(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 687 627 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.01.2014 Bulletin 2014/04

(51) Int Cl.:
D01H 5/32 *(2006.01)* ***D01H 13/22*** *(2006.01)*

(21) Application number: **13173783.5**

(22) Date of filing: **26.06.2013**

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

(30) Priority: **29.06.2012 JP 2012147240**

(71) Applicant: **Murata Machinery, Ltd.**
Kyoto-shi, Kyoto 601-8326 (JP)

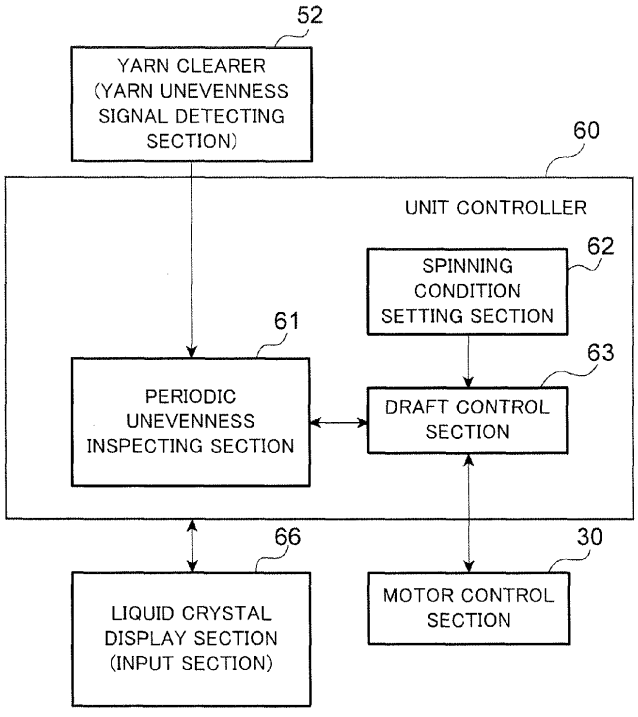
(72) Inventor: **Ikkai, Tomoyuki**
Kyoto, 612-8686 (JP)

(74) Representative: **Stöckeler, Ferdinand et al**
Patentanwälte SCHOPPE, ZIMMERMANN, STÖCKELER, ZINKLER & PARTNER
P.O. Box 246
82043 Pullach (DE)

(54) Textile machinery and periodic unevenness detecting method therein

(57) When a periodic unevenness of a drafted fiber bundle (8) is detected, a draft ratio in a draft device (7) is changed. Since a generation period of the periodic unevenness in the fiber bundle changes in accordance with a change in the draft ratio, a textile machinery detects the periodic unevenness under a plurality of different draft ratios, acquires the detection result, and inspects a change in the detection result. The periodic unevenness may be generated by a plurality of overlapped causes depending on generated positions of the periodic unevenness on the fiber bundle. In such a case, a position where the generation cause of the periodic unevenness may exist can be limited by changing the draft ratio and inspecting the change in the detection result.

FIG. 3



EP 2 687 627 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a textile machinery and a periodic unevenness detecting method therein.

2. Description of the Related Art

[0002] Conventionally, there is known a spinning machine (a textile machinery) described in Japanese Unexamined Patent Publication No. 62-53430 (Patent Document 1) as an art in such a field. The spinning machine includes a draft device adapted to draft a fiber bundle. The draft device includes a back roller, a middle roller, and a front roller as a plurality of draft rollers arranged along a feeding direction of the fiber bundle at a prescribed interval. An apron, which is an endless elastic belt, is wound around the middle roller. Each of the draft rollers is arranged by pair with the fiber bundle therebetween. For example, the front roller includes a front top roller arranged above the fiber bundle and a front bottom roller arranged below the fiber bundle.

[0003] The spinning machine includes a sensor arranged downstream of the draft device and adapted to detect a variation in a yarn thickness, and detects an unevenness of the yarn thickness by collecting data from the sensor. The spinning machine according to Patent Document 1, by performing frequency analysis on the data from the sensor, specifies that "a periodic unevenness caused by the front top roller is an abnormality in the front top roller", "a periodic unevenness caused by the front bottom roller is an abnormality in the front bottom roller", "a periodic unevenness not caused by the front roller is an abnormality in the apron", and that "an aperiodic unevenness is an abnormality in the apron or the fiber bundle".

SUMMARY OF THE INVENTION

[0004] In the art described in Patent Document 1, an abnormality is specified by performing the frequency analysis on the data output from the sensor. However, depending on positions of the periodic unevenness, a plurality of causes may be overlapping. In such a case, the plurality of the causes could not be specified even if the frequency analysis is performed.

[0005] An object of the present invention is to improve accuracy of detecting the generation cause of the periodic unevenness, and to provide a textile machinery and a periodic unevenness detecting method in the textile machinery that can reduce trouble in specifying the generation cause of the periodic unevenness.

[0006] A textile machinery according to the present invention includes a draft device having a plurality of pairs of draft rollers arranged along a feeding direction of a fiber bundle and adapted to draft the fiber bundle using the draft rollers, a draft control section adapted to change a peripheral speed of the draft roller to control a draft ratio of the draft device, a detecting section adapted to detect a periodic unevenness generated in the drafted fiber bundle, and a periodic unevenness inspecting section adapted to transmit a signal to the draft control section so as to draft by changing the draft ratio, to acquire a detection result of the periodic unevenness under a plurality of different draft ratios, and to inspect a change in the detection result.

[0007] A generation period (a frequency) of the periodic unevenness in the fiber bundle varies according to a change of the draft ratio. The textile machinery can accurately specify the generation cause of the periodic unevenness by detecting the periodic unevenness under the plurality of different draft ratios and inspecting the change in the detection result. Depending on generated positions of the periodic unevenness on the fiber bundle, the periodic unevenness may be generated by a plurality of overlapped factors. In such a case, by changing the draft ratio and inspecting the change in the detection result, a range (a position) where the generation cause of the periodic unevenness may exist can be limited. As a result, trouble in specifying the generation cause of the periodic unevenness can be reduced.

[0008] The periodic unevenness inspecting section includes a specifying section adapted to specify the generation cause of the periodic unevenness from the inspection result of the periodic unevenness inspecting section. The draft control section changes the draft ratio by changing the peripheral speed of a reference draft roller, which is at least one of the draft rollers, and maintaining the peripheral speed of the draft rollers other than the reference draft roller. The specifying section can specify the generation cause of the periodic unevenness in accordance with the detection result of the periodic unevenness before and after the change of the draft ratio.

[0009] The draft control section changes the draft ratio by changing the peripheral speed of the draft roller located most downstream in the feeding direction as the reference draft roller and maintaining the peripheral speed of the draft rollers other than the reference draft roller. When the change in the detection result of the periodic unevenness before and after the change of the draft ratio is a prescribed level or within the prescribed level, the specifying section can specify that the generation cause of the periodic unevenness is located at the reference draft roller or downstream of the reference draft roller. In this case, as the generation cause located at the reference draft roller or downstream of the reference draft roller, there may be a front roller that is the most downstream draft roller, a nip roller, a delivery roller, and a slack eliminating roller.

