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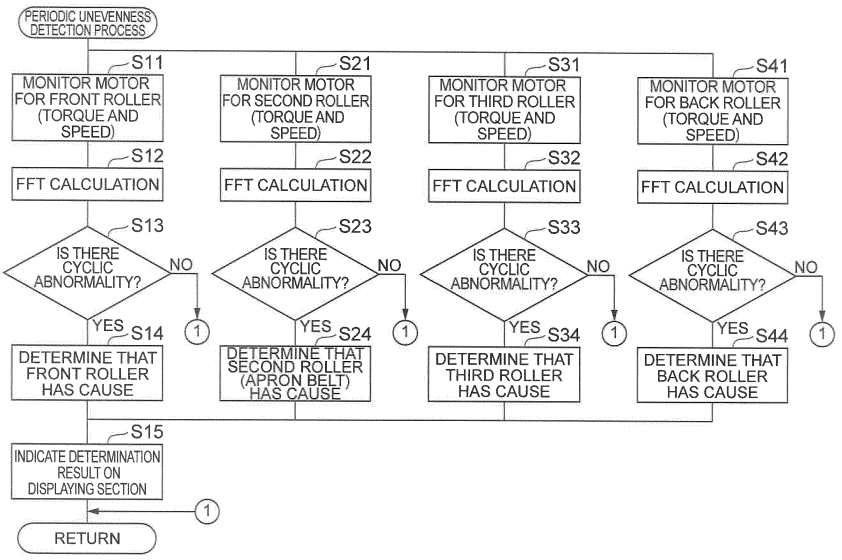
(54) **SPINNING MACHINE, TAKE-UP DEVICE, AND TEXTILE MACHINE**

(57) A spinning machine, a winding device, and a textile machine capable of detecting a cyclic abnormality of a rotary body and improving detection accuracy of such an abnormality are provided. A configuration monitors at least one of torque and revolution speed of a motor driving a rotary body for drafting or winding to determine whether or not a cyclic abnormality appears on the rotary body based on the monitor result. For example, if a fiber band moving in response to the rotation of the rotary body has a defect such as a periodic variation in the thickness, load torque acting on the motor varies, and the revolution speed of the motor varies. Thus, the configuration determines whether or not a cyclic abnormality appears on the rotary body by monitoring at least one of the torque and the revolution speed of the motor, thereby detecting the periodic abnormality on the fiber band drafted or wound by the rotary body.

Fig.5



EP 2 759 623 A1

Description

Technical Field

[0001] The present invention relates to a spinning machine, a winding device, and a textile machine.

Background Art

[0002] A textile machine described in Patent Literature 1 has been conventionally known as a technique in such a field. The technique described in Patent Literature 1 digitizes a yarn unevenness electric signal obtained from a yarn unevenness detector (for example, a clearer) installed on a textile machine such as a spinning frame, and analyzes the digitized signal with a calculator, thereby detecting yarn unevenness.

[0003] In addition, a technique described in Patent Literature 2 has been known as an abnormality detection method for a drafting device in a spinning machine. With this technique, variation in load torque acting on a driving motor that drives a drafting roller is monitored, and the operation of the drafting device is stopped if it is determined that there is an abnormality because the variation of the load torque exceeded a certain rate.

Citation List

Patent Literature

[0004]

Patent Literature 1: Japanese Patent Application Laid-Open Publication No. 58-62511
Patent Literature 2: Japanese Patent Application Laid-Open Publication No. 2003-166135

Summary of Invention

Technical Problem

[0005] The technique described in Patent Literature 1 may fail to detect relatively long-periodic unevenness if an unevenness detector has insufficient detection accuracy. The technique described in Patent Literature 2 monitors variation in load torque on a motor, but does not detect a cyclic abnormality.

[0006] An object of the present invention is to provide a spinning machine that is capable of detecting a cyclic abnormality of a drafting roller and improving detection accuracy of such an abnormality.

[0007] The present invention aims to provide a winding device that is capable of detecting a cyclic abnormality of a rotary drum and improving detection accuracy of such an abnormality.

[0008] The present invention aims to provide a textile machine that is capable of detecting a cyclic abnormality of a rotary body and improving detection accuracy of such an abnormality.

Solution to Problem

[0009] A spinning machine includes: a drafting roller drafting a fiber band; a motor rotationally driving the drafting roller; a monitoring section monitoring at least one of torque and revolution speed of the motor; and a periodic unevenness determining section determining a cyclic abnormality of the drafting roller that appears as periodic unevenness on the fiber band, on the basis of a monitor result of the monitoring section.

[0010] This spinning machine monitors at least one of the torque and the revolution speed of the motor driving the drafting roller that drafts the fiber band, determining whether or not a cyclic abnormality appears on the drafting roller on the basis of the monitor result. With this configuration, the cyclic abnormality of the drafting roller that appears as periodic unevenness on the fiber band can be detected, and a cyclic abnormality of the drafted fiber band can be detected. Using a conventional unevenness detector (clearer) commonly installed on a spinning machine may fail to detect long-periodic unevenness. The values of torque and/or revolution speed (monitor value) of the motor can be detected precisely. Thus, the periodic unevenness determining section can determine the periodic abnormality on the fiber band in higher accuracy than the clearer, on the basis of the monitor value obtained by monitoring the motor.

[0011] The periodic unevenness determining section may perform frequency analysis on a value relating to at least one of the torque and the revolution that are each the monitor result of the monitoring section to determine the cyclic abnormality of the drafting roller. The frequency analysis is effective means for determining a cyclic abnormality, thus the cyclic abnormality of the drafting roller can be detected precisely.

[0012] The spinning machine may include a plurality of such drafting rollers arranged along a transporting direction of the fiber band, and a plurality of such motors independently driving the drafting rollers. The periodic unevenness determining section may determine which motor out of the motors has cyclic abnormalities, on the basis of the monitor result of the monitoring section. With this configuration, the periodic unevenness determining section can reliably identify which drafting roller among the drafting rollers has a cause of a periodic unevenness. It is difficult to determine the drafting roller causing the periodic unevenness with unevenness detection using a conventional clearer in the case where multiple periodic unevenness occurs in an overlapping manner.

[0013] The spinning machine may further include a periodic unevenness detecting section disposed on a downstream of the drafting roller. The periodic unevenness detecting section may detect unevenness on the fiber band drafted with the drafting roller. The periodic unevenness determining section may determine a cyclic abnormality of the drafting roller on the basis of the monitor

result of the monitoring section and a detection result of the unevenness detecting section to detect the periodic unevenness on the fiber band. The periodic unevenness determining section can precisely detect the cyclic abnormality of the drafting rollers on the basis of the monitor result on the motors driving the drafting rollers and the detection result of the unevenness on the fiber band detected by the unevenness detecting section.

[0014] The spinning machine may further include a notifying section notifying information relating to the monitor result of the monitoring section. An operator can easily check for a cyclic abnormality of the drafting rollers and promptly take an appropriate action, on the basis of the information notified by the notifying section. Examples of the notifying section are a displaying section and an audio outputting section. In the case where the notifying section is the displaying section, the operator can easily check the cyclic abnormality by looking at the displaying section.

[0015] The spinning machine may further include: an air spinning device spinning the fiber band drafted with the drafting roller, with swirl flows; and a winding device winding the fiber band spun from the air spinning device into a package. The periodic unevenness determining section may determine a cyclic abnormality of the drafting roller while the winding device winds the fiber band into the package.

[0016] The periodic unevenness determining section can determine a cyclic abnormality of the drafting rollers even while the winding device winds the fiber band into the package. Thus, decrease in operating efficiency of the spinning machine can be reduced.

[0017] A windier includes: a rotary drum making contacting with and rotating a winding package to cause the winding package to wind a yarn; a motor rotationally driving the rotary drum; a monitoring section monitoring at least one of torque and revolution speed of the motor; and a determining section determining a cyclic abnormality of the rotary drum on the basis of a monitor result of the monitoring section.

[0018] This winding device monitors at least one of the torque and the revolution speed of the motor driving the rotary drum, determining whether or not a cyclic abnormality appears on the rotary drum on the basis of the monitor result. With this configuration, the cyclic abnormality of the rotary drum can be detected to ensure detection of an abnormality such as eccentricity of the winding package, therefore, the reliability of the winding device can be improved. Examples of the winding device are a winding device in a spinning machine, and an automatic winder.

[0019] The determining section may perform frequency analysis on a value relating to at least one of the torque and the revolution speed that are each the monitor result of the monitoring section to determine the cyclic abnormality of the rotary drum. The frequency analysis is effective means for determining a cyclic abnormality, thus the cyclic abnormality of the rotary drum can be detected precisely.

[0020] The winding device may further include: a notifying section notifying information relating to the monitor result of the monitoring section. The operator can easily check a cyclic abnormality of the drafting rollers and promptly take an appropriate action, on the basis of the information notified by the notifying section. Examples of the notifying section are a displaying section and an audio outputting section. In the case where the notifying section is the displaying section, the operator can easily check the cyclic abnormality by looking at the displaying section.

[0021] A textile machine includes: a rotary body transporting a fiber band; a motor rotationally driving the rotary body; a monitoring section monitoring at least one of torque and revolution speed of the motor; and a determining section determining a cyclic abnormality of the rotary body on the basis of a monitor result of the monitoring section.

