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(71) Applicant: **KABUSHIKI KAISHA TOYOTA JIDOSHOKKI**
Aichi-ken (JP)

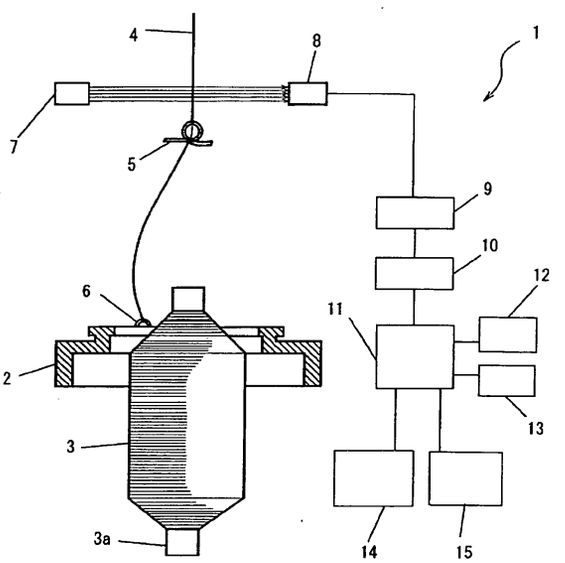
(72) Inventor: **Shinozaki, Yutaka**
Kariya-shi, Aichi-ken (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) Quality control method for fiber bundle in spinning machine

(57) A quality control method for a fiber bundle spun in a spinning machine, including the steps of: detecting the spun fiber bundle by installing a quality measurement and processing unit for the fiber bundle in the spinning machine, and storing a data on quality of the fiber bundle obtained from a detection signal; inspecting the quality of the fiber bundle with a standard inspection machine in an inspection room; setting the data on the quality of the fiber bundle in the quality measurement and processing unit at a period of time while the fiber bundle, which is judged to be non-defective by the standard inspection machine, is spun as a reference value for judging the quality of the fiber bundle spun in the spinning machine; and judging the quality of the spun fiber bundle during operation of the spinning machine based on the reference value.

FIG. 1



EP 1 574 607 A2

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a quality control method for a fiber bundle such as yarn or sliver spun in a spinning machine.

[0002] In inspection for quality items of a fiber bundle spun in a spinning machine such as unevenness, fuzz, and tensile, for example, it is generally performed so that yarn spun by a plurality of spindles of a ring spinning machine is partially drawn out as a sample yarn, judged whether it is non-defective or defective by setting the sample yarn in a reliable standard inspection machine which is exclusively prepared in a cotton mill, and, when the quality is non-defective, the ring spinning machine continues to operate spinning. The inspection of the sample yarn should regularly be performed, for example, for every time a cop is spun, to produce yarn of non-defective quality. Thus, a complicated quality control for spun yarn has required much time and cost. A longer interval of each quality inspection of yarn for comfort may yield a greater number of defectives. A defective yarn may go to the following process, so that a shorter-interval regular quality inspection is required even for complicated work.

[0003] For solving the above problem, there has been proposed such various quality control methods for spinning machines as disclosed in Japanese Unexamined Patent Publications No. 61-132644, No. 62-57953, and No. 6-322621.

[0004] In the Publication No. 61-132644, in a pneumatic spinning machine (or bundling spinning machine), there is performed quality inspection in which a slub catcher is arranged in a path where yarn travels for detecting unevenness of the yarn delivered from a delivery roller, a detection signal from the slub catcher is computed, and then the obtained data indicative of thickness of yarn is compared with a set value for monitoring the unevenness.

[0005] In the Publication No. 62-57953, in a bundling spinning machine, there is performed quality inspection in which a capacitance sensor is arranged in a path of yarn drawn by a draw-off roller and top roller, unevenness of yarn obtained by processing a signal from the sensor is compared with a predetermined reference value, thus judging whether it is non-defective or defective. Then, there is explained that the reference value should not be a value to determine as a defective unit when a value of unevenness exceeds the reference value, but should be an indicative value to yield a possible defective unit.