[0010] The draft control section changes the draft ratio by changing the peripheral speed of the reference draft roller, which is a draft roller other than the most down-

stream draft roller and the most upstream draft roller in the feeding direction, and maintaining the peripheral speed of the draft rollers other than the reference draft roller. When the change in the detection result of the periodic unevenness before and after the change of the draft ratio is greater than a prescribed level, the specifying section can specify that the generation cause of the periodic unevenness is located at the reference draft roller or an element related to the reference draft roller. An example of the element related to the reference draft roller is an apron belt wound around the draft roller.

[0011] The draft control section changes the draft ratio by changing the peripheral speed of the draft roller located most upstream in the feeding direction as the reference draft roller and maintaining the peripheral speed of the draft rollers other than the reference draft roller. When the change in the detection result of the periodic unevenness before and after the change of the draft ratio is greater than a prescribed level, the specifying section can specify that the generation cause of the periodic unevenness is located at the reference draft roller or upstream of the reference draft roller.

[0012] The textile machinery may further include a notifying section adapted to notify information relating to the generation cause. Since an operator can easily check the generation cause of the periodic unevenness in accordance with the information notified by the notifying section, an appropriate countermeasure can be promptly taken. An example of the notifying section may be a display section, a voice output section, or the like. When the notifying section is the display section, the operator can easily check the generation cause of the periodic unevenness by seeing the display section of the spinning machine.

[0013] The textile machinery may include an input section for selecting an inspection mode in which inspection by the periodic unevenness inspecting section is executed, and the periodic unevenness inspecting section may start the inspection in accordance with a signal from the input section. When an input operation by the operator is detected by the input section, the inspection mode can be executed. The operator can easily switch to the inspection mode by performing the input operation as required.

[0014] The textile machinery further includes a spinning section adapted to spin by airflow, the fiber bundle drafted by the draft device to produce a spun yarn. The detecting section may be a clearer arranged downstream of the spinning section in the feeding direction of the fiber bundle and adapted to detect the periodic unevenness of the spun yarn. The periodic unevenness is detected using the clearer that is typically provided in the spinning machine, and the periodic unevenness inspecting section can execute inspection on the periodic unevenness in accordance with the detection. Since the detecting section for detecting the periodic unevenness is not required to be newly arranged, a configuration can be simple.

[0015] A periodic unevenness detecting method in a textile machinery according to the present invention is a method for detecting a periodic unevenness that generates in the textile machinery including a draft device adapted to draft a fiber bundle. The draft device has a plurality of pairs of draft rollers arranged along a feeding direction of the fiber bundle and is adapted to draft the fiber bundle using the draft rollers. The periodic unevenness detecting method includes a draft control step of controlling a draft ratio in the draft device by changing a peripheral speed of the draft roller, a detecting step of detecting the periodic unevenness generated in the drafted fiber bundle, and a periodic unevenness inspecting step of acquiring a detection result of the periodic unevenness under a plurality of different draft ratios and inspecting a change in the detection result.

[0016] Since a generation period of the periodic unevenness in the fiber bundle varies according to a change of the draft ratio, a generation cause of the periodic unevenness can be accurately specified by detecting the periodic unevenness under the plurality of different draft ratios and inspecting the change in the detection result. Depending on generated positions of the periodic unevenness on the fiber bundle, the periodic unevenness may be generated by a plurality of overlapped causes. In such a case, by changing the draft ratio and inspecting the change in the detection result, a range (a position) where the generation cause of the periodic unevenness may exist can be limited. As a result, trouble in specifying the generation cause of the periodic unevenness can be reduced.

[0017] The periodic unevenness inspecting step includes a specifying step of specifying the generation cause of the periodic unevenness from the inspection result of the periodic unevenness inspecting step. In the draft control step, control of changing the draft ratio is performed by changing the peripheral speed of a reference draft roller, which is at least one of the draft rollers, and maintaining the peripheral speed of the draft rollers other than the reference draft roller. In the specifying step, the generation cause of the periodic unevenness can be specified in accordance with the detection result of the periodic unevenness before and after the change of the draft ratio.

[0018] In the draft control step, control of changing the draft ratio is performed by changing the peripheral speed of the draft roller located most downstream in the feeding direction as the reference draft roller and maintaining the peripheral speed of the draft rollers other than the reference draft roller. In the specifying step, when the change in the detection result of the periodic unevenness before and after the change of the draft ratio is a prescribed level or within the prescribed level, the generation cause of the periodic unevenness can be specified to be located at the reference draft roller or downstream of the reference draft roller.

[0019] In the draft control step, the draft ratio is changed by changing the peripheral speed of the reference draft roller, which is the draft roller other than the

most downstream draft roller and the most upstream draft roller in the feeding direction, and maintaining the peripheral speed of the draft rollers other than the reference draft roller. In the specifying step, when the change in the detection result of the periodic unevenness before and after the change of the draft ratio is greater than a prescribed level, the generation cause of the periodic unevenness can be specified to be located at the reference draft roller or an element related to the reference draft roller.

[0020] In the draft control step, the draft ratio is changed by changing the peripheral speed of the draft roller located most upstream in the feeding direction as the reference draft roller and maintaining the peripheral speed of the draft rollers other than the reference draft roller. In the specifying step, when the change in the detection result of the periodic unevenness before and after the change of the draft ratio is greater than a prescribed level, the generation cause of the periodic unevenness can be specified to be located at the reference draft roller or upstream of the reference draft roller.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a front view of a spinning machine relating to one embodiment of the present invention.

FIG. 2 is a vertical sectional view of the spinning machine illustrated in FIG. 1.

FIG. 3 is a block diagram illustrating a unit controller of a spinning unit relating to the embodiment of the present invention.

FIG. 4 is a schematic view illustrating an arrangement of draft rollers.

FIG. 5 is a flowchart illustrating processing procedure executed in a periodic unevenness automatic inspection mode.

FIG. 6 is a table indicating whether or not there is a change in a periodic unevenness generation frequency.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0022] Next, a spinning machine (a textile machinery) according to one embodiment of the present invention will be described with reference to the drawings. "Upstream" and "downstream" in the present specification respectively indicate upstream and downstream in a travelling direction of a yarn at the time of spinning.

[0023] A spinning machine 1 illustrated in FIG. 1 and FIG. 2 includes a plurality of spinning units 2 arranged next to each other. The spinning machine 1 includes a yarn joining cart 3 arranged so as to freely travel along a direction in which the spinning units 2 are arranged next to each other, a motor box 5, a central control section, which is not illustrated, adapted to control the spinning machine 1, and a unit controller 60 adapted to control the spinning unit 2 (refer to FIG. 3).

[0024] The central control section is arranged in the motor box 5, for example. The central control section is electrically connected to a plurality of the unit controllers 60 and adapted to control the plurality of the unit controllers 60 in an integrated manner. The unit controller 60 is arranged in each of the spinning units 2 and adapted to individually control each of the spinning units 2 (its details will be described later).