[0022] This textile machine monitors at least one of the torque and the revolution speed of the motor driving the rotary body that transports the fiber band, determining whether or not a cyclic abnormality appears on the rotary body on the basis of the monitor result. Note that "a rotary body transporting a fiber band" includes a device transporting a fiber band and other devices capable of performing certain processing, such as "drafting a fiber band (sliver)" and/or "winding a yarn", accompanying the rotation of the rotary body.

[0023] For example, in the case where a fiber band (including a sliver and a yarn) moving accompanying the rotation of the rotary body has a defect such as a periodically changing thickness, load torque acting on the motor varies, and the revolution speed of the motor varies. Thus, whether or not a cyclic abnormality appears on the rotary body is determined by monitoring at least one of the torque and the revolution speed of the motor, thereby detecting the periodic abnormality on the fiber band processed by the rotary body. This makes it possible to detect long-periodic unevenness which is difficult to be detected by a conventional unevenness detector (clearer).

[0024] The determining section may perform frequency analysis on a value relating to at least one of the torque and the revolution speed that are each the monitor result of the monitoring section to determine the cyclic abnormality of the rotary body. The frequency analysis is effective means for determining a cyclic abnormality, thus the cyclic abnormality of the rotary body can be detected precisely.

[0025] The textile machine may further include: a notifying section notifying information relating to the monitor result of the monitoring section. The operator can easily check a cyclic abnormality of the rotary body and promptly take an appropriate action, on the basis of the information notified by the notifying section. Examples of the notifying section are a displaying section and an audio outputting section. In the case where the notifying section

is the displaying section, the operator can easily check the cyclic abnormality by looking at the displaying section.

Advantageous Effects of Invention

[0026] A spinning machine of the present invention is capable of detecting a cyclic abnormality of a drafting roller and improving detection accuracy of such an abnormality.

[0027] A winding device of the present invention is capable of detecting a cyclic abnormality of a rotary drum and improving detection accuracy of such an abnormality.

[0028] A textile machine of the present invention is capable of detecting a cyclic abnormality of a rotary body and improving detection accuracy of such an abnormality.

Brief Description of Drawings

[0029]

[Fig. 1] Fig. 1 is a front view of a spinning frame of an embodiment of the present invention.

[Fig. 2] Fig. 2 is a longitudinal sectional view of the spinning frame illustrated in Fig. 1.

[Fig. 3] Fig. 3 is a block configuration diagram illustrating a unit controller in a spinning unit of a first embodiment of the present invention.

[Fig. 4] Fig. 4 is a block configuration diagram illustrating the unit controller in the spinning unit of a second embodiment of the present invention.

[Fig. 5] Fig. 5 is a flow chart illustrating a procedure executed in a periodic unevenness detection process.

[Fig. 6] Fig. 6 is a schematic configuration diagram illustrating a winding unit in an automatic winder of a third embodiment of the present invention.

Description of Embodiments

[0030] A spinning frame (spinning machine) according to an embodiment of the present invention is described with reference to the accompanying drawings. Note that an "upstream" and a "downstream" in this description mean the upstream and the downstream in a running direction of a yarn during spinning, respectively.

[0031] A spinning frame 1 illustrated in Fig. 1 and Fig. 2 includes a plurality of spinning units 2 aligned next to each other. The spinning frame 1 includes a yarnm joining carriage 3 capable of running along the aligning direction of the spinning units 2, a motor box 5, a central controller (not illustrated) controlling the spinning frame 1, and unit controllers 60 (refer to Fig. 3 and Fig. 4) controlling the spinning units 2.

[0032] For example, the central controller may be installed in the motor box 5. The central controller is electrically connected to the multiple unit controllers 60 to integrally control the unit controllers 60. The unit controller 60 is provided to each spinning unit 2 to independently control the spinning unit 2 (will be described in detail later).

[0033] Each spinning unit 2 (spinning machine) includes a drafting device 7, a spinning section 9 (air spinning device), a yarn clearer 52, a yarn slack-eliminating device 12 (yarn storage device), and a winding device 13, in this order from upstream to downstream. The drafting device 7 is provided near the top end of a case 6 of the spinning frame 1. A fiber band 8 fed from the drafting device 7 is supplied to the spinning section 9 to be spun. A spun yarn 10 that has been spun by the spinning section 9 passes through the yarn clearer 52. Thereafter, the spun yarn 10 is fed by the yarn slack-eliminating device 12 and wound by the winding device 13, whereby a package 45 is formed.

[0034] The drafting device 7 drafts a sliver 15 to obtain a fiber band 8. The drafting device 7 includes a plurality of pairs of drafting rollers 16, 17, 19, and 20 (rotary bodies) aligned along a feeding direction (transporting direction) of the fiber band 8 and drafts the fiber band 8 with the drafting rollers 16, 17, 19, and 20. As illustrated in Fig. 2, the drafting device 7 includes back rollers 16, third rollers 17, second rollers 19 around which apron belts 18 are wound, and front rollers 20, serving as the drafting rollers 16, 17, 19, and 20, respectively. The drafting rollers 16, 17, 19, and 20 each include a pair of a top roller and a bottom roller. The top roller and the bottom roller are arranged to sandwich therebetween the sliver 15.

[0035] The drafting device 7 includes a drafting cradle (not illustrated). The drafting cradle supports the top rollers and opens and closes by swinging about a certain pivot. Under a state in which the drafting cradle is closed, the top rollers make contact with the bottom rollers, and the drafting device 7 drafts the fiber band 8. If the drafting cradle is not closed at a proper position, a periodic unevenness can be generated on the fiber band 8.

[0036] The drafting device 7 includes motors 31 to 34 to drive the bottom rollers of the drafting rollers 16, 17, 19, and 20. The motor 31 rotationally drives the back roller 16. The motor 32 rotationally drives the third roller 17. The motor 33 rotationally drives the second roller 19. The motor 34 rotationally drives the front roller 20. Although a single motor rotationally drives a single drafting roller in the present embodiment, a single motor may rotationally drive a plurality of drafting rollers. For example, a single motor may rotationally drive the back roller 16 and the third roller 17 which are drafting rollers in a low-speed side.

[0037] The top rollers of the drafting rollers 16, 17, 19, and 20 are configured to rotate by following the bottom rollers rotationally driven by the motors 31 to 34.

[0038] The spinning unit 2 includes a motor controller 30 that controls the rotation of the motors 31 to 34. The motor controller 30 is electrically connected to the motors 31 to 34. The motor controller 30 can detect load torque

acting on each of the motors 31 to 34. The motor controller 30 can detect the revolution speed of the output shaft of each of the motors 31 to 34. It is enough for the motor controller 30 to be capable of detecting at least one of the torque and the revolution speed. The motor controller 30 outputs data relating to the torque and/or the revolution speed of each of the motor s 31 to 34 to the unit controller 60.

[0039] The detailed structure of the spinning section 9 is not illustrated, but the present embodiment employs a pneumatic structure using swirling air flow (swirl flow) to twist the fiber band 8, so as to produce a spun yarn 10.

[0040] The yarn slack-eliminating device 12 applies certain tension to the spun yarn 10 and draws the spun yarn 10 from the spinning section 9. The yarn slack-eliminating device 12 prevents the spun yarn 10 from slacking by storing the spun yarn 10 fed out from the spinning section 9 when the yarn joining carriage 3 performs yarn joining. The yarn slack-eliminating device 12 adjusts the tension of the spun yarn 10 so as to prevent the variation in the tension of the spun yarn 10 at the winding device 13 from propagating to the spinning section 9.

[0041] The yarn slack-eliminating device 12 includes a slack eliminating roller (yarn storage roller) 21, a yarn hooking member 22, an upstream guide 23, an electric motor 25, a downstream guide 26, and a yarn storage amount sensor 27.

[0042] The yarn hooking member 22 is configured to hook the spun yarn 10. The yarn hooking member 22 hooked with the spun yarn 10 integrally rotates with the slack eliminating roller 21, thereby winding the spun yarn 10 on an outer peripheral surface of the slack eliminating roller 21.

[0043] The slack eliminating roller 21 winds a certain amount of the spun yarn 10 around the outer peripheral surface thereof to store the spun yarn 10. The slack eliminating roller 21 is rotationally driven by the electric motor 25. Rotation of the slack eliminating roller 21 tightens the spun yarn 10 wound around the outer peripheral surface of the slack eliminating roller 21, thereby drawing the spun yarn 10 from the upstream of the yarn slack-eliminating device 12. That is, when the spun yarn 10 is wound around the outer peripheral surface of the slack eliminating roller 21, rotation of the slack eliminating roller 21 in a certain revolution speed applies certain tension to the spun yarn 10 and draws the spun yarn 10 out from the spinning section 9 at a certain speed, thereby transporting the spun yarn 10 to the downstream at a certain speed.

[0044] A certain contact area can be obtained between the slack eliminating roller 21 and the spun yarn 10 by winding the certain amount of the spun yarn 10 around the outer peripheral surface of the slack eliminating roller 21. This configuration enables the slack eliminating roller 21 to hold and draw the spun yarn 10 with sufficient strength. Thus, the spun yarn 10 can be drawn out from the spinning section 9 at a stable speed without causing slip for example. As illustrated in Fig. 2, since there is no additional component (such as a conventional delivery roller) applying the tension to the spun yarn 10 between the spinning section 9 and the slack-eliminating device 12, the revolution speed of the slack eliminating roller 21 determines the speed of the spun yarn 10 drawn out from the spinning section 9. Consequently, the spinning frame 1 of the present embodiment applies the tension to the spun yarn 10 with the slack-eliminating device 12, thereby drawing out the spun yarn 10 from the spinning section 9 at an accurate speed with less variation.