[0006] In the Publication No. 6-322621, in a draw-twisting machine, there is performed quality inspection in which a tension sensor is arranged in a path of spun yarn, a tension signal obtained from the tension sensor is compared with an upper and lower detection reference value (an upper limit value and lower limit value) with respect to a predetermined target value, thus judging whether it is non-defective or defective.

[0007] The above known arts disclosed in the above Publications are all directed so that a detection device for yarn is provided with the spinning machine, quality of yarn is monitored and then controlled through data obtained from the detection signal. However, no known art mentioned above pays attention to a reference value for judging whether the obtained data is non-defective or defective. Specifically, the reference value for the yarn detection device of the spinning machine is an experiential value or experimental value. In addition, the yarn detection devices are not consistent, and a yarn detection device at one spindle of the spinning machine is different from the aforementioned standard inspection machine in measurement point and sensitivity of a detector. Therefore, it is difficult to obtain such detection accuracy as the standard inspection machine. Even if the yarn detection device which has substantially the same accuracy as the standard inspection machine is provided on the spinning machine, a value measured by the yarn detection device on the spinning machine and a value measured by the standard inspection machine in the inspection room for the identical fiber bundle do not correspond with each other due to difference between environment on the spinning machine and environment in the inspection room. That is, the value measured by the standard inspection machine in the inspection room is not directly applied to a reference value for the yarn detection device on the spinning machine.

[0008] This is disadvantageous in that yarn quality data measured by the yarn detection device on the spinning machine may not be the equivalent data to that obtained by the standard inspection machine and is not reliable. In practice, in a ring spinning machine or the like, there is no yarn detection device employed for yarn quality control. Normally, it is an actual situation of the quality control that requires the sample yarn to be set in the standard inspection machine, as described above.

SUMMARY OF THE INVENTION

[0009] The present invention is directed to provide a quality control method for a fiber bundle, whereby substantially an equivalent result to that obtained by a standard inspection machine is obtained through a quality data obtained by measuring a traveling fiber bundle after being spun in a spinning machine.

[0010] The present invention has the following features. A quality control method for a fiber bundle spun in a spinning machine, including the steps of: detecting the spun fiber bundle by installing a quality measurement and processing unit for the fiber bundle in the spinning machine, and storing a data on quality of the fiber bundle obtained from a detection signal; inspecting the quality of the fiber bundle with a standard inspection machine in an inspection room; setting the data on the quality of the fiber bundle in the quality measurement and

processing unit at a period of time while the fiber bundle, which is judged to be non-defective by the standard inspection machine, is spun as a reference value for judging the quality of the fiber bundle spun in the spinning machine; and judging the quality of the spun fiber bundle during operation of the spinning machine based on the reference value.

[0011] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The features of the present invention that are believed to be novel are set forth with particularity in the appended claims. The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments, together with the accompanying drawings, in which:

FIG. 1 is a schematic view showing a spindle of a ring spinning machine, and a quality measurement and processing unit according to a first preferred embodiment of the present invention;

FIG. 2 is a flow chart showing a quality control method according to the first preferred embodiment of the present invention; and

FIG. 3 is a schematic view showing a spindle of a ring spinning machine, and a quality measurement and processing unit according to a second preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] A first preferred embodiment of the present invention will now be described with reference to FIG. 1. FIG. 1 is a schematic view showing a part of a ring spinning machine. The ring spinning machine includes a bobbin 3a which is connected to a drive source (not shown) for rotation, and a ring rail 2 which rises and falls relative to the bobbin 3a for forming a cop 3 provided by a yarn 4 which is delivered from a drafting portion (not shown). The delivered yarn 4 is passed through a snail wire 5 and then wound around the bobbin 3a one after another though a traveler 6 with forming a ballooning shape.

