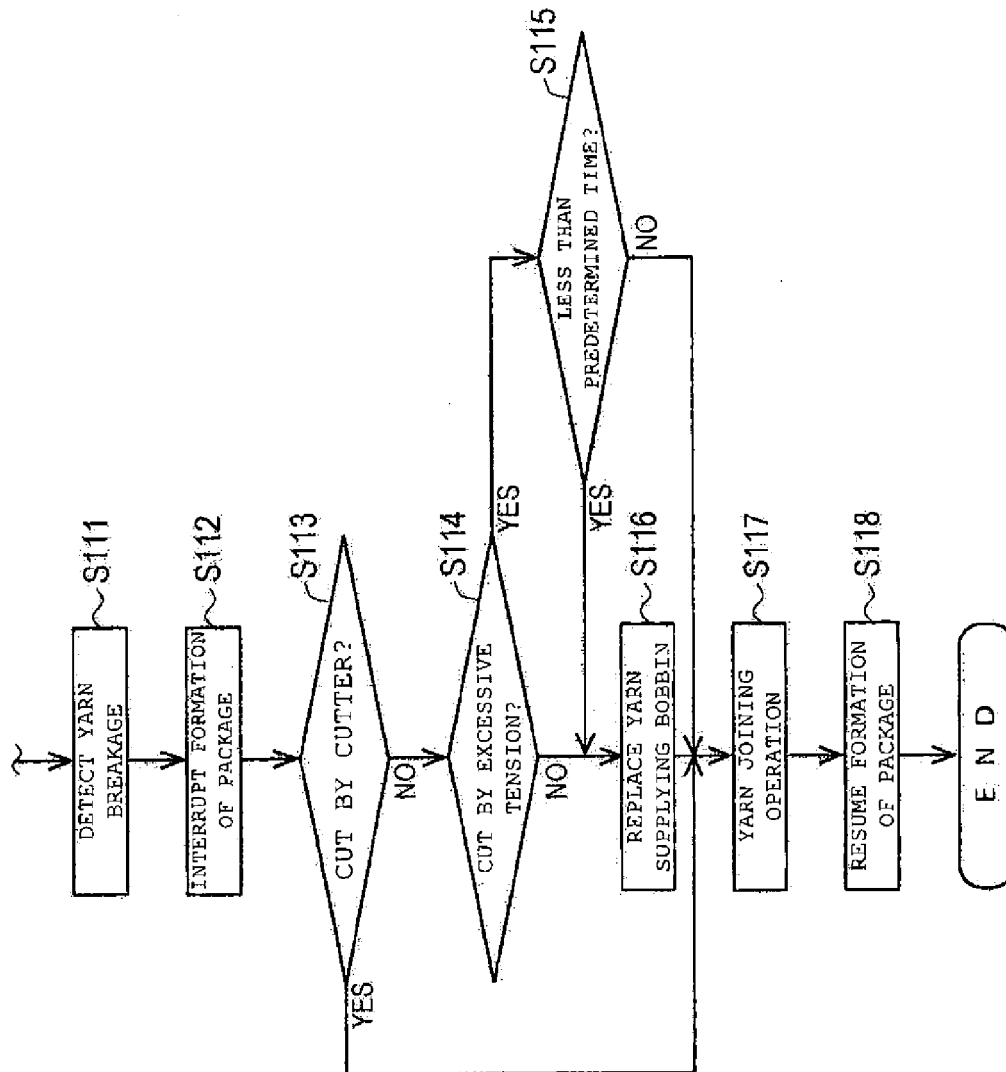
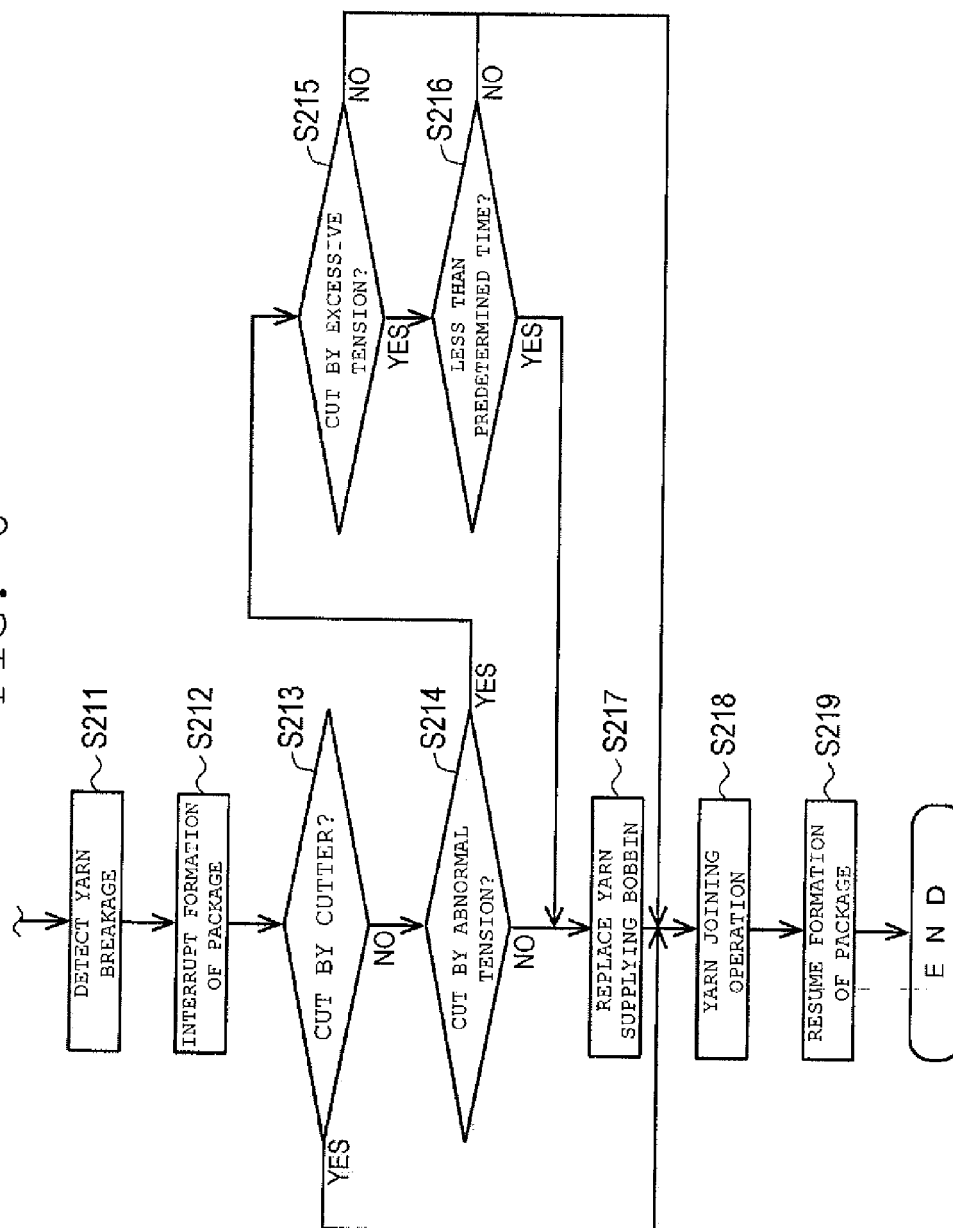


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3714218 B [0002]