[0045] The yarn storage amount sensor 27 detects a storage amount of the spun yarn 10 stored on the slack eliminating roller 21 in a non-contact manner and sends the detected storage amount to the unit controller 60.

[0046] The upstream guide 23 is arranged slightly upstream of the slack eliminating roller 21. The upstream guide 23 properly guides the spun yarn 10 to the outer peripheral surface of the slack eliminating roller 21. The upstream guide 23 prevents a twist of the spun yarn 10 propagating from the spinning section 9 from being propagated to the downstream of the upstream guide 23.

[0047] The yarn clearer 52 is provided between the spinning section 9 and the slack-eliminating device 12, in the front face side of the case 6 of the spinning frame 1. The spun yarn 10 spun in the spinning section 9 passes through the yarn clearer 52 before being wound by the slack-eliminating device 12. The yarn clearer 52 monitors the thickness of the spun yarn 10 running therethrough and sends a yarn defect detection signal to the unit controller 60 (controller) if a yarn defect on the spun yarn 10 is detected. The yarn clearer 52 is arranged downstream of the drafting device 7 and serves as an unevenness detecting section detecting unevenness on the fiber band 8 drafted with the drafting device 7.

[0048] In the case where a yarn defect is detected and yarns are to be joined, the unit controller 60 stops the drafting device 7, the spinning section 9, and other devices, in a certain timing. In this case, the unit controller 60 cuts the spun yarn 10 by interrupting the blow of compressed air from a nozzle in the spinning section 9 which generates swirl flow.

[0049] The unit controller 60 sends a control signal to the yarn joining carriage 3 to move the yarn joining carriage 3 to the front of the relevant spinning unit 2. Thereafter, the unit controller 60 drives the spinning section 9 and other devices again, causes the yarn joining carriage 3 to perform yarn joining, and restarts winding. In this case, the yarn slack-eliminating device 12 eliminates slack on the spun yarn 10 by storing the spun yarn 10 continuously fed out from the spinning section 9 on the slack eliminating roller 21 during a period from the restart of spinning in the spinning section 9 to the restart of winding.

[0050] The yarn joining carriage 3 includes a splicer (yarn joining device) 43, a suction pipe 44, and a suction mouth 46. When a yarn breakage or a yarn cut has occurred in one spinning unit 2, the yarn joining carriage 3 travels on a rail 41 to the relevant spinning unit 2 and

stops there. The suction pipe 44 swings up and down about a pivot, sucks and catches a yarn end fed out from the spinning section 9, and guides it to the splicer 43. The suction mouth 46 swings up and down about a pivot, sucks and catches a yarn end from the package 45 supported with the winding device 13, and guides it to the splicer 43. The splicer 43 joins the yarn ends guided thereto.

[0051] The winding device 13 includes a cradle arm 71 supported to be able to swing about a pivot 70. The cradle arm 71 rotationally supports a bobbin 48 for winding the spun yarn 10.

[0052] The winding device 13 includes a winding drum 72 (rotary drum), and a traverse device 75. The winding drum 72 can drive while making contact with an outer circumferential surface of the bobbin 48 or the package 45. The traverse device 75 includes a traverse guide 76 that can hook the spun yarn 10. While reciprocating the traverse guide 76 using unillustrated driving means, the winding device 13 drives the winding drum 72 with an electric motor (not illustrated) for rotating the package 45 making contact with the winding drum 72, thereby winding the spun yarn 10 while traversing the spun yarn 10. Fig. 1 illustrates the winding device 13 that is configured to wind the cylindrical package 45. The winding device 13, however, may be configured to wind a conical package.

[0053] The spinning frame 1 may be configured to rotationally drive the winding drums 72 of the spinning units 2 using a common electric motor or configured to provide each spinning unit 2 with a dedicated electric motor and rotationally drive each winding drum 72 independently.

[0054] The unit controller 60 can detect cyclic abnormalities on the drafting rollers 16, 17, 19, and 20. The unit controller 60 (controller) includes a central processing unit (CPU) performing arithmetic processing, a read only memory (ROM) and a random access memory (RAM) each serving as a storage, an input signal circuit, an output signal circuit, and a power supply circuit, for example. The unit controller 60 executes a program stored in the storage, thereby realizing a yarn unevenness signal detecting section 61, a yarn unevenness/periodic unevenness determining section 62, a motor monitoring section 63 (monitoring section), and a motor periodic unevenness determining section 64.

[0055] The yarn unevenness signal detecting section 61 is electrically connected to the yarn clearer 52 and obtains information relating to yarn unevenness output from the yarn clearer 52. The yarn unevenness/periodic unevenness determining section 62 obtains information output from the yarn unevenness signal detecting section 61 to determine whether periodic yarn unevenness (periodic unevenness) is formed on the spun yarn 10.

[0056] The motor monitoring section 63 is electrically connected to the motor controller 30 and obtains information (monitor value) relating to torque of each of the motors 31 to 34 and/or information (monitor value) relating to revolution speed of each of the motors 31 to 34, output from the motor controller 30. The motor monitoring section 63 serves as a monitoring section that monitors at least one of the torque and the revolution speed of each of the motors 31 to 34. The information relating to torque of a motor can include information relating to load torque acting on the output shaft of the motor and information available to calculate the torque. The information relating to revolution speed of a motor can include information relating to revolution speed of the output shaft of the motor and information available to calculate the revolution speed.

[0057] The motor periodic unevenness determining section 64 obtains information (monitor value) relating to the torque of each of the motors 31 to 34 and/or information (monitor value) relating to the revolution speed of each of the motors 31 to 34, output from the motor monitoring section 63 to determine whether there are cyclic abnormalities on the drafting rollers 16, 17, 19, and 20. The motor periodic unevenness determining section 64 determines that the spun yarn 10 has a periodic unevenness if a cyclic abnormality is detected on at least one of the drafting rollers 16, 17, 19, and 20.

[0058] The motor periodic unevenness determining section 64 identifies drafting rollers among the drafting rollers 16, 17, 19, and 20 that have a cyclic abnormality. When determining that the monitor value of the motor 31 has a cyclic abnormality, the motor periodic unevenness determining section 64 determines that the back rollers 16 have a cyclic abnormality. When determining that the monitor value of the motor 32 has a cyclic abnormality, the motor periodic unevenness determining section 64 determines that the third rollers 17 have a cyclic abnormality. When determining that the monitor value of the motor 33 has a cyclic abnormality, the motor periodic unevenness determining section 64 determines that the second rollers 19 (or the apron belts 18) have a cyclic abnormality. When determining that the monitor value of the motor 34 has a cyclic abnormality, the motor periodic unevenness determining section 64 determines that the front rollers 20 have a cyclic abnormality.

[0059] The motor periodic unevenness determining section 64 determines whether or not a cyclic abnormality appears on the drafting rollers 16, 17, 19, and 20 by performing frequency analysis on a value (monitor value) relating to at least one of the torque and the revolution speed of each of the motors 31 to 34. The motor periodic unevenness determining section 64 performs frequency analysis such as fast Fourier transform (FFT) calculation in order to convert a time axis into frequency. The monitor periodic unevenness determining section 64 may analyze the torque and/or the revolution speed by different techniques and determine whether or not a cyclic abnormality appears on the drafting rollers 16, 17, 19, and 20.

[0060] The spinning frame 1 may include a unit controller 60B illustrated in Fig. 4, instead of the unit controller 60 illustrated in Fig. 3. The unit controller 60B illustrated in Fig. 4 differs from the unit controller 60 illustrated in Fig. 3 in that a periodic unevenness determining section

65 is included therein, instead of the yarn unevenness/periodic unevenness determining section 62 and the motor periodic unevenness determining section 63.

[0061] The periodic unevenness determining section 65 obtains information relating to the detection result output from the yarn unevenness signal detecting section 61 and information (monitor value) relating to the torque of each of the motors 31 to 34 and/or information (monitor value) relating to the revolution speed of each of the motors 31 to 34, output from the motor monitoring section 63. The periodic unevenness determining section 65 detects a cyclic abnormality of the drafting rollers 16, 17, 19, and 20 on the basis of the monitor result (monitor value) from the motor monitoring section 63 and the detection result from the yarn unevenness signal detecting section 61. The periodic unevenness determining section 65 determines that the spun yarn 10 has a periodic unevenness if a cyclic abnormality is detected on at least one of the drafting rollers 16, 17, 19, and 20. The periodic unevenness determining section 65 has both functions of the yarn unevenness/periodic unevenness determining section 62 and the motor periodic unevenness determining section 63.

[0062] The spinning frame 1 includes a displaying section 66 (notifying section) that displays the determination result from the motor periodic unevenness determining section 64 (or the periodic unevenness determining section 65). The displaying section 66 may be provided on the case of the motor box 5 of the spinning frame 1. A liquid crystal display device may be used as the displaying section 66. In accordance with signals from the unit controller 60, the displaying section 66 electrically connected to the unit controller 60 can display information relating to whether there is a cyclic abnormality. Thus, the operator can easily check for a cyclic abnormality by looking at the display contents on the displaying section 66. The displaying section 66 can display different information other than the display contents relating to the abnormality in the drafting rollers 16, 17, 19, and 20.

[0063] The spinning frame 1 may include an audio outputting section instead of the displaying section 66. This configuration allows the spinning frame 1 to notify whether there is an abnormality by a voice and/or an alarm. A warning lamp, for example, may be used as the displaying section.