[0014] A quality measurement and processing unit 1 for the yarn 4 will now be described with reference to FIG. 1. A projector 7 and an optical receiver 8 sandwich a path of the yarn 4 which travels from the drafting portion to the snail wire 5. The projector 7 and the optical receiver 8 form an optical yarn detector. The optical receiver 8 is connected to an arithmetic-logic unit 11 through an amplifier 9 and an A/D converter 10. The arithmetic-logic unit 11 is connected to a read-only memory 12 and a random-access memory 13. The read-only memory 12 stores a publicly known program for computing a data, which reflects a quality item such as yarn unevenness or yarn fuzz, based on a receiving signal of the optical receiver 8. The random-access memory 13 stores a measurement data obtained by the optical receiver 8, a computed yarn quality item data, and a reference value and a control limit value (Refer to the following section for detail). The arithmetic-logic unit 11 is further connected to an indicator 14 which indicates the foregoing various datum and an input device 15 into which an operator is capable of entering a necessary data.

[0015] While the light which is projected from the projector 7 is partially blocked off by the yarn 4, the light which is not blocked off by the yarn 4 reaches the optical receiver 8. Therefore, the amount of light received by the optical receiver 8 is varied by the factor such as the thickness of the yarn 4 or quantity of fuzz thereof. The receiving signal of the optical receiver 8 is amplified by the amplifier 9, and converted into a digital signal by the A/D converter 10, and thereafter transmitted to the arithmetic-logic unit 11.

[0016] The arithmetic-logic unit 11 stores the digital signal as it is or in its processed state, as a measurement data which reflects a state of the yarn 4 in real time, in the random-access memory 13. The arithmetic-logic unit 11 also computes the quality item data, which reflects generation of the yarn unevenness or the yarn fuzz, from the measurement data with the arithmetic program which is read out from the read-only memory 12, and stores the quality item data in the random-access memory 13. It is noted that the data for the yarn unevenness in the present embodiment is represented by U % which reflects the dispersion of the yarn thickness, and that the data for the yarn fuzz in the present embodiment is represented by the number of fibers which protrudes from the yarn per unit length.

[0017] The indicator 14 indicates the measurement data in real time, and also reads out and indicates the computed data for the yarn unevenness and the yarn fuzz. The reference value, the control limit value and another necessary data are entered into the input device 15 in which comparative evaluation of the measurement data and the quality item data is performed.

[0018] A quality control method for spun yarn in the foregoing ring spinning machine will now be described with reference to FIG. 2. The bobbin 3a is first set on a spindle (not shown) by a publicly known method. As a spinning operation of the ring spinning machine is started, the yarn 4 drafted by the drafting portion is delivered therefrom, and passed through the snail wire 5 and then wound around the bobbin 3a one after another though the traveler 6 with forming the ballooning shape. Meanwhile, the operator adjusts the operation of the ring spin-

ning machine for obtaining a prescribed yarn quality.

[0019] During the spinning operation, the optical yarn detector is operated, so that the projected light from the projector 7 is received by the optical receiver 8 while being partially blocked off by the traveling yarn 4. This received light is amplified by the amplifier 9, and then converted into the digital signal by the A/D converter 10, and thereafter transmitted to the arithmetic-logic unit 11 as described above. Also, the arithmetic-logic unit 11 stores the measurement data and the yarn quality item data in the random-access memory 13 based on the yarn detection signal transmitted in real time, every predetermined spinning period one after another. When the cop 3 reaches a fully wound state by continuation of the spinning operation, the ring spinning machine is stopped for replacing the fully wound cop 3.

[0020] Thus, the fully wound cop 3 is replaced one after another, and a plurality of cops 3 is taken as samples. The sample cops 3 are carried into an inspection room in which a standard inspection machine (not shown) is installed for quality inspection. In the inspection room, an inspector inspects the quality of the sample cops 3 for obtaining various datum on the factor such as the yarn unevenness or the yarn fuzz with the standard inspection machine by a publicly known method. These inspection datum are used in print if needed. Also, the inspector judges the quality of each of the sample cops 3 based on the above inspection datum.