[0025] Each of the spinning units 2 (the spinning machine) includes a draft device 7, a spinning section 9 (an air-jet spinning device), a yarn clearer 52, a yarn slack eliminating device 12 (a yarn accumulating device), and a winding device 13 in this order from upstream towards downstream. In the spinning unit 2, the draft device 7 is arranged in proximity to an upper end of a housing 6 of the spinning machine 1. A fiber bundle 8 fed from the draft device 7 is introduced to the spinning section 9 and spun. After passing through the yarn clearer 52, a spun yarn 10 that has been spun in the spinning section 9 is fed by the yarn slack eliminating device 12 and wound by the winding device 13, and thereby a package 45 is formed.

[0026] The draft device 7 drafts the fiber bundle 8. The draft device 7 has a plurality of pairs of draft rollers 16, 17, 19, and 20 arranged along a feeding direction (a transporting direction) of the fiber bundle 8, and drafts the fiber bundle 8 using the draft rollers 16, 17, 19, and 20. The draft device 7 includes, as illustrated in FIG. 2, a back roller 16, a third roller 17, a second roller 19 around which an apron belt 18 is wound, and a front roller 20 as the plurality of draft rollers 16, 17, 19, and 20. The draft rollers 16, 17, 19, and 20 respectively have a pair of a top roller and a bottom roller. The top roller and the bottom roller are arranged so as to sandwich the fiber bundle 8 therebetween. In the present specification, where the back roller 16, the third roller 17, the second roller 19 and the front roller 20 are not differentiated from each other, the back roller 16, the third roller 17, the second roller 19, and the front roller 20 may be described as the draft rollers 16, 17, 19, and 20.

[0027] The draft device 7 includes motors 31 to 34 to drive the bottom rollers of the plurality of the draft rollers 16, 17, 19, and 20. The motor 31 rotates the back roller 16. The motor 32 rotates the third roller 17. The motor 33 rotates the second roller 19. The motor 34 rotates the front roller 20. In the present embodiment, one motor rotates one draft roller, but one motor may rotate a plurality of draft rollers. For example, one motor may rotate both the back roller 16 and the third roller 17, which are draft rollers located at a low speed side.

[0028] The top rollers of the plurality of the draft rollers 16, 17, 19, and 20 are arranged to be rotated by the bottom rollers that is rotated by the motors 31 to 34.

[0029] The spinning unit 2 includes a motor control section 30 adapted to control rotation of each of the motors 31 to 34. The motor control section 30 is electrically con-

nected to each of the motors 31 to 34. The motor control section 30 can detect a load torque that is applied to each of the motors 31 to 34. The motor control section 30 can detect a rotation speed of an output shaft of each of the motors 31 to 34. The motor control section 30 is merely required to be capable of detecting at least either of the torque or the rotation speed.

[0030] Although a detailed configuration of the spinning section 9 is not illustrated, in the present embodiment, an air-jet type is employed, in which twists are added to the fiber bundle 8 using whirling airflow to produce the spun yarn 10.

[0031] The yarn slack eliminating device 12 draws the spun yarn 10 from the spinning section 9 by adding a prescribed tension to the spun yarn 10. The yarn slack eliminating device 12 prevents the spun yarn 10 from slackening by accumulating the spun yarn 10 that is fed from the spinning section 9 at the time of yarn joining by the yarn joining cart 3, or the like. Furthermore, the yarn slack eliminating device 12 adjusts the tension such that a variation in the tension of the spun yarn 10 in the winding device 13 is not propagated to the spinning section 9.

[0032] The yarn slack eliminating device 12 includes a slack eliminating roller (a yarn accumulating roller) 21, a yarn hooking member 22, an upstream guide 23, an electric motor 25, a downstream guide 26, and a yarn accumulation amount sensor 27.

[0033] The yarn hooking member 22 is configured capable of engaging with the spun yarn 10, and adapted, by integrally rotating with the slack eliminating roller 21 while being engaged with the spun yarn 10, to wind the spun yarn 10 around an outer periphery of the relevant slack eliminating roller 21.

[0034] The slack eliminating roller 21 accumulates the spun yarn 10 by winding a prescribed amount of the spun yarn 10 around the outer periphery thereof. The slack eliminating roller 21 is rotated by the electric motor 25. The spun yarn 10 that has been wound around the outer periphery of the slack eliminating roller 21, is wound by the rotating slack eliminating roller 21, tightening the relevant slack eliminating roller 21, and pulls the spun yarn 10 upstream of the yarn slack eliminating device 12. That is, since the slack eliminating roller 21 with the spun yarn 10 wound around the outer periphery thereof is rotated at a prescribed rotation speed, the yarn slack eliminating device 12 can draw the spun yarn 10 from the spinning section 9 at a prescribed speed while applying the prescribed tension, and transport the spun yarn 10 to downstream at a prescribed speed.

[0035] By winding the prescribed amount of the spun yarn 10 around the outer periphery of the slack eliminating roller 21, a prescribed contact area can be secured between the slack eliminating roller 21 and the spun yarn 10. Accordingly, the slack eliminating roller 21 becomes capable of pulling the spun yarn 10 while maintaining the spun yarn 10 with sufficient force. As a result, the yarn slack eliminating device 12 can draw the spun yarn 10 from the spinning section 9 at a stable speed without generating a slip and the like.

[0036] The yarn accumulation amount sensor 27 detects in a non-contact manner an accumulation amount of the spun yarn 10 that is accumulated on the slack eliminating roller 21, and transmits the accumulation amount of the spun yarn 10 to the unit controller 60.

[0037] The upstream guide 23 is arranged slightly upstream of the slack eliminating roller 21. The upstream guide 23 appropriately guides the spun yarn 10 with regard to the outer periphery of the slack eliminating roller 21. The upstream guide 23 prevents twists of the spun yarn 10 that is propagated from the spinning section 9 from being propagated to downstream of the relevant upstream guide 23.

[0038] The yarn clearer 52 is arranged at a position on a front surface of the housing 6 of the spinning machine 1 and between the spinning section 9 and the yarn slack eliminating device 12. The "front surface of the housing 6" indicates a surface of a side where a yarn path is formed. The spun yarn 10 spun from the spinning section 9 passes through the yarn clearer 52 before being wound by the yarn slack eliminating device 12. The yarn clearer 52 monitors a thickness of the travelling spun yarn 10 and transmits a yarn defect detection signal to the unit controller 60 when detecting a yarn defect of the spun yarn 10. The yarn clearer 52 is arranged downstream of the draft device 7 and adapted to detect a thickness unevenness (hereinafter simply referred to as an "unevenness") and/or a periodic thickness unevenness (hereinafter simply referred to as a "periodic unevenness") of the fiber bundle 8 drafted by the draft device 7. The yarn clearer 52 transmits a detection result to a periodic unevenness inspecting section 61 that will be described later.

[0039] When the yarn defect is detected, the unit controller 60 stops the draft device 7, the spinning section 9, or the like at a prescribed timing. At this time, the unit controller 60 cuts the spun yarn 10 by stopping injection of compressed air from a nozzle of the spinning section 9 that generates whirling airflow.