[0064] Next, a periodic unevenness detection process is described with reference to Fig. 5. The periodic unevenness detection process is performed, for example, in a normal spinning operation. As illustrated in Fig. 5, the unit controller 60 processes steps S11 to S 14, steps S21 to S24, steps S31 to S34, and steps S41 to S44, concurrently. These processes are performed repeatedly. The processing of steps S11 to S14, steps S21 to S24, steps S31 to S34, and steps S41 to S44 may be performed in this order or in a different order.

[0065] The following describes the processing of steps S11 to S14. First, the motor monitoring section 63 of the unit controller 60 monitors the motor 34 rotationally driving the bottom roller of the front rollers 20 to obtain the monitor value (such as torque and revolution speed) of the motor 34 (step S11). Next, the motor periodic unevenness determining section 54 of the unit controller 60 obtains the monitor value of the motor 34 from the motor monitoring section 63, and performs FFT calculation on the obtained monitor value (step S 12).

[0066] Thereafter, the motor periodic unevenness determining section 64 of the unit controller 60 determines whether there is a cyclic abnormality on the basis of the analysis result of the FFT calculation (step S13). For example, the motor periodic unevenness determining section 64 determines that there is a cyclic abnormality in the case where the data vary periodically (Yes at step S13). When it is determined that there is a cyclic abnormality, the process of the unit controller 60 proceeds to step S14. When it is determined that there is no cyclic abnormality (No at step S13), the process of the unit controller 60 terminates. At step S14, the motor periodic unevenness determining section 64 determines that a periodic unevenness caused by the front rollers 20 is appearing on the spun yarn 10.

[0067] The following describes the processing of steps S21 to S24. First, the motor monitoring section 63 of the unit controller 60 monitors the motor 33 rotationally driving the bottom roller of the second rollers 19 to obtain the monitor value (such as torque and revolution speed) of the motor 33 (step S21). Next, the motor periodic unevenness determining section 54 of the unit controller 60 obtains the monitor value of the motor 33 from the motor monitoring section 63, and performs FFT calculation on the obtained monitor value (step S22).

[0068] Thereafter, the motor periodic unevenness determining section 64 of the unit controller 60 determines whether there is a cyclic abnormality on the basis of the analysis result of the FFT calculation (step S23). For example, the motor periodic unevenness determining section 64 determines that there is a cyclic abnormality in the case where portions including a prominent value appear periodically (Yes at step S23). When it is determined that there is a cyclic abnormality, the process of the unit controller 60 proceeds to step S24. When it is determined that there is no cyclic abnormality (No at step S23), the process of the unit controller 60 terminates. At step S24, the motor periodic unevenness determining section 64 determines that a periodic unevenness caused by the second rollers 19 (apron belt 18) is appearing on the spun yarn 10.

[0069] The following describes the processing of steps S31 to S34. The motor monitoring section 63 of the unit controller 60 monitors the motor 32 rotationally driving the bottom roller of the third rollers 17 to obtain the monitor value (such as torque and revolution speed) of the motor 32 (step S31). Next, the motor periodic unevenness determining section 54 of the unit controller 60 obtains the monitor value of the motor 32 from the motor monitoring section 63, and performs FFT calculation on the obtained monitor value (step S32).

[0070] Thereafter, the motor periodic unevenness determining section 64 of the unit controller 60 determines whether there is a cyclic abnormality on the basis of the analysis result of the FFT calculation (step S33). For example, the motor periodic unevenness determining section 64 determines that there is a cyclic abnormality in the case where portions including a prominent value appear periodically (Yes at step S33), and the process proceeds to step S34. When it is determined that there is no cyclic abnormality (No at step S33), the process of the unit controller 60 terminates. At step S34, the motor periodic unevenness determining section 64 determines that a periodic unevenness caused by the third rollers 17 is appearing on the spun yarn 10.

[0071] The following describes the processing of steps S41 to S44. The motor monitoring section 63 of the unit controller 60 monitors the motor 31 rotationally driving the bottom roller of the back rollers 16 to obtain the monitor value (such as torque and revolution speed) of the motor 31 (step S41). Next, the motor periodic unevenness determining section 54 of the unit controller 60 obtains the monitor value of the motor 31 from the motor monitoring section 63, and performs FFT calculation on the obtained monitor value (step S42).

[0072] Thereafter, the motor periodic unevenness determining section 64 of the unit controller 60 determines whether there is a cyclic abnormality on the basis of the analysis result of the FFT calculation (step S43). For example, the motor periodic unevenness determining section 64 determines that there is a cyclic abnormality in the case where portions including a prominent value appear periodically (Yes at step S43). When it is determined that there is a cyclic abnormality, the process of the unit controller 60 proceeds to step S44. When it is determined that there is no cyclic abnormality (No at step S43), the process of the unit controller 60 terminates. At step S44, the motor periodic unevenness determining section 64 determines that a periodic unevenness caused by the back rollers 16 is appearing on the spun yarn 10.

[0073] The unit controller 60 displays the above-mentioned determination results on the displaying section 66 after steps steps S14, S24, S34, and S44 (step S15). The displaying section 66 displays information relating to the determination results in accordance with signal output from the unit controller 60. For example, the displaying section 66 indicates that the cause of the periodic unevenness occurred on the spun yarn 10 is the front roller 20. The displaying section 66 may display the drafting rollers 16, 17, 19, or 20 that are the cause of periodic unevenness, with character information. For example, the displaying section 66 may display the layout of the drafting rollers 16, 17, 19, and 20, and exclusively highlight drafting rollers which are the cause of the periodic unevenness (for example, displaying in red and/or displaying in blinking). The displaying section 66 may display the determination result by displaying a graph of the monitor values of each of the drafting rollers 16, 17, 19, and/or 20.

[0074] If it is determined that any one of the drafting rollers 16, 17, 19, and 20 has a cyclic abnormality, the unit controller 60 (controller) may stop the operation of the spinning unit 2, instead of displaying the result at step S15 or in addition to the result display. As mentioned above, in the case where the unit controller 60 stops the operation of the spinning unit 2, the unit controller 60 may cause the displaying section 66 to display that the drafting cradle is not closed at a proper position and/or at least one of the drafting rollers 16, 17, 19, and 20 has reached the replacement time thereof. In the case where the drafting cradle is not closed at a proper position and at least one of the drafting rollers 16, 17, 19, and 20 is displaced from a proper position, the unit controller 60 can determine that at least one of the drafting rollers 16, 17, 19, and 20 includes a cyclic abnormality.

[0075] Note that, the unit controller 60 may determine whether or not a cyclic abnormality is appearing on the basis of the yarn defect detection signal from the yarn clearer 52 after each step of S 13, S23, S33, and S43. For example, by comparing the determination result of FFT calculation and a signal from the yarn clearer 52, the unit controller 60 can precisely perform periodic unevenness detection when a determination can be made that periodic unevenness is appearing in the same cycle.

[0076] The spinning frame 1 of the embodiment monitors the torque and/or the revolution speed of each of the motors 31 to 34 driving the respective drafting rollers 16, 17, 19, and 20 drafting the fiber band, thereby determining whether or not a cyclic abnormality appears on the drafting rollers 16, 17, 19, and 20 on the basis of the monitor results. This configuration enables detection of a cyclic abnormality of the drafting rollers 16, 17, 19, and 20, thereby detecting periodic unevenness on the spun yarn 10. The spinning frame 1 can detect periodic unevenness on the spun yarn 10 with higher precision than that by the detection of periodic unevenness using only a conventional clearer.

[0077] The present invention is described on the basis of an embodiment thereof, but is not limited to the embodiment.

[0078] Although the spinning frame 1 (air spinning machine) is not provided with a delivery roller and a nip roller in the above-described embodiment, the spinning machine of the present invention is not limited thereto and may be provided with the delivery roller and the nip roller. The delivery roller and the nip roller are arranged downstream of the spinning section 9, for example. The spun yarn 10 spun from the spinning section 9 is sandwiched between the delivery roller and the nip roller and transported, and wound in the winding device 13. Note that the torque and/or the revolution speed of a motor rotationally driving the delivery roller may be monitored to determine whether or not a cyclic abnormality appears on the delivery roller and/or the nip roller.

[0079] The spinning machine is not limited to an air spinning machine, and may be different spinning machines including a drafting device. A ring spinning frame

and a drawing frame are examples of the spinning machine.

[0080] The motor monitoring section (monitoring section) may monitor at least one of the torque and the revolution speed of the motor. For example, when the motor is a brushless motor, current detection for monitoring torque is not typically performed, and only revolution speed detection is performed. Thus, revolution speed is monitored in this case.

[0081] In the detection of periodic unevenness in the above-described embodiment, the monitor result of the motor monitoring section 63 and the detection result of the yarn clearer 52 are both used to make determination. However, periodic unevenness may be detected only on the basis of the monitor result of the motor monitoring section 63.

[0082] In the above-described embodiment, when a yarn defect is detected and yarns are to be joined, the spun yarn 10 is cut by interrupting the blow of compressed air from the nozzle in the spinning section 9 which generates swirl flow, however, other methods may be used to cut the spun yarn 10. For example, the spun yarn 10 can be cut by a cutter arranged between the spinning section 9 and the yarn clearer 52.

[0083] In the above-described air spinning machine, a yarn path is oriented from the upside to the downside in the machine height direction, but this is not limiting a configuration thereof. For example, a different arrangement in which the yarn path is oriented from the downside to the upside may be possible.