[0021] As a result of the above inspection, when the yarn quality of the sample cop 3 is judged to be non-defective, the operator brings the judged result back to his working area where the ring spinning machine having spun the sample cop 3 is operated for yarn quality control of the subsequent spinning operation. More specifically, in the case where the measurement data and quality item data at a period of time while the yarn, which is judged to be non-defective by the standard inspection machine, is spun, are compared with the inspection data obtained by the standard inspection machine, absolute values of those datum are different due to the difference in structure and accuracy of both machines. However, the meanings of the datum obtained from both machines are regarded as substantially the same due to the measurement result of the identical yarn.

[0022] Therefore, the operator reads out the measurement data at the period of time while the inspected yarn in the sample cop 3 is spun, and the quality item data, such as the yarn unevenness or the yarn fuzz, calculated from the measurement data, from the random-access memory 13 through the input device 15, and stores those datum as a reference value in the random-access memory 13. Also, the operator inputs the control limit value relative to the reference value, based on a statistical value about dispersion of the yarn quality item data, or a predetermined rate, to the input device 15 for storing it in the random-access memory 13.

[0023] The operator starts spinning operation of the ring spinning machine after setting the forgoing reference value and the control limit value. The ring spinning machine continuously receives the digital signal from the optical receiver 8 of the optical yarn detector during the spinning operation. The arithmetic-logic unit 11 stores the measurement data based on the digital signal and the yarn quality item data computed from the measurement data in the random-access memory 13 while monitoring generation of quality abnormality of spun yarn in real time by comparing those datum with the set reference value or control limit value.

[0024] In the case where the yarn quality item data deviates from the control limit value while the arithmetic-logic unit 11 monitors the spun yarn, the indicator 14 or another display unit indicates abnormal signal for warning the operator about the generation of quality abnormality, thereby enabling the operator to take a necessary action with regard to the target ring spinning machine.

[0025] The operator operates the input device 15 so that the indicator 14 indicates change of the yarn quality item data for the cop 3 while the cop 3 is spun, thereby enabling the operator to check the yarn state at an optional time. Also, in the case where the sample cop 3 is judged to be defective by inspection of the standard inspection machine, the spinning operation of the ring spinning machine is re-adjusted. Thereafter, a cop obtained by the re-adjusted operation is inspected by the standard inspection machine as aforementioned.

[0026] The first preferred embodiment of the present invention has the following effects.

(1) Since a relative relation between the data on the fiber bundle in the quality measurement and processing unit of the spinning machine, and the inspection result of the fiber bundle in the standard inspection machine, is used, it is guessed that the measurement result of the fiber bundle in the quality measurement and processing unit is almost equivalent to the inspection result of the fiber bundle in the standard inspection machine. Therefore, even the quality measurement and processing unit which is installed in the spinning machine is capable of performing a reliable quality control. As a result, since an inspection which is regularly performed by the standard inspection machine is not needed, man-hour for inspection is drastically reduced. In addition, the probability of missing defective yarn is also drastically reduced.

(2) Since a reliable control limit value is set, a quality control for the fiber bundle in which tolerance is set is not hindered.

(3) Such an expensive and accurate measuring device as the standard inspection machine does not need to be used, and even a low-cost measuring device which has a simple structure capable of being installed in the spinning machine is sufficiently

practicable.

(4) Regarding unevenness which is the most important on the quality control for the fiber bundle, a reliable control is achieved.

(5) A reliable quality control for the fiber bundle that is almost equivalent to a case inspected by a generally reliable standard inspection machine is achieved just to use a simple unit such as the quality measurement and processing unit installed in the spinning machine for directly detecting the fiber bundle while spinning.

(6) Since the measurement data is a real-time data which is obtained over a long period of time, a standard dispersion of the subject machine is accurately and statistically calculated, thereby enabling to easily set an accurate control limit value using the calculated value.