[0040] The unit controller 60 transmits a control signal to the yarn joining cart 3, and the yarn joining cart 3 travels to a front of the relevant spinning unit 2. Then, the unit controller 60 drives the spinning section 9 or the like again to cause the yarn joining cart 3 to perform the yarn joining, and the winding device 13 to resume winding the package 45. Between when the spinning section 9 resumes spinning and when winding is resumed, the yarn slack eliminating device 12 eliminates the slackening of the spun yarn 10 that is continuously fed from the spinning section 9 by accumulating the spun yarn 10 around the slack eliminating roller 21.

[0041] The yarn joining cart 3 includes a splicer (a yarn joining device) 43, a suction pipe 44, and a suction mouth 46. When a yarn breakage or a yarn cut occurs in a spinning unit 2, the yarn joining cart 3 travels on a rail 41 to the relevant spinning unit 2 and stops. While swinging vertically around an axis, the suction pipe 44 sucks and catches a yarn end fed from the spinning section 9, and

guides the yarn end to the splicer 43. While swinging vertically around an axis, the suction mouth 46 sucks and catches a yarn end from the package 45 supported by the winding device 13, and guides the yarn end to the splicer 43. The splicer 43 joins the guided yarn ends.

[0042] The winding device 13 includes a cradle arm 71 swingably supported around a support shaft 70. The cradle arm 71 rotatably supports a bobbin 48 around which the spun yarn 10 is wound.

[0043] The winding device 13 includes a winding drum 72 and a traverse device 75. The winding drum 72 is driven while being in contact with an outer peripheral surface of the bobbin 48 or an outer peripheral surface of the package 45 that is formed by winding the spun yarn 10 around the bobbin 48. The traverse device 75 includes a traverse guide 76 that is capable of engaging with the spun yarn 10. By driving the winding drum 72 using an electric motor (not illustrated) while causing the traverse guide 76 to reciprocate by a drive means (not illustrated), the winding device 13 rotates the package 45 being in contact with the winding drum 72 and winds the spun yarn 10 while traversing the spun yarn 10. In FIG. 1, the winding device 13 is illustrated to wind the cheese-shaped package 45. However, the winding device 13 may be configured to wind a cone-shaped package.

[0044] The unit controller 60 can detect an periodic abnormality in the draft rollers 16, 17, 19, and 20. As illustrated in FIG. 3, the unit controller (a control section) 60 is configured of a Central Processing Unit (CPU) for performing arithmetic processing, a Read Only Memory (ROM) and a Random Access Memory (RAM) for functioning as a storage section, an input signal circuit, an output signal circuit, a power circuit, or the like. In the unit controller 60, by performing a program stored in the storage section, the periodic unevenness inspecting section 61 (a specifying section), a spinning condition setting section 62, and a draft control section 63 are established.

[0045] The periodic unevenness inspecting section 61 is electrically connected to the yarn clearer 52 and acquires information relating to the periodic unevenness output from the yarn clearer 52. When executing a periodic unevenness automatic inspection mode that will be described later, the periodic unevenness inspecting section 61 acquires the information output from the yarn clearer 52 and transmits a control signal to the draft control section 63 so as to automatically change a draft ratio. When manually inspecting a generation cause of the periodic unevenness, the periodic unevenness inspecting section 61 displays the information acquired from the yarn clearer 52 in a display section 66 that will be described later. An operator checks displayed contents of the display section 66 and determines whether or not to inspect the generation cause of the periodic unevenness. When inspecting the generation cause of the periodic unevenness, the operator inputs an instruction for inspecting from the display section 66, and a command for executing the inspection mode is transmitted from the display section 66 to the periodic unevenness inspecting section 61. The periodic unevenness inspecting section 61, in accordance with the command received from the display section 66, transmits the control signal to the control section 63 so as to automatically change the draft ratio.

[0046] The spinning condition setting section 62 sets a spinning condition required for controlling the draft ratio. The spinning condition is set in accordance with a condition on the fiber bundle 15 before being introduced to the draft device 7. The condition on the fiber bundle 15 before being introduced to the draft device 7 may be, for example, a grain (Gr/yd) of the fiber bundle 8, a material type of the fiber bundle 8, or the like. Another spinning condition, may be, for example, a spinning speed, a yarn count of the spun yarn 10 to be produced, draft ratio (TDR, BDR, IDR and/or MDR), or the like.

[0047] The draft control section 63 controls the draft ratio in accordance with a command signal from the periodic unevenness inspecting section 61 and/or the spinning condition setting section 62. The draft control section 63 outputs the command signal to the motor control section 30.

[0048] FIG. 4 is a schematic view illustrating an arrangement of the draft rollers, and is a view for describing a draft ratio. The draft ratio is a ratio of the amount of fibers or the number of fibers of a fiber bundle before and after the fiber bundle is processed by the draft rollers. By changing the peripheral speed of the draft roller, the draft ratio can be changed.

[0049] Examples of the draft ratio are the TDR (Total Draft Ratio), the BDR (Brake Draft Ratio), the IDR (Intermediate Draft Ratio), and the MDR (Main Draft Ratio).

[0050] The TDR can be described by the following equation (1).

$$TDR=BDR\times IDR\times MDR \quad \ldots(1)$$

The TDR is a ratio of the amount of fibers or the number of fibers of the fiber bundle 8 after having been processed by the front roller 20 with respect to the amount of fibers or the number of fibers of the fiber bundle 8 before being introduced to the back roller 16. By changing a peripheral speed of at least one of the plurality of the draft rollers 16, 17, 19, and 20, the TDR can be changed.

[0051] The BDR is a ratio of the amount of fibers or the number of fibers of the fiber bundle 8 after having been processed by the third roller 17 with respect to the amount of fibers or the number of the fibers of the fiber bundle 8 before being introduced to the back roller 16. By changing a peripheral speed of at least one of the plurality of the draft rollers 16 and 17, the BDR can be changed.

[0052] The IDR is a ratio of the amount of fibers or the number of fibers of the fiber bundle 8 after having been processed by the second roller 19 with respect to the amount of fibers or the number of fibers of the fiber bundle 8 before being introduced to the third roller 17. By chang-

ing a peripheral speed of at least one of the plurality of the draft rollers 17 and 19, the IDR can be changed.

[0053] The MDR is a ratio of the amount of fibers or the number of fibers of the fiber bundle 8 after having been processed by the front roller 20 with respect to the amount of fibers or the number of fibers of the fiber bundle 8 before being introduced to the second roller 19. By changing a peripheral speed of at least one of the plurality of the draft rollers 19 and 20, the MDR can be changed.

[0054] The spinning machine 1 includes the display section (a notifying section) 66 for displaying an inspection result of the periodic unevenness inspecting section 61. The display section 66 is arranged in a housing of the motor box 5 of the spinning machine 1, for example. For example, the display section 66 may be a liquid crystal display. The display section 66 is electrically connected to the unit controller 60 and is capable of displaying information relating to the generation cause of the periodic unevenness in accordance with a signal from the unit controller 60. The operator can easily check the information relating to the generation cause of the periodic unevenness by seeing the displayed contents of the display section 66. The display section 66 can also display other information in addition to the information relating to the generation cause of the periodic unevenness.

[0055] Instead of or in addition to the display section 66, a voice output section may be arranged in the spinning machine 1. Accordingly, the spinning machine 1 can notify using voice and/or warning sound whether or not there is an abnormality. As the display section 66, a warning light also may be used.