[0084] It is preferable that the spinning section 9 include a needle (needle-like member) to prevent a yarn twist in the spinning section 9 from propagating to the front rollers 20. However, the needle can be omitted.

[0085] The air spinning machine may be configured such that the bottom roller of the drafting device and the traverse mechanism of the winding device of a plurality of the spinning units 2 are commonly driven (by a line shaft). In the air spinning machine, the drafting device and/or the winding device may be provided independently in each winding unit.

[0086] The spinning frame 1 in the above-described embodiment includes the motor controller 30 controlling the motors 31 to 34 and the unit controller 60 controlling the spinning units 2, separately. However, the unit controller 60 may control the motors. The motor controller 30 may serve as the determining section to determine whether there is a cyclic abnormality.

[0087] The spinning frame 1 in the above-described embodiment includes the unit controller 60 that controls each spinning unit 2 independently. However, the unit controller 60 controlling a certain number of spinning units 2 may be provided for the spinning units 2.

[0088] The unit controller 60 in the above-described embodiment normally monitors at least one of the torque and the revolution speed of each of the motors 31 to 34 during winding of the package 45. However, the monitoring may be performed during a specific time and, whether or not a cyclic abnormality appears on the drafting rollers 16, 17, 19, and 20 may be determined on the basis of the monitor result. The spinning frame 1 may be provided with a spinning test mode and monitor at least one of the torque and the revolution speed of each of the motors 31 to 34 while operating under the spinning test mode. In this case, whether or not a cyclic abnormality appears on the drafting rollers 16, 17, 19, and 20 may be determined on the basis of the monitor result. Note that, it is preferable to perform the monitoring during winding of the package 45 in order to maintain the operation efficiency of the spinning frame 1.

[0089] The unit controller 60 in the above-described embodiment monitors at least one of the torque and the revolution speed of each of the motors 31 to 34 driving the respective drafting rollers 16, 17, 19, and 20 and determines whether there is periodic unevenness associated with each of the motors 31 to 34. However, this is not limiting the embodiment. For example, the unit controller 60 may monitor at least one of the torque and the revolution speed of the specific motor among the motors 31 to 34 to determine whether there is periodic unevenness caused by a cyclic abnormality of the specific motor.

[0090] The spinning frame 1 in the above-described embodiment includes a plurality of unit controllers 60 and the respective spinning units 2 are controlled by the unit controllers 60. However, the control of the spinning units 2 may be integrated and executed in the central controller.

[0091] The present invention can be applied to a winding device as well as the spinning frame 1. Examples of the winding device in the present invention are a winding device in a spinning machine, and a winding device in an automatic winder.

[0092] An automatic winder according to a third embodiment of the present invention is described with reference to the accompanying drawings. The automatic winder in the present embodiment illustrated in Fig. 6 includes a plurality of winder units 110 and a central controller (not illustrated) controlling the automatic winder. Note that the same explanations with those of the above-described embodiments are omitted.

[0093] Each winder unit 110 winds a spun yarn 120 unwound from a yarn supplying bobbin 121 around a winding bobbin 122 while traversing the spun yarn 120 to form a package 130 having a certain length and a certain shape.

[0094] The winder unit 110 includes a winding unit body 116 and a unit controller 160. The winding unit body 116 includes a yarn supplying section 112, a yarn tensioner 113, splicer 114 (yarn joining device), a yarn clearer 115, and a winding device 117 that are arranged in this order along the yarn running direction.

[0095] The yarn supplying section 111 feeds the spun yarn 120 to be wound around the package 130. The yarn supplying section 111 includes an unwinding assisting device 112. The unwinding assisting device 112 lowers a restriction member 140 covering a core tube as the

spun yarn 120 unwinds from the feeder bobbin 121 to assist the unwinding of the spun yarn 120 from the feeder bobbin 121.

[0096] The yarn tensioner 113 applies certain tension to the spun yarn 120 to be wound around the package 130. A gate-type yarn tensioner in which movable comb teeth are arranged with respect to fixed comb teeth may be used as the yarn tensioner 113. The yarn tensioner 113 can apply constant tension to the spun yarn 120 to be wound, thereby improving the quality of the package 130. A disc-type yarn tensioner can be used as the yarn tensioner 113 instead of the above-described gate-type tensioner.

[0097] The yarn clearer 115 monitors the quality of the spun yarn 120 to be wound around the package 130. When the yarn clearer 115 detects a yarn defect, the spun yarn 120 is cut and the yarn defect is removed. The yarn clearer 115 includes a clearer head 149 provided with a sensor (not illustrated) to detect a thickness of the spun yarn 120. The yarn clearer 115 detects a yarn defect by monitoring yarn thickness signals from the sensor. Near the clearer head 149, a cutter (not illustrated) is arranged to cut the spun yarn 120 immediately when the yarn clearer 115 detects a yarn defect.

[0098] The splicer 114 joins the spun yarn 120 from the feeder bobbin 121 (lower yarn) and the spun yarn 120 from the package 130 (upper yarn) when the yarn clearer 115 cuts the yarn upon detection of a yarn defect or when the yarn unwound from the feeder bobbin 121 breaks, for example.

[0099] A lower yarn guide pipe 125 is arranged below the splicer 114 (by the feeder bobbin 121) to capture the lower yarn from the feeder bobbin 121 and guide it to the splicer 114. An upper yarn guide pipe 126 is arranged above the splicer 114 (by the package 130) to capture the upper yarn from the package 130 and guide it to the splicer 114.

[0100] The lower yarn guide pipe 125 and the upper yarn guide pipe 126 are able to swing about pivots 133 and 135, respectively. The tip end of the lower yarn guide pipe 125 is provided with a suction opening 132. The tip end of the upper yarn guide pipe 126 is provided with a suction mouth 134. The lower yarn guide pipe 125 and the upper yarn guide pipe 126 are each connected to an appropriate negative pressure source (not illustrated). The negative pressure source generates suction flows which allow the suction opening 132 and the suction mouth 134 to suck and capture the upper yarn and the lower yarn, respectively.

[0101] The winding device 117 includes a cradle 123 rotationally supporting the package 130, a winding drum 124 (rotary drum, rotary body) rotating the package 130 while making contact with the package 130, a motor 153 rotationally driving the winding drum 124, and a motor controller 154 controlling the rotation of the motor 153. The winding drum 124 is provided with traversing grooves 127 for traversing the spun yarn 120 with respect to the package 130. With this configuration, the winder unit 110 can wind the spun yarn 120 around the package 130 while traversing the spun yarn 120.

[0102] The motor controller 154 is electrically connected to the motor 153. The motor controller 154 detects load torque acting on the motor 153. The motor controller 154 detects the revolution speed of the output shaft of the motor 153. It is enough for the motor controller 154 to be capable of detecting at least one of the torque and the revolution speed. The motor controller 154 outputs data relating to the torque and/or the revolution speed of a motor 154 to the unit controller 160.

[0103] The unit controller 160 can detect cyclic abnormalities on the winding drum 124. The unit controller 160 (controller) includes a CPU performing arithmetic processing, a ROM and a RAM each serving as a storage, an input signal circuit, an output signal circuit, and a power supply circuit, for example. The unit controller 160 executes a program stored in the storage, thereby realizing a motor monitoring section 163 (monitoring section), and a determining section 164.

[0104] The motor monitoring section 163 is electrically connected to the motor controller 154 and obtains information (monitor value) relating to the torque of the motor 153 and/or information (monitor value) relating to the revolution speed of the motor 153, output from the motor controller 154. The motor monitoring section 163 serves as a monitoring section that monitors at least one of the torque and the revolution speed of the motor 153.

[0105] The determining section 164 determines whether or not a cyclic abnormality appears on the winding drum 124 by performing frequency analysis on a value (monitor value) relating to at least one of the torque and the revolution speed of the motor 153. The determining section 164 performs frequency analysis such as fast Fourier transform (FFT) calculation in order to convert a time axis into frequency. The determining section 164 may analyze the torque and/or the revolution speed by different techniques and determine whether or not a cyclic abnormality appears on the winding drum 124.

[0106] The automatic winder includes a displaying section 66 (notifying section) displaying the determination result of the determining section 164. In accordance with signals from the unit controller 160, the displaying section 66 electrically connected to the unit controller 160 can display information relating to whether there is a cyclic abnormality. Thus, the operator can easily check a cyclic abnormality by looking at the display contents on the displaying section 66. The displaying section 66 can display different information other than the display contents relating to the abnormality in the winding drum 124.

[0107] The winding device 117 in the automatic winder determines whether or not a cyclic abnormality appears on the motor 153 by monitoring at least one of the torque and the revolution speed of the motor 153, thereby detecting the cyclic abnormality of the winding drum 124. With this configuration, an abnormality such as eccentricity of the package 130 can be detected in an early stage.

[0108] The winding device 117 may include a traverse mechanism separate from a winding drum 124, instead of the winding drum 124 on which the traversing grooves 127 are formed, similarly to the winding device 13 of the spinning frame 1. In this case, the monitoring section of the winding device monitors at least one of the torque and the revolution speed of the motor rotationally driving a winding drum having no traversing grooves.

[0109] In the case where the automatic winder includes a winding drum having no traversing grooves, the package 130, instead of the winding drum, may be rotationally driven directly. In this case, the monitoring section monitors at least one of the torque and the revolution speed of a motor directly rotationally driving the package 130.