(7) The ring spinning machine indicates the change of the measurement data and the quality item data in the indicator at an optional time during the spinning operation, so that the operator is capable of checking the change. Therefore, the operator is capable of reading the change of data and future tendency immediately and is capable of gathering the possibility of occurrence of trouble beforehand.

A second preferred embodiment of the present invention will now be described with reference to FIG. 3. In the present embodiment, a partially different structure is added to the first preferred embodiment, and the drawing for the second preferred embodiment uses like reference numerals to denote like parts or elements of the first preferred embodiment. The arithmetic-logic unit 11 of the quality measurement and processing unit 1, which is installed in the ring spinning machine, further has a first communication means 16. The first communication means 16, the read-only memory 12 and the random-access memory 13 form a first control means 17.

Meanwhile, a standard inspection machine 18 is installed in an inspection room 19 which is located far from an installation location of the ring spinning machine. An inspection data for yarn set in the standard inspection machine 18 is processed in a control unit 20 and stored therein. The control unit 20 is provided with a second communication means 21 for forming a second control means 22. The second communication means 21 is connected to the first communication means 16 of the quality measurement and processing unit 1 in communication via a cable 23. Thus, datum of the first control means 17 and the second control means 22 are communicated to each other.

The present embodiment is the same as the first embodiment in that the sample cop 3 formed by the ring spinning machine is carried into the inspection room 19 and is inspected by the standard inspection machine 18. The standard inspection machine 18 processes the inspection data for yarn of the sample cop 3 into a predetermined data on yarn quality such as yarn quality item by a publicly known method in the control unit 20 and stores the processed data therein. The standard inspection machine 18 also judges whether the quality of the sample cop 3 is non-defective or defective based on the data on the yarn quality, and stores the judged result and the data on the yarn quality together with identification mark of the target ring spinning machine in the control unit 20.

The control unit 20 transmits the judged result of the sample cop 3 from the second communication means 21 to the first communication means 16 of the ring spinning machine side through the cable 23. The arithmetic-logic unit 11 reads out the yarn quality item data at a period of time while the sample cop 3 is spun from the random-access memory 13 only if a signal of the judged result which is received from the control unit 20 through the cable 23 is non-defective. In this case, the arithmetic-logic unit 11 automatically sets the yarn quality item data as a reference value for the ring spinning machine which has spun the sample cop 3. It is noted that the control limit value is automatically set upon setting the reference value by storing a statistical value about dispersion of data or fuzz, or a predetermined rate in the random-access memory 13 beforehand.

In addition to the effects in the first preferred embodiment, the second preferred embodiment of the present invention has the following effects.

(8) In such a case that the inspection room exists in a mill different from that in which the spinning machine is installed, or that a position of installation of the spinning machine and the inspection room exist in far locations from each other even in the same mill, the inspection result from the standard inspection machine is immediately transmitted to the target spinning machine via communication, and the reference value or the control limit value is set in the quality measurement and processing unit of the spinning machine based on the signal. Therefore, man-hour of preparation for quality control of the spinning machine is drastically reduced.

(9) The inspection result obtained by the standard inspection machine is automatically communicated to the quality measurement and processing unit of the ring spinning machine, and the reference value and control limit value for yarn quality control are automatically set in the quality measurement and processing unit based on the received signal of the inspection result. Therefore, the operator has only

to check whether the signal of the inspection result is non-defective or defective, thereby drastically reducing his burden.

[0027] The present invention is not limited to the above-mentioned first and second embodiments, but may be modified within the scope of the appended claims, as exemplified below.

[0028] In the first and second embodiments, the data acquisition about the quality of the yarn at the time of spinning of the spinning machine may be performed by each spindle or an average value of each spindle.

[0029] In the first and second embodiments, the arithmetic-logic unit, the indicator and the input device may be shared with a controller of the ring spinning machine.

[0030] In the first and second embodiments, the method of judging whether the yarn quality is abnormal or not in the quality measurement and processing unit is not limited to a level wherein whether the quality item data exceeds the reference value (or the control limit value) or not is judged as described in the above embodiments, but may be judged by a magnitude of the value obtained by differentiating the data with respect to time.