[0056] The spinning machine 1 may include an operation button (an input section), which is not illustrated, for selecting the inspection mode to execute the inspection by the periodic unevenness inspecting section 61. The periodic unevenness inspecting section 61 starts to inspect the generation cause of the periodic unevenness in accordance with a signal from the operation button. The draft control section 63 changes the draft ratio by changing the peripheral speed of a reference draft roller (16, 17, 19, or 20). The input section is not limited to the operation button, but a liquid crystal display to which input is possible by touching, may be used.

[0057] For example, the unit controller 60 may display in the display section 66 information for guiding operation related to the inspection mode. In accordance with the information displayed in the display section 66, the operator can enter inputs from the input section, and select the inspection mode.

[0058] Next, a periodic unevenness detection processing will be described with reference to FIG. 5.

[0059] The periodic unevenness inspecting section 61 of the unit controller 60 firstly determines whether or not a periodic unevenness has been detected (step S1). When detecting a yarn unevenness signal output from the yarn clearer 52, the periodic unevenness inspecting section 61 determines that a periodic unevenness has been detected (step S1: YES), and proceeds to step S2. When not detecting the yarn unevenness signal (step S1: NO), the periodic unevenness inspecting section 61 continues the processing in step S1.

[0060] In step S2, the unit controller 60, by changing the peripheral speed of the front roller 20, controls the draft ratio such that the TDR and the MDR are changed. At this time, the unit controller 60, by making constant the peripheral speed of the draft rollers (16, 17, and 19) other than the front roller 20, controls the draft ratio such that the IDR and the BDR are constant. The periodic unevenness inspecting section 61 transmits the command signal to the draft control section 63 to change the draft ratio.

[0061] Next, the periodic unevenness inspecting section 61 determines (inspects) whether or not detection period (cycle, frequency) of the periodic unevenness (a periodic unevenness length, a detection result) has changed (step S3). The periodic unevenness inspecting section 61 detects the yarn unevenness signal output from the yarn clearer 52 and determines whether or not the detection period has changed before and after the change of the draft ratio. When determining that the detection period of the periodic unevenness has not changed (step S3: NO), the periodic unevenness inspecting section 61 proceeds to step S4. When determining that the detection period of the periodic unevenness has changed (step S3: YES), the periodic unevenness inspecting section 61 proceeds to step S5. When the change in the detection period of the periodic unevenness before and after the change of the draft ratio is a prescribed level or within the prescribed level (when the change is smaller than a determination threshold value), the periodic unevenness inspecting section 61 determines that the detection period of the periodic unevenness has not changed.

[0062] In step S4, the periodic unevenness inspecting section 61 specifies that the generation cause of the periodic unevenness is related to the front controller 20 or is located downstream of the front roller 20. Examples of the generation cause located downstream of the front roller 20 may be an abnormality (e.g., a scratch, vibration) in a delivery roller that is not illustrated, an abnormality (e.g., a scratch, vibration) in the yarn accumulating roller 21, or the like. "The abnormality in the delivery roller" can be inspected when the yarn clearer 52 is arranged downstream of the delivery roller. "The abnormality in the yarn accumulating roller 21" can be inspected when the yarn clearer 52 is arranged downstream of the yarn accumulating roller 21. In the present embodiment, the spun yarn 10 is drawn from the spinning section 9 by the yarn accumulating roller 21. However, by arranging a delivery roller and a nip roller, which are publicly-known, between the spinning section 9 and the yarn accumulating roller 21, the spun yarn 10 may be drawn from the spinning section 9 by the delivery roller and the nip roller. After performing the processing in step S4, the unit controller 60 proceeds to step S12.

[0063] In step S5, the unit controller 60, by changing

the peripheral speed of the second roller 19, controls the draft ratio such that the MDR and the IDR are changed. At this time, the unit controller 60, by making constant the peripheral speed of the draft rollers (16, 17, and 20) other than the second roller 19, controls the draft ratio such that the TDR and the BDR are constant. The periodic unevenness inspecting section 61 transmits the command signal to the draft control section 63 to change the draft ratio.

[0064] Next, the periodic unevenness inspecting section 61 determines whether or not the detection period of the periodic unevenness (the periodic unevenness length) has changed (step S6). The periodic unevenness inspecting section 61 detects the yarn unevenness signal output from the yarn clearer 52 and determines whether or not the detection period has changed before and after the change of the draft ratio. When determining that the detection period of the periodic unevenness has changed (step S6: YES), the periodic unevenness inspecting section 61 proceeds to step S7. When determining that the detection period of the periodic unevenness has not changed (step S6: NO), the periodic unevenness inspecting section 61 proceeds to step S8. When the change in the detection period of the periodic unevenness before and after the change of the draft ratio is greater than a prescribed level (when the change is greater than a determination threshold value), the periodic unevenness inspecting section 61 determines that the detection period of the periodic unevenness has changed.

[0065] In step S7, the periodic unevenness inspecting section 61 specifies that the generation cause of the periodic unevenness is related to the second roller 19 (or the apron belt 18) (an element related to the reference draft roller). After performing the processing in step S7, the unit controller 60 proceeds to step S12.

[0066] In step S8, the unit controller 60, by changing the peripheral speed of the third roller 17, controls the draft ratio such that the IDR and the BDR are changed. At this time, the unit controller 60, by making constant the peripheral speed of the draft rollers (16, 19, and 20) other than the third roller 17, controls the draft ratio such that the MDR and the TDR are constant. The periodic unevenness inspecting section 61 transmits the command signal to the draft control section 63 to change the draft ratio.

[0067] Next, the periodic unevenness inspecting section 61 determines whether or not the detection period of the periodic unevenness (the periodic unevenness length) has changed (step S9). The periodic unevenness inspecting section 61 detects the yarn unevenness signal output from the yarn clearer 52 and determines whether or not the detection period has changed before and after the change of the draft ratio. When determining that the detection period of the periodic unevenness has changed (step S9: YES), the periodic unevenness inspecting section 61 proceeds to step S10. When determining that the detection period of the periodic unevenness has not changed (step S9: NO), the periodic unevenness inspecting section 61 proceeds to step S11.

[0068] In step S10, the periodic unevenness inspecting section 61 specifies that the generation cause of the periodic unevenness is related to the third roller 17. After performing the processing in step S11, the periodic unevenness inspecting section 61 proceeds to step S12.

[0069] In step S11, the periodic unevenness inspecting section 61 specifies that the generation cause of the periodic unevenness is related to the back roller 16 or the fiber bundle 8 before being inserted into the back roller 16 (a preceding process). After performing the processing in step S11, the unit controller 60 proceeds to step S12.

[0070] When further specifying that the generation cause of the periodic unevenness is located at the back roller 16, the operator sets in another draft device, the fiber bundle 8 that is currently being used. When the same fiber bundle 8 is drafted by the relevant another draft device and a similar periodic unevenness is not detected, the generation cause of the periodic unevenness can be specified to be located at the back roller 16 of the previous draft device 7.