[0110] The above-described embodiments describe the applications to the spinning machine and the winding device, however, the embodiments are not limiting the invention. The present invention can be embodied as other kinds of textile machines. That is, the configuration may be suitable for a textile machine provided with a motor driving a rotary body, in which a cyclic abnormality of the rotary body can be determined by monitoring at least one of the load torque acting on the motor and the revolution speed of the motor.

[0111] Such a textile machine includes a rotary body transporting the fiber band, a motor rotationally driving the rotary body, a monitoring section monitoring at least one of torque and revolution speed of the motor, and a determining section determining a cyclic abnormality appearing on the rotary body on the basis of the monitor result of the monitoring section. The determining section of the textile machine may perform frequency analysis on a value relating to at least one of the torque and the revolution speed that are each the monitor result of the monitoring section to determine the cyclic abnormality of the rotary body. The textile machine may further include a notifying section notifying information relating to the monitor result of the monitoring section. Such a textile machine determines whether or not a cyclic abnormality appears on the rotary body by monitoring at least one of the torque and the revolution speed of the motor, thereby detecting a periodic abnormality on the fiber band processed by the rotary body.

Industrial Applicability

[0112] A spinning machine of the present invention is capable of detecting a cyclic abnormality of a drafting roller and improving detection accuracy of such an abnormality. A winding device of the present invention is capable of detecting a cyclic abnormality of a rotary drum and improving detection accuracy of such an abnormality. A textile machine of the present invention is capable of detecting a cyclic abnormality of a rotary body and improving detection accuracy of such an abnormality.

Reference Signs List

[0113] 1... spinning frame (spinning device, textile machine), 2... spinning unit (spinning machine), 7... drafting device, 8... fiber band, 9... spinning section, 10... spun yarn, 16... back rollers (drafting roller), 17... third rollers (drafting roller), 18... apron belts, 19... second rollers (drafting roller), 20... front rollers, 30, 154... motor controller, 31 to 34... motor, 52... yarn clearer, 60, 60B, 160... unit controller, 63, 163... motor monitoring section (monitoring section), 64... motor periodic unevenness determining section (determining section), 65... periodic unevenness determining section (determining section), 66... displaying section (notifying section), 110... automatic winder (textile machine), 117... winding device in the automatic winder, 124... winding drum (rotary drum), 130... package, 164... determining section.

Claims

1. A spinning machine comprising:

   a drafting roller drafting a fiber band;
   a motor rotationally driving the drafting roller;
   a monitoring section monitoring at least one of torque and revolution speed of the motor; and
   a periodic unevenness determining section determining a cyclic abnormality of the drafting roller, the cyclic abnormality appearing as periodic unevenness on the fiber band, on the basis of a monitor result of the monitoring section.

2. The spinning machine according to claim 1, wherein the periodic unevenness determining section performs frequency analysis on a value relating to at least one of the torque and the revolution speed that are each the monitor result of the monitoring section to determine the cyclic abnormality of the drafting roller.

3. The spinning machine according to claim 1 or 2, wherein
   a plurality of such drafting rollers are arranged along a transporting direction of the fiber band,
   a plurality of such motors are independently driving the drafting rollers, and
   the periodic unevenness determining section determines which motor out of the motors has a cyclic abnormality, on the basis of the monitor result of the monitoring section.

4. The spinning machine according to any one of claims 1 to 3, further comprising an unevenness detecting section disposed downstream of the drafting roller to detect unevenness on the fiber band drafted with the drafting roller, wherein
   the periodic unevenness determining section deter-

mines a cyclic abnormality of the drafting roller on the basis of the monitor result of the monitoring section and a detection result of the unevenness detecting section to detect the periodic unevenness on the fiber band.

5. The spinning machine according to any one of claims 1 to 4, further comprising a notifying section notifying information relating to the monitor result of the monitoring section.

6. The spinning machine according to any one of claims 1 to 5, further comprising:

an air spinning device spinning the fiber band drafted with the drafting roller, with swirl flows; and
a winding device winding the fiber band spun from the air spinning device into a package, wherein
the periodic unevenness determining section determines a cyclic abnormality of the drafting roller during winding of the package by the winding device.

7. A winding device comprising:

a rotary drum making contact with and rotating a winding package to wind a yarn around the winding package;
a motor rotationally driving the rotary drum;
a monitoring section monitoring at least one of torque and revolution speed of the motor; and
a determining section determining a cyclic abnormality of the rotary drum on the basis of a monitor result of the monitoring section.

8. The winding device according to claim 7, wherein the determining section performs frequency analysis on a value relating to at least one of the torque and the revolution speed that are each the monitor result of the monitoring section to determine the cyclic abnormality of the rotary drum.

9. The winding device according to claim 7 or 8, further comprising:

a notifying section notifying information relating to the monitor result of the monitoring section.

10. A textile machine comprising:

a rotary body transporting a fiber band;
a motor rotationally driving the rotary body;
a monitoring section monitoring at least one of torque and revolution speed of the motor; and
a determining section determining a cyclic abnormality of the rotary body on the basis of a monitor result of the monitoring section.

11. The textile machine according to claim 10, wherein the determining section performs frequency analysis on a value relating to at least one of the torque and the revolution speed that are each the monitor result of the monitoring section to determine the cyclic abnormality of the rotary body.

12. The textile machine according to claim 10 or 11, further comprising:

a notifying section notifying information relating to the monitor result of the monitoring section.