[0031] In the first and second embodiments, even in the case where the yarn quality in the quality measurement and processing unit is judged to be abnormal due to the change of roving set in the ring spinning machine or the change of the yarn quality data measured by the quality measurement and processing unit by abrasion of a traveler or other parts, if the cop spun at the time is inspected by the standard inspection machine and the inspection result is judged to be non-defective, the data which is stored in the quality measurement and processing unit at the time when the cop is spun is reset as a renewed reference value. Although this method lowers a control level of the yarn quality, even in the control level the quality of the spun yarn passes the inspection of the standard inspection machine. This means that kinds of yarn which is used in the ring spinning machine with the same level of the quality control are increased.

[0032] A detection device for yarn used in the quality measurement and processing unit may employ a capacitance detector which is capable of detecting yarn unevenness.

[0033] The length of the yarn set in the standard inspection machine is not limited to a unit of cop as described in the first and second embodiments, but may be a unit of a divided bundle.

[0034] The reference value about the yarn unevenness may be set by a histogram, besides U % which reflects the dispersion of the yarn thickness. A yarn count may be combined with the U % reflecting the dispersion, or the histogram.

[0035] The reference value about the fuzz may be set by the number of the fuzzes, the length of the fuzz and the number of the fuzzes, or the total length of the fuzzes. The reference value about the fuzz may also be set by the histogram of these values.

[0036] In the second embodiment, the inspection result from the standard inspection machine is transmitted to the quality measurement and processing unit of the ring spinning machine via communication. In an alternative embodiment to the second embodiment, the operator may input the reference value and the control limit value to the quality measurement and processing unit by hand after checking the inspection result on the indicator of the quality measurement and processing unit.

[0037] The present invention is not only embodied to the ring spinning machine as exemplified in the first and second embodiments, but may be implemented to the spinning machine such as a ring twister, an open-end spinning machine, a bundling spinning machine, a winder, a roving machine, or a drawing machine.

[0038] Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive and the invention is not to be limited to the details given herein but may be modified.

Claims

1. A quality control method for a fiber bundle spun in a spinning machine, which has a plurality of winding portions that winds the spun fiber bundle around bobbins, **characterized by**:

   detecting the spun fiber bundle by installing a quality measurement and processing unit for the fiber bundle in the spinning machine, and storing a data on quality of the fiber bundle obtained from a detection signal;
   inspecting the quality of the fiber bundle with a standard inspection machine in an inspection room;
   setting the data on the quality of the fiber bundle in the quality measurement and processing unit at a period of time while the fiber bundle, which is judged to be non-defective by the standard inspection machine, is spun as a reference value for judging the quality of the fiber bundle spun in the spinning machine; and
   judging the quality of the spun fiber bundle during operation of the spinning machine based on the reference value.

2. The method according to claim 1, further including the step of setting a control limit value of the spinning machine relative to the reference value by a statistical value or a predetermined rate on the quality of the fiber bundle.

3. The method according to claim 1 or 2, further including the steps of:

   providing the quality measurement and processing unit of the spinning machine with a

first control means including a first communication means;
providing the standard inspection machine with a second control means including a second communication means while installing the standard inspection machine in the inspection room;
transmitting an inspection result of the fiber bundle inspected by the standard inspection machine from the second control means of the standard inspection machine to the first control means of the spinning machine via a communication; and
setting the reference value in the quality measurement and processing unit by the first control means of the spinning machine based on a signal of the inspection result of the fiber bundle which is judged to be non-defective.

4. The method according to claim 1 or 2, further including the steps of:

providing the quality measurement and processing unit of the spinning machine with a first control means including a first communication means;
providing the standard inspection machine with a second control means including a second communication means while installing the standard inspection machine in the inspection room;
transmitting an inspection result of the fiber bundle inspected by the standard inspection machine from the second control means of the standard inspection machine to the first control means of the spinning machine via a communication; and
setting the reference value and the control limit value in the quality measurement and processing unit by the first control means of the spinning machine based on a signal of the inspection result of the fiber bundle which is judged to be non-defective.