[0071] When further specifying that the generation cause of the periodic unevenness is located in the preceding process, the operator sets in the draft device 7, another fiber bundle that is different from the fiber bundle 8 currently being used. When the relevant another fiber bundle is drafted by the draft device 7 and a similar periodic unevenness is not detected by the periodic unevenness inspecting section 61, the generation cause of the periodic unevenness can be specified to be located at the previous fiber bundle 8.

[0072] In step S12, the periodic unevenness inspecting section 61 displays the information relating to the generation cause of the periodic unevenness (the inspection result) in the display section 66. The display section 66 displays the information relating to a specification result of the generation cause of the periodic unevenness in accordance with the signal output from the unit controller 60. For example, the display unit 66 displays that the generation cause of the periodic unevenness that is being generated in the spun yarn 10 is located at the front roller 20. The display section 66 may display as character information the draft rollers 16, 17, 19, or 20 that is the generation cause of the periodic unevenness. For example, the display section 66 may display a layout drawing of the draft rollers 16, 17, 19, and 20 and highlight (e.g., display in red or by flashing) only a draft roller, which is the generation cause.

[0073] When the periodic abnormality is determined to exist in the draft rollers 16, 17, 19, or 20, the unit controller 60 may stop operation of the spinning unit 2 instead of or in addition to a result display in step S12. When the unit controller 60 stops the operation of the spinning unit 2, the unit controller 60 may cause the display section 66 to display that the draft ratio and/or a gauge distance (a distance between the draft rollers) is inappropriate and/or that the draft rollers 16, 17, 19, and/or 20 are re-

quired to be replaced. When the draft ratio and/or the gauge distance are inappropriate, the draft unevenness is generated.

[0074] In this manner, according to the spinning machine 1 of the present embodiment, when the periodic unevenness of the drafted fiber bundle 8 is detected, the draft ratio in the draft device 7 can be changed. Since a generated position (the generation period) of the periodic unevenness in the fiber bundle 8 varies according to the change of the draft ratio, the spinning machine 1, by detecting the periodic unevenness under a plurality of different draft ratios, can accurately specify the generation cause of the periodic unevenness in accordance with the detection result. Depending on the generated position of the periodic unevenness in the fiber bundle 8, the periodic unevenness may be generated by a plurality of overlapped causes. In such a case, by changing the draft ratio and inspecting the generation cause of the periodic unevenness, a range where the generation cause of the periodic unevenness may exist can be limited. As a result, trouble in specifying the generation cause of the periodic unevenness can be reduced.

[0075] In the spinning machine 1 of the present embodiment, since the generation cause of the periodic unevenness can be specified, an abnormal portion (the periodic unevenness) in the yarn 10 can be detected. The spinning machine 1 is also capable of compensating accuracy of detection by the yarn clearer 52. For example, even when the accuracy of the detection by the yarn clearer 52 is low, the periodic unevenness can be detected by executing the periodic unevenness automatic inspection mode.

[0076] When changing the draft ratio, the spinning machine 1 firstly changes the downstream draft ratio (the TDR and the MDR) by changing the peripheral speed of the front roller 20 (step S2). The spinning machine 1 can firstly specify the generation cause located at the front roller 20 or downstream of the front roller 20 by changing the TDR and the MDR. Since the periodic unevenness of which generation cause is located at the front roller 20 or downstream of the front roller 20 generates more frequently than the periodic unevenness of which generation cause is located in the preceding process or at the back roller 16, the generation cause is more likely to be immediately specified by changing the downstream draft ratio (the TDR and the MDR) first than by changing the upstream draft ratio (the BDR and the TDR) first.

[0077] Next, with reference to FIG. 6, a description will be made on how the changing of the peripheral speed of each one of the draft rollers 16, 17, 19, and 20 relates to specification of the generation cause of the periodic unevenness (whether or not there is a change in a frequency). A verification has been performed as to whether the generation cause of which periodic unevenness can be specified by changing the peripheral speed of which one of the draft rollers 16, 17, 19, and 20. In a table of FIG. 6, a left column indicates the peripheral speed of which one of the draft rollers 16, 17, 19, and 20 is changed, and an upper row indicates the generation causes of the periodic unevenness.

[0078] In FIG. 6, "Y" indicates that the frequency always changes. In FIG. 6, "N" indicates that the frequency does not change. The change in the frequency indicates that the change in the generation period of the periodic unevenness (the periodic unevenness length) before and after the change of the draft ratio is greater than a prescribed level. No change in the frequency indicates that the change in the generation period of the periodic unevenness is the prescribed level or within the prescribed level.

[0079] When changing the peripheral speed of the front roller 20 and making constant the peripheral speed of the draft rollers (16, 17, and 19) other than the front roller 20, the frequency always changes in a case where the generation cause of the periodic unevenness is located at the back roller 16 or upstream of the back roller 16 (in the precedent process or at the back roller 16), in a case where the generation cause of the periodic unevenness is located at the third roller 17, and in a case where the generation cause of the periodic unevenness is located at the second roller 19 (the apron belt 18). When changing the peripheral speed of the front roller 20 and making constant the peripheral speed of the draft rollers (16, 17, and 19) other than the front roller 20, the frequency does not change in a case where the generation cause of the periodic unevenness is located at the front roller 20 or downstream of the front roller 20.

[0080] When changing the peripheral speed of the second roller 19 and making constant the peripheral speed of the draft rollers (16, 17, and 20) other than the second roller 19, the frequency always changes in the case where the generation cause of the periodic unevenness is located at the second roller 19 (the apron belt 18). When changing the peripheral speed of the second roller 19 and making constant the peripheral speed of the draft rollers (16, 17, and 20) other than the second roller 19, the frequency does not change in the case where the generation cause of the periodic unevenness is located at the back roller 16 or upstream of the back roller 16 (in the precedent process or at the back roller 16), in the case where the generation cause of the periodic unevenness is located at the third roller 17, and in the case where the generation cause of the periodic unevenness is located at the front roller 20 or downstream of the front roller 20.

[0081] When changing the peripheral speed of the third roller 17 and making constant the peripheral speed of the draft rollers (16, 19, and 20) other than the third roller 17, the frequency always changes in the case where the generation cause of the periodic unevenness is located at the third roller 17. When changing the peripheral speed of the third roller 17 and making constant the peripheral speed of the draft rollers (16, 19, and 20) other than the third roller 17, the frequency does not change in the case where the generation cause of the periodic unevenness is located at the back roller 16 or upstream of the back

roller 16 (in the precedent process or at the back roller 16), in the case where the generation cause of the periodic unevenness is located at the second roller 19 (the apron belt 18), and in the case where the generation cause of the periodic unevenness is located at the front roller 20 or downstream of the front roller 20.

[0082] When changing the peripheral speed of the back roller 16 and making constant the peripheral speed of the draft rollers (17, 19, and 20) other than the back roller 16, the frequency always changes in the case where the generation cause of the periodic unevenness is located at the back roller 16 or upstream of the back roller 16 (in the precedent process or at the back roller 16). When changing the peripheral speed of the back roller 16 and making constant the peripheral speed of the draft rollers (17, 19, and 20) other than the back roller 16, the frequency does not change in the case where the generation cause of the periodic unevenness is located at the third roller 17, in the case where the generation cause of the periodic unevenness is located at the second roller 19 (the apron belt 18), and in the case where the generation cause of the periodic unevenness is located at the front roller 20 or downstream of the front roller 20.