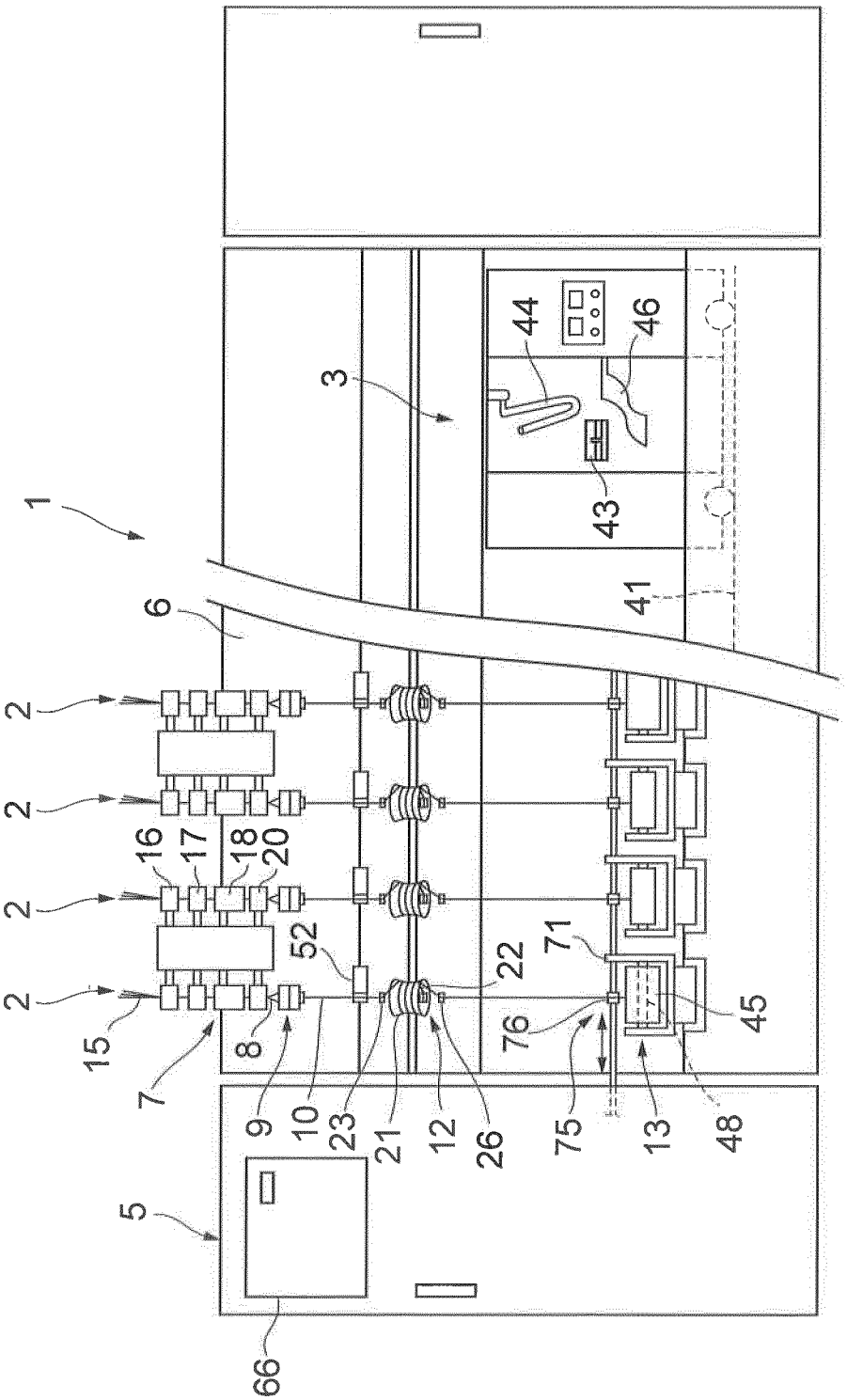

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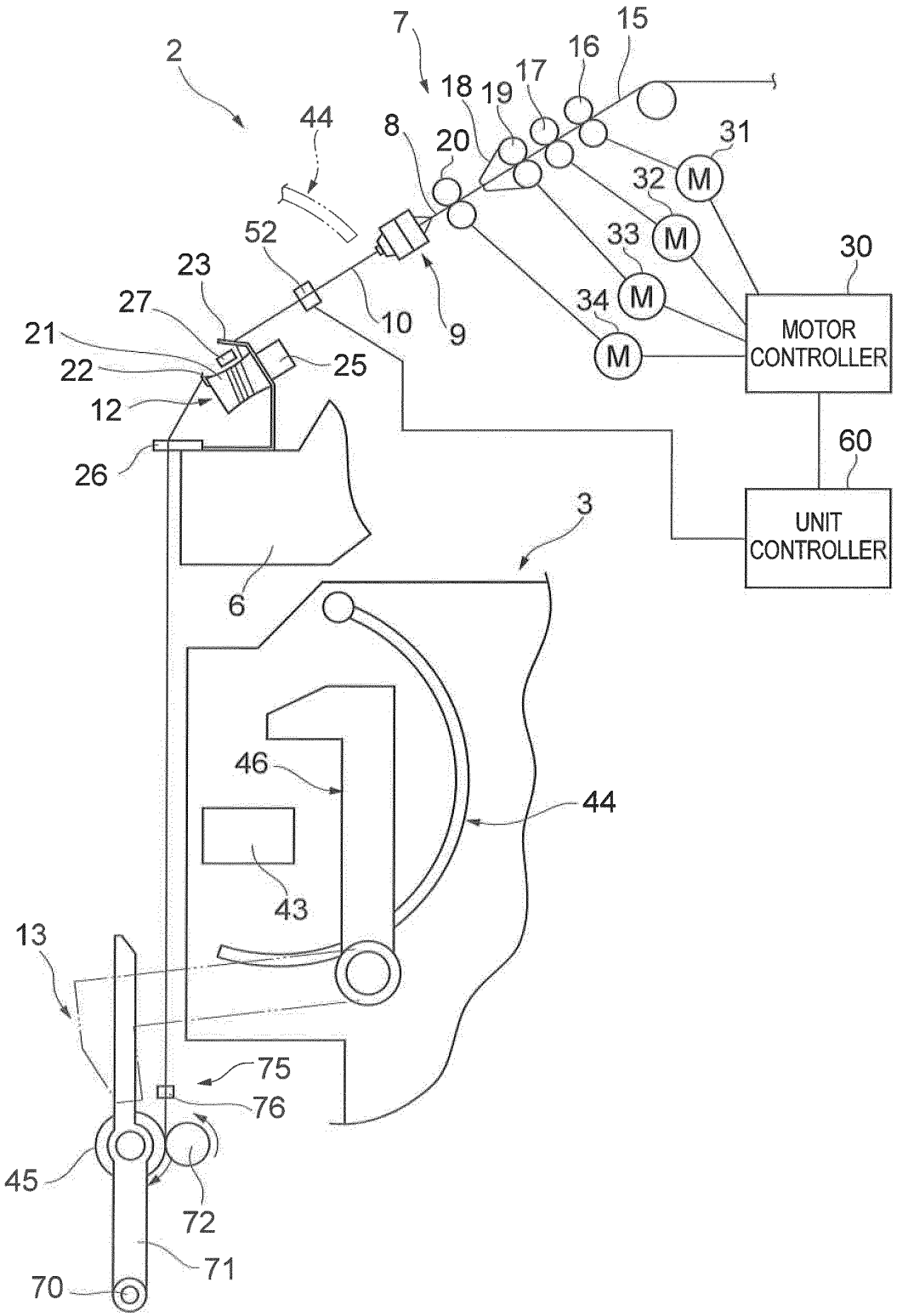
Fig.1

Fig.2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44
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34
M
52
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22
12
26
25
10
9
30
MOTOR CONTROLLER
60
UNIT CONTROLLER
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44
43
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Fig.3

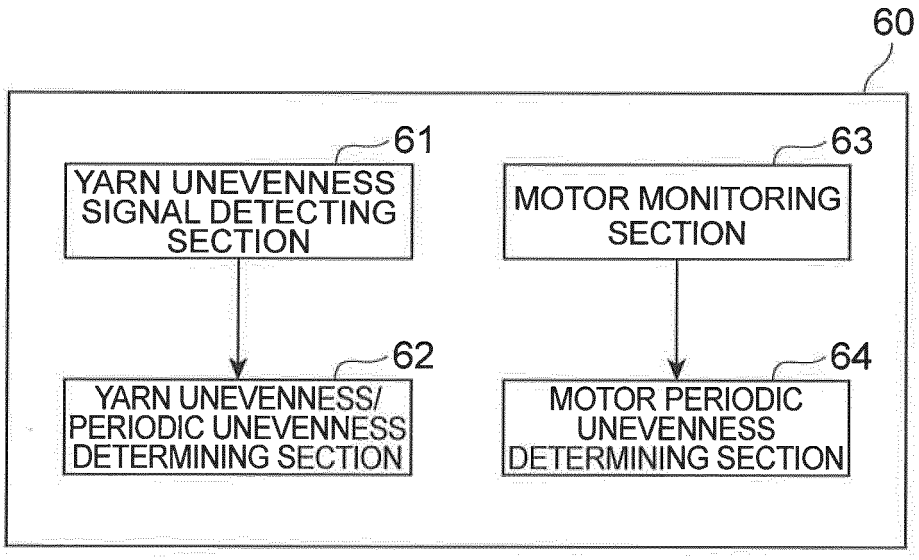
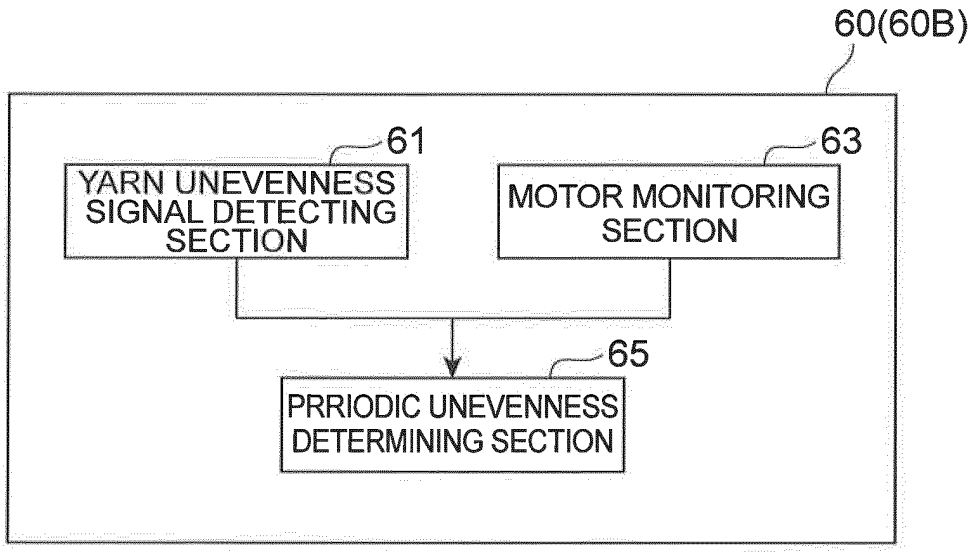

60
61
YARN UNEVENNESS SIGNAL DETECTING SECTION
63
MOTOR MONITORING SECTION
62
YARN UNEVENNESS/ PERIODIC UNEVENNESS DETERMINING SECTION
64
MOTOR PERIODIC UNEVENNESS DETERMINING SECTION

Fig.4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YARN UNEVENNESS SIGNAL DETECTING SECTION
63
MOTOR MONITORING SECTION
65
PRRIODIC UNEVENNESS DETERMINING SECTION