5. The method according to any one of claims 1 through 4, wherein the data on the quality of the fiber bundle obtained by the quality measurement and processing unit has a real-time measurement data obtained from the detection signal of a detector which detects the fiber bundle which travels toward the bobbins of the winding portions, and a quality item data of the fiber bundle calculated from the measurement data.

6. The method according to claim 5, wherein a quality item of the fiber bundle has at least fiber bundle unevenness.

FIG. 1

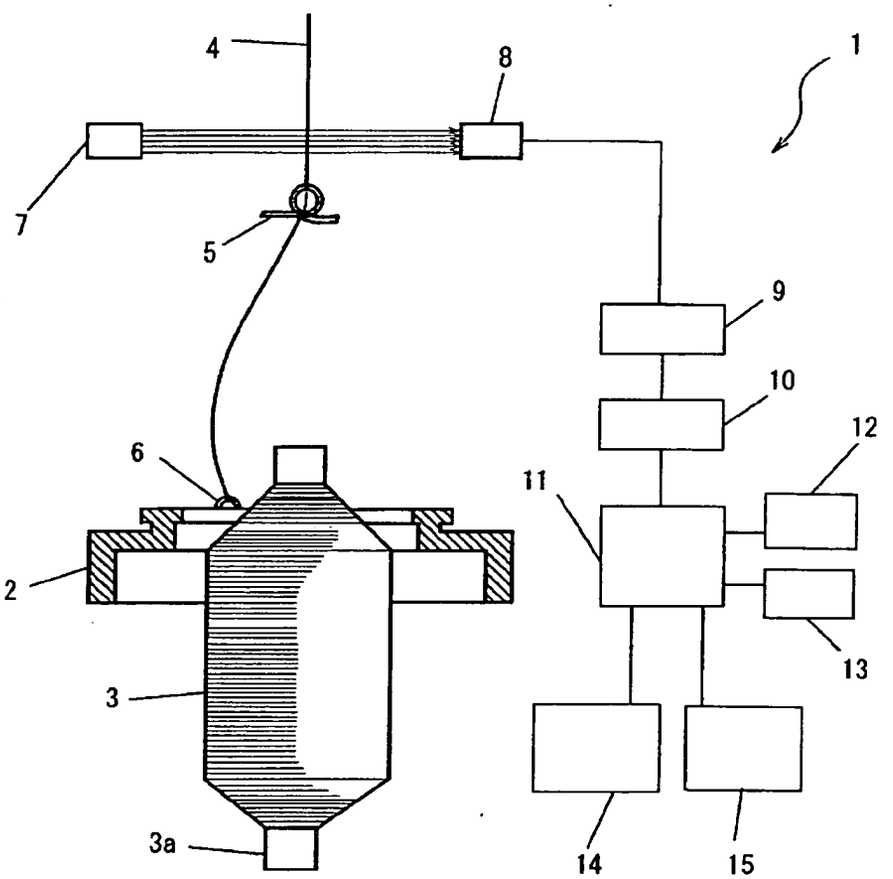


FIG. 2

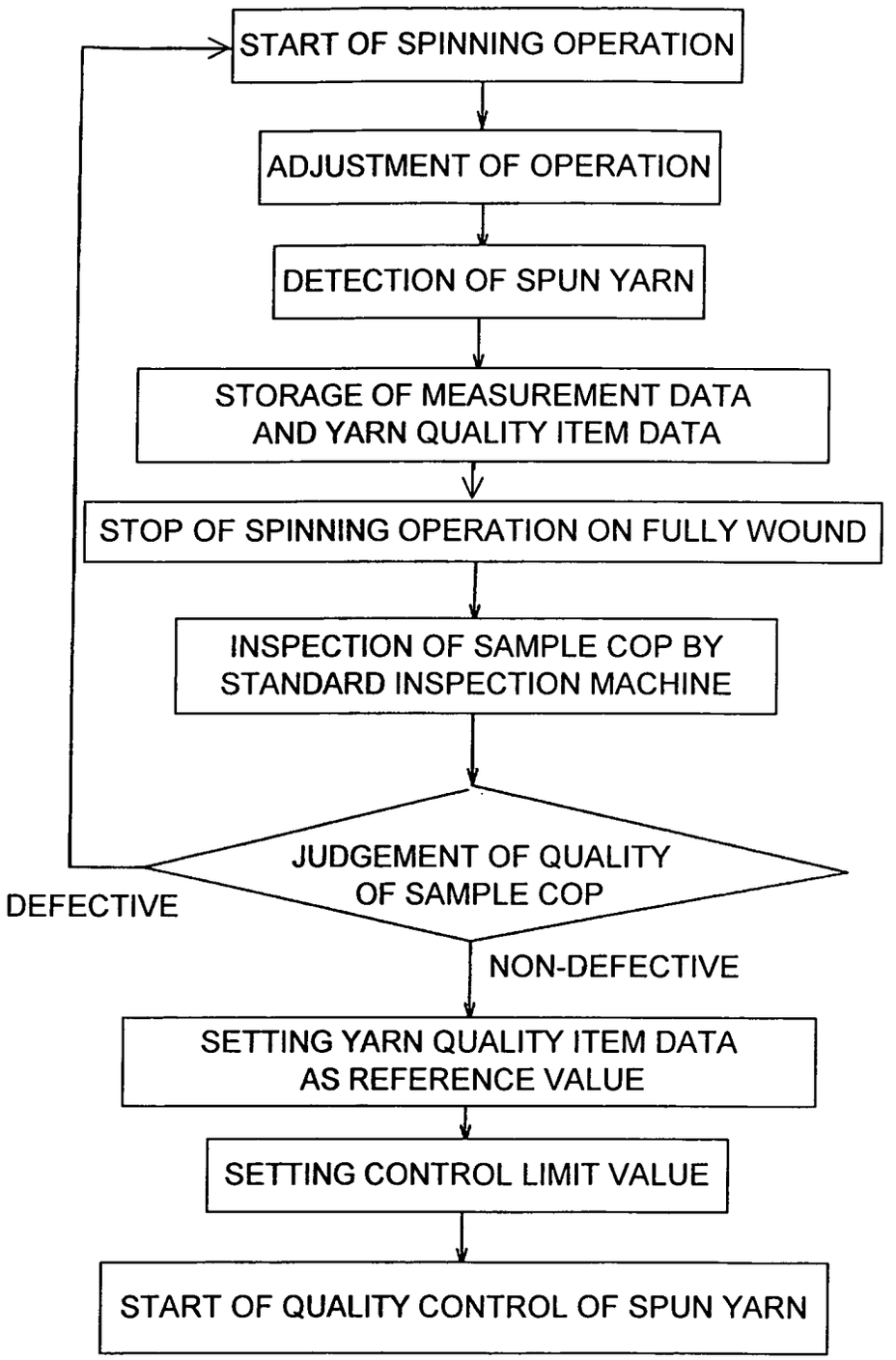

START OF SPINNING OPERATION
ADJUSTMENT OF OPERATION
DETECTION OF SPUN YARN
STORAGE OF MEASUREMENT DATA AND YARN QUALITY ITEM DATA
STOP OF SPINNING OPERATION ON FULLY WOUND
INSPECTION OF SAMPLE COP BY STANDARD INSPECTION MACHINE
JUDGEMENT OF QUALITY OF SAMPLE COP
DEFECTIVE
NON-DEFECTIVE
SETTING YARN QUALITY ITEM DATA AS REFERENCE VALUE
SETTING CONTROL LIMIT VALUE
START OF QUALITY CONTROL OF SPUN YARN

FIG. 3