[0083] The present invention is specifically described based on its embodiment as above, but the present invention is not limited to the above-described embodiment.

[0084] According to the above-described embodiment, the spinning machine 1 (an air-jet spinning machine) does not include a delivery roller and a nip roller, but the spinning machine of the present invention may be, without limited thereto, provided with the delivery roller and the nip roller. The delivery roller and the nip roller are, for example, arranged downstream of the spinning section 9. The spun yarn 10 spun from the spinning section 9 is sandwiched and transported between the delivery roller and the nip roller, and wound by the winding device 13.

[0085] The textile machinery is not limited to the air-jet spinning machine, but may be another textile machinery provided with the draft device. The textile machinery may be a ring spinning machine and a drawing frame.

[0086] In the above-described embodiment, when the yarn defect is detected, the spun yarn 10 is cut by stopping the injection of the compressed air from the whirling airflow generating nozzle of the spinning device 9. However, the spun yarn 10 may be cut by another method. For example, the spun yarn 10 can be cut using a cutter, which is not illustrated, arranged between the spinning section 9 and the yarn clearer 52.

[0087] In the spinning machine 1 according to the above-described embodiment, the yarn path is arranged downward from above in a direction of machine height. However, the yarn path may be arranged upward from below.

[0088] Although the spinning section 9 preferably has a configuration in which a needle (a needle-like member) is provided for preventing the interior twists from propagating to the front roller 20, the spinning section 9 may not be provided with the needle.

[0089] The air-jet spinning machine may be configured such that a bottom roller of the draft device and/or a traverse mechanism of the winding device are commonly driven in the plurality of spinning units 2 (line shaft). The air-jet spinning machine may have a configuration in which the draft device and/or the winding device are independently arranged in each winding unit.

[0090] The spinning machine 1 according to the above-described embodiment includes the unit controller 60 for individually controlling each of the spinning units 2. However, the unit controller 60 for controlling a prescribed number of the spinning units 2 may be arranged in every prescribed number of the spinning units 2.

[0091] The spinning machine 1 according to the above-described embodiment includes the plurality of the unit controllers 60 and each unit controller 60 controls each spinning unit 2. However, one unit controller 60 may control the plurality of the spinning units 2, or the central control section may collectively control all of the spinning units 2 provided in the spinning machine 1.

[0092] In the spinning machine 1 according to the above-described embodiment, when the yarn clearer 52 detects the periodic unevenness, the unit controller 60 executes the periodic unevenness automatic inspection mode (see FIG. 5) for automatically specifying the generation cause of the periodic unevenness. However, the inspection mode may be executed in accordance with an input operation by the operator. For example, in a flowchart illustrated in FIG. 5, step S1 may not be performed and when button operation (the input operation by the operator) is detected, the change of the draft ratio (the TDR and the MDR) may be started by changing the peripheral speed of the front roller 20 in step S2. Furthermore, the spinning machine may select the draft roller 16, 17, 19, or 20, of which the peripheral speed is to be changed, in accordance with the input operation by the operator.

[0093] For example, in the flowchart illustrated in FIG. 5, as the change of the peripheral speed of the draft rollers 16, 17, 19, and 20, the change of the peripheral speed of the front roller 20 (step S2), the second roller 19 (step S5), the third roller 17 (step S8), and the back roller 16 (step S11) can be performed. The change of the peripheral speed of the draft rollers 16, 17, 19, and 20 is not limited thereto. For example, the spinning machine may change the peripheral speed of the front roller 20 (step S2) as the change of the peripheral speed of the draft roller, and automatically specify only the generation cause that is located at the front roller 20 or downstream of the front roller 20.

[0094] In the flowchart illustrated in FIG. 5, the change of the peripheral speed of the front roller 20 (step S2), the second roller 19 (step S5), the third roller 17 (step S8), and the back roller 16 (step S11) can be performed in this order. The change of the peripheral speed of the draft rollers 16, 17, 19, and 20 is not limited thereto. For

example, the change of the peripheral speed of the back roller 16, the third roller 17, the second roller 19, and the front roller 20 may be performed in this order.

[0095] For example, a case where the change of the peripheral speed of the third roller 17 (step S8), the back roller 16 (step S11), the front roller 20 (step S2), and the second roller 19 (step S5) is performed in this order will be described. When determining that the periodic unevenness is detected in the processing of step S1, the unit controller 60 proceeds to step S8. In the following step S9, when determining that the detection period of the periodic unevenness has not changed, the unit controller 60 changes the peripheral speed of the back roller 16. Then, the unit controller 60 determines whether or not the detection period has been changed before and after the change of the peripheral speed of the back roller 16. At this point, when determining that the detection period has changed, the periodic unevenness inspecting section 61 proceeds to step S11 and determines that the generation cause of the periodic unevenness is related to the back roller 16. On the other hand, when determining that the detection period has not changed, the periodic unevenness inspecting section 61 proceeds to step S2 and changes the peripheral speed of the front roller 20. Then, the subsequent processing illustrated in FIG. 5 is executed.

[0096] As a first alternative embodiment, the spinning machine may have a configuration in which the nip roller and the delivery roller (the draft roller) are further provided downstream of the spinning section 9. In the case of the spinning machine having this configuration, the draft ratio between the nip roller downstream of the spinning section 9 and the back roller 16 arranged most upstream may be an overall draft ratio (TDR2), and the draft ratio between the nip roller and the front roller 20 may be MDR2. In such a case, the TDR2 and the MDR2 may be changed by changing the peripheral speed of the nip roller. In a case where there is no change in the periodic unevenness length when the TDR2 and the MDR2 are changed, the generation cause can be specified to be located at the nip roller or downstream of the nip roller.

[0097] As a second alternative embodiment, the draft ratio between the slack eliminating roller 21 (the yarn accumulating roller) of the yarn slack eliminating device 12 (the yarn accumulating device) and the back roller 16 arranged most upstream may be an overall draft ratio (TDR3), and the draft ratio between the slack eliminating roller 21 and the front roller 20 may be MDR3. In such a case, the TDR3 and the MDR3 may be changed by changing the peripheral speed of the slack eliminating roller 21. In a case where there is no change in the periodic unevenness length when the TDR3 and the MDR3 are changed, the generation cause can be specified to be located at the slack eliminating roller 21 or downstream of the slack eliminating roller 21.

[0098] In the above-described embodiments, the peripheral speed of the draft rollers 16, 17, 19, and 20 is changed by changing the output of the motor 31 to 34. The change of the peripheral speed, without limited thereto, may be performed by another method. The peripheral speed of the draft rollers 16, 17, 19, and 20 may be changed to change the draft ratio by changing a gear ratio, a transmission ratio, or the like of a transmission mechanism that transmits the output of the motor 31 to 34.

[0099] In the above-described embodiments, although the spinning machine includes four draft rollers 16, 17, 19, and 20, the number of the draft rollers is not limited to four, but for example, may be three, or five or more. Any number of the draft rollers between the most upstream draft roller 16 and the most downstream draft roller 20 may be arranged.

Claims

1. A textile machinery comprising:

   a draft device (7) including a plurality of pairs of draft rollers (16, 17, 19, 20) arranged along a feeding direction of a fiber bundle (8) and adapted to draft the fiber bundle (8) using the pairs of the draft rollers (16, 17, 19, 20);
   a draft control section (63) adapted to change a peripheral speed of at least one of the pairs of the draft rollers (16, 17, 19, 20) to control a draft ratio of the draft device (7);
   a detecting section (52) adapted to detect a periodic unevenness generated in the drafted fiber bundle (8); and
   a periodic unevenness inspecting section (61) adapted to transmit a signal to the draft control section (63) so as to draft by changing the draft ratio, to acquire a detection result of the periodic unevenness under a plurality of different draft ratios, and to inspect a change in the detection result.

2. The textile machinery according to claim 1, wherein the periodic unevenness inspecting section (61) includes a specifying section (61) adapted to specify a generation cause of the periodic unevenness from an inspection result of the periodic unevenness inspecting section (61);
   the draft control section (63) is adapted to change the draft ratio by changing the peripheral speed of a reference draft roller, which is at least one of the draft rollers (16, 17, 19, 20), and maintaining the peripheral speed of the draft rollers other than the reference draft roller; and
   the specifying section (61) is adapted to specify the generation cause of the periodic unevenness in accordance with the detection result of the periodic unevenness before and after the change of the draft ratio.

3. The textile machinery according to claim 2, wherein the draft control section (63) is adapted to change the draft ratio by changing the peripheral speed of the draft roller (20) located most downstream in the feeding direction as the reference draft roller and maintaining the peripheral speed of the draft rollers (16, 17, 19) other than the reference draft roller (20); and
when the change in the detection result of the periodic unevenness before and after the change of the draft ratio is a prescribed level or within the prescribed level, the specifying section (61) is adapted to specify that the generation cause of the periodic unevenness is located at the reference draft roller (20) or downstream of the reference draft roller (20).

4. The textile machinery according to claim 2, wherein the draft control section (63) is adapted to change the draft ratio by changing the peripheral speed of the reference draft roller (17, 19), which is a draft roller other than the most downstream draft roller (20) and the most upstream draft roller (16) in the feeding direction, and maintaining the peripheral speed of the draft roller (16, 20) other than the reference draft roller (17, 19); and
when the change in the detection result of the periodic unevenness before and after the change of the draft ratio is greater than a prescribed level, the specifying section (61) is adapted to specify that the generation cause of the periodic unevenness is located at the reference draft roller (17, 19) or an element (18) related to the reference draft roller (19).

5. The textile machinery according to claim 2, wherein the draft control section (63) is adapted to change the draft ratio by changing the peripheral speed of the draft roller (16) located most upstream in the feeding direction as the reference draft roller (16) and maintaining the peripheral speed of the draft rollers (17, 19, 20) other than the reference draft roller (16); and
when the change in the detection result of the periodic unevenness before and after the change of the draft ratio is greater than a prescribed level, the specifying section (61) is adapted to specify that the generation cause of the periodic unevenness is located at the reference draft roller (16) or upstream of the reference draft roller (16).

6. The textile machinery according to any one of claim 2 through claim 5, further comprising a notifying section (66) adapted to notify information relating to the generation cause.

7. The textile machinery according to any one of claim 1 through claim 6, further comprising an input section (66) adapted to select an inspection mode to execute the inspection by the periodic unevenness inspecting section (61);
wherein the periodic unevenness inspecting section (61) is adapted to start the inspection in accordance with a signal from the input section (66).

8. The textile machinery according to any one of claim 1 through claim 7, further comprising a spinning section (9) adapted to spin by airflow, the fiber bundle (8) drafted by the draft device (7), to produce a spun yarn (10);
wherein the detecting section (53) is a clearer arranged downstream of the spinning section (9) in the feeding direction of the fiber bundle (8) and adapted to detect the periodic unevenness of the spun yarn (10).

9. A periodic unevenness detecting method in a textile machinery for detecting a periodic unevenness that generates in the textile machinery comprising a draft device (7) adapted to draft a fiber bundle (8), the draft device (7) including a plurality of pairs of draft rollers (16, 17, 19, 20) arranged along a feeding direction of the fiber bundle (8) and adapted to draft the fiber bundle (8) using the pairs of the draft rollers (16, 17, 19, 20), the method comprising:

a draft control step of controlling a draft ratio of the draft device (7) by changing a peripheral speed of at least one of the pairs of the draft rollers (16, 17, 19, 20);
a detecting step of detecting a periodic unevenness generated in the drafted fiber bundle (8); and
a periodic unevenness inspecting step of acquiring a detection result of the periodic unevenness under a plurality of different draft ratios, and inspecting a change in the detection result.

10. The periodic unevenness detecting method in the textile machinery according to claim 9, wherein the periodic unevenness inspecting step includes a specifying step of specifying a generation cause of the periodic unevenness from an inspection result of the periodic unevenness inspecting step;
in the draft control step, control of changing the draft ratio is performed by changing the peripheral speed of a reference draft roller, which is at least one of the draft rollers (16, 17, 19, 20), and maintaining the peripheral speed of the draft rollers other than the reference draft roller; and
in the specifying step, the generation cause of the periodic unevenness is specified in accordance with the detection result of the periodic unevenness before and after the change of the draft ratio.

11. The periodic unevenness detecting method in the textile machinery according to claim 10, wherein in the draft control step, control of changing the draft

ratio is performed by changing the peripheral speed of the draft rollers (20) located most downstream in the feeding direction as the reference draft roller and maintaining the peripheral speed of the draft rollers (16, 17, 19) other than the reference draft roller (20); and

in the specifying step, when the change in the detection result of the periodic unevenness before and after the change of the draft ratio is a prescribed level or within the prescribed level, the generation cause of the periodic unevenness is specified to be located at the reference draft roller (20) or downstream of the reference draft roller (20).

12. The periodic unevenness detecting method in the textile machinery according to claim 10, wherein in the draft control step, the draft ratio is changed by changing the peripheral speed of the reference draft roller (17, 19), which is the draft roller other than the most downstream draft roller (20) and the most upstream draft roller (16) in the feeding direction, and maintaining the peripheral speed of the draft rollers (16, 20) other than the reference draft roller (17, 19); and

in the specifying step, when the change in the detection result of the periodic unevenness before and after the change of the draft ratio is greater than a prescribed level, the generation cause of the periodic unevenness is specified to be located at the reference draft roller (17, 19) or an element (18) related to the reference draft roller (19).

13. The periodic unevenness detecting method in the textile machinery according to claim 10, wherein in the draft control step, the draft ratio is changed by changing the peripheral speed of the draft roller (16) located most upstream in the feeding direction as the reference draft roller (16) and maintaining the peripheral speed of the draft rollers (17, 19, 20) other than the reference draft roller (16); and

in the specifying step, when the change in the detection result of the periodic unevenness before and after the change of the draft ratio is greater than a prescribed level, the generation cause of the periodic unevenness is specified to be located at the reference draft roller (16) or upstream of the reference draft roller (16).

FIG. 1