Fig.5

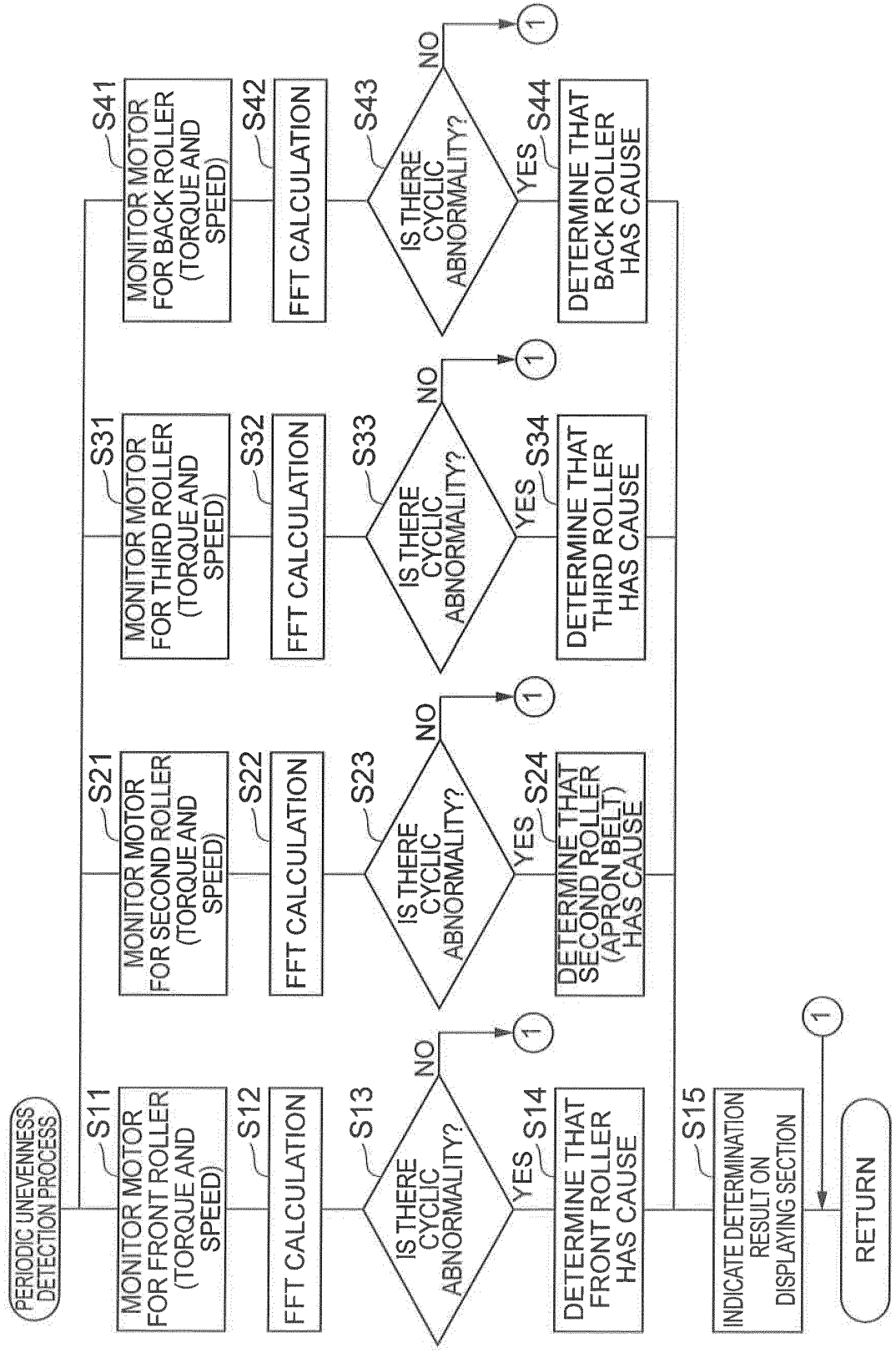
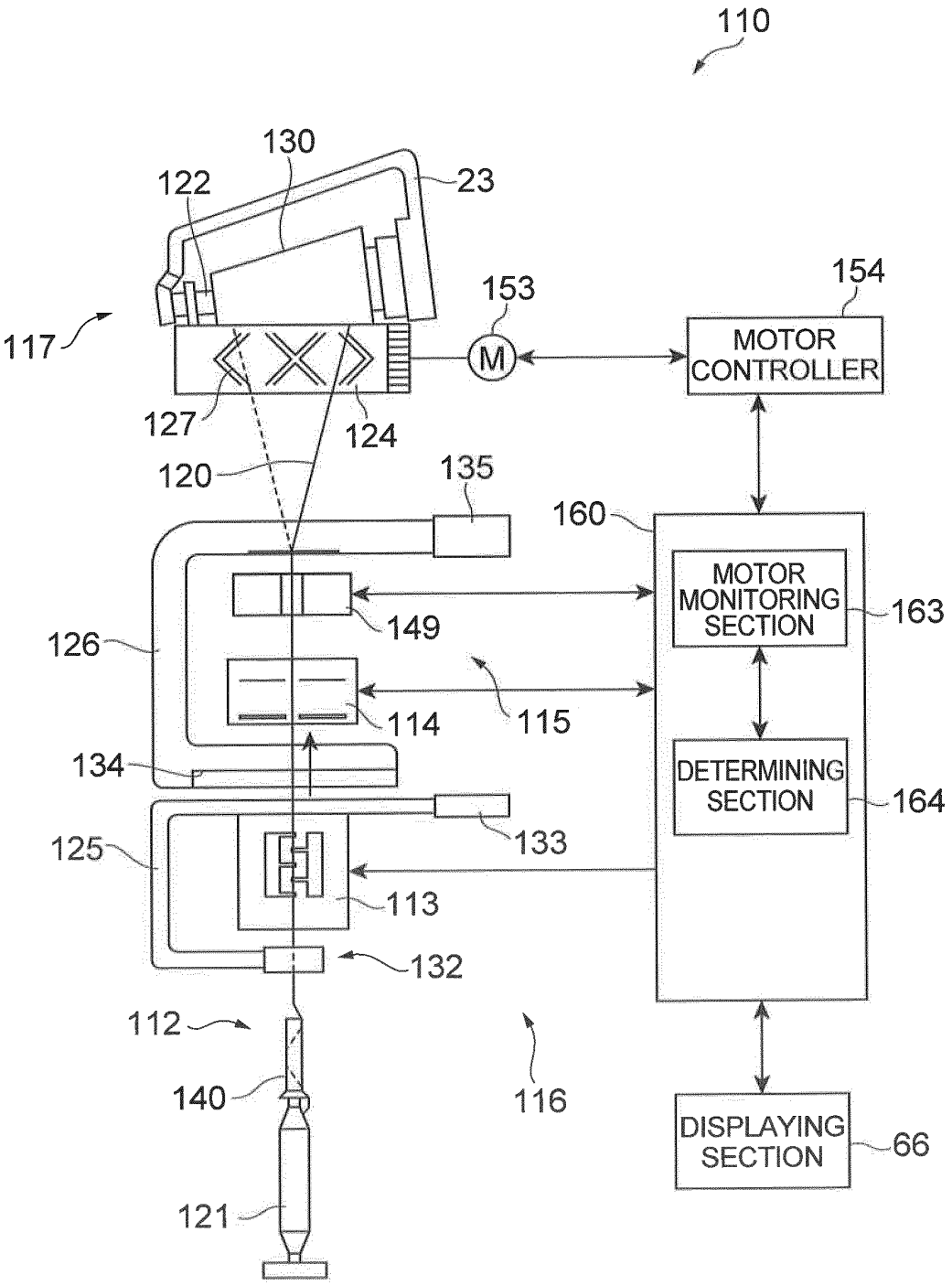

PERIODIC UNEVENNESS DETECTION PROCESS
S11
MONITOR MOTOR FOR FRONT ROLLER (TORQUE AND SPEED)
S12
FFT CALCULATION
S13
IS THERE CYCLIC ABNORMALITY?
NO
YES
S14
DETERMINE THAT FRONT ROLLER HAS CAUSE
S15
INDICATE DETERMINATION RESULT ON DISPLAYING SECTION
RETURN
S21
MONITOR MOTOR FOR SECOND ROLLER (TORQUE AND SPEED)
S22
FFT CALCULATION
S23
IS THERE CYCLIC ABNORMALITY?
NO
YES
S24
DETERMINE THAT SECOND ROLLER (APRON BELT) HAS CAUSE
S31
MONITOR MOTOR FOR THIRD ROLLER (TORQUE AND SPEED)
S32
FFT CALCULATION
S33
IS THERE CYCLIC ABNORMALITY?
NO
YES
S34
DETERMINE THAT THIRD ROLLER HAS CAUSE
S41
MONITOR MOTOR FOR BACK ROLLER (TORQUE AND SPEED)
S42
FFT CALCULATION
S43
IS THERE CYCLIC ABNORMALITY?
NO
YES
S44
DETERMINE THAT BACK ROLLER HAS CAUSE
1

Fig.6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MOTOR CONTROLLER
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124
120
135
160
MOTOR MONITORING SECTION
163
149
126
114
115
DETERMINING SECTION
164
134
133
125
113
132
112
140
116
DISPLAYING SECTION
66
121

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/067088

A. CLASSIFICATION OF SUBJECT MATTER
D01H13/14(2006.01)i, *D01H5/38*(2006.01)i, *D01H13/32*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D01H1/00-17/02, H02P5/00, H02P7/00, B65H54/02, B65H54/70

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012
Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2003-166135 A (Toyota Industries Corp.), 13 June 2003 (13.06.2003), paragraphs [0017], [0023], [0035], [0036], [0043]; fig. 1 to 3 & EP 1314804 A1	1-6,10-12
Y	JP 2010-166686 A (Yaskawa Electric Corp.), 29 July 2010 (29.07.2010), paragraphs [0010], [0014], [0017]; fig. 1 (Family: none)	1-12
Y	JP 2000-316292 A (Canon Inc.), 14 November 2000 (14.11.2000), paragraphs [0035], [0042], [0043] (Family: none)	1-6,10-12

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 August, 2012 (03.08.12)	14 August, 2012 (14.08.12)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/067088

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2010-174387 A (Murata Machinery Ltd.), 12 August 2010 (12.08.2010), paragraph [0051] (Family: none)	3-6,12
Y	JP 2004-260870 A (Toyota Motor Corp.), 16 September 2004 (16.09.2004), paragraphs [0021], [0024], [0025] (Family: none)	3-6,12
Y	JP 62-57955 A (Toyoda Automatic Loom Works, Ltd.), 13 March 1987 (13.03.1987), page 3, upper left column, line 11 to lower left column, line 18; fig. 1 (Family: none)	4-6,9,12
Y	JP 2011-99192 A (Murata Machinery Ltd.), 19 May 2011 (19.05.2011), paragraphs [0045], [0069]; fig. 2 & EP 2309042 A2 & CN 102031604 A	6
Y	JP 2010-269915 A (Murata Machinery Ltd.), 02 December 2010 (02.12.2010), paragraphs [0033], [0034], [0058] to [0079]; fig. 2, 4 to 6 & EP 2433889 A1 & WO 2010/134294 A1	7-9

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 58062511 A **[0004]**
- JP 2003166135 A **[0004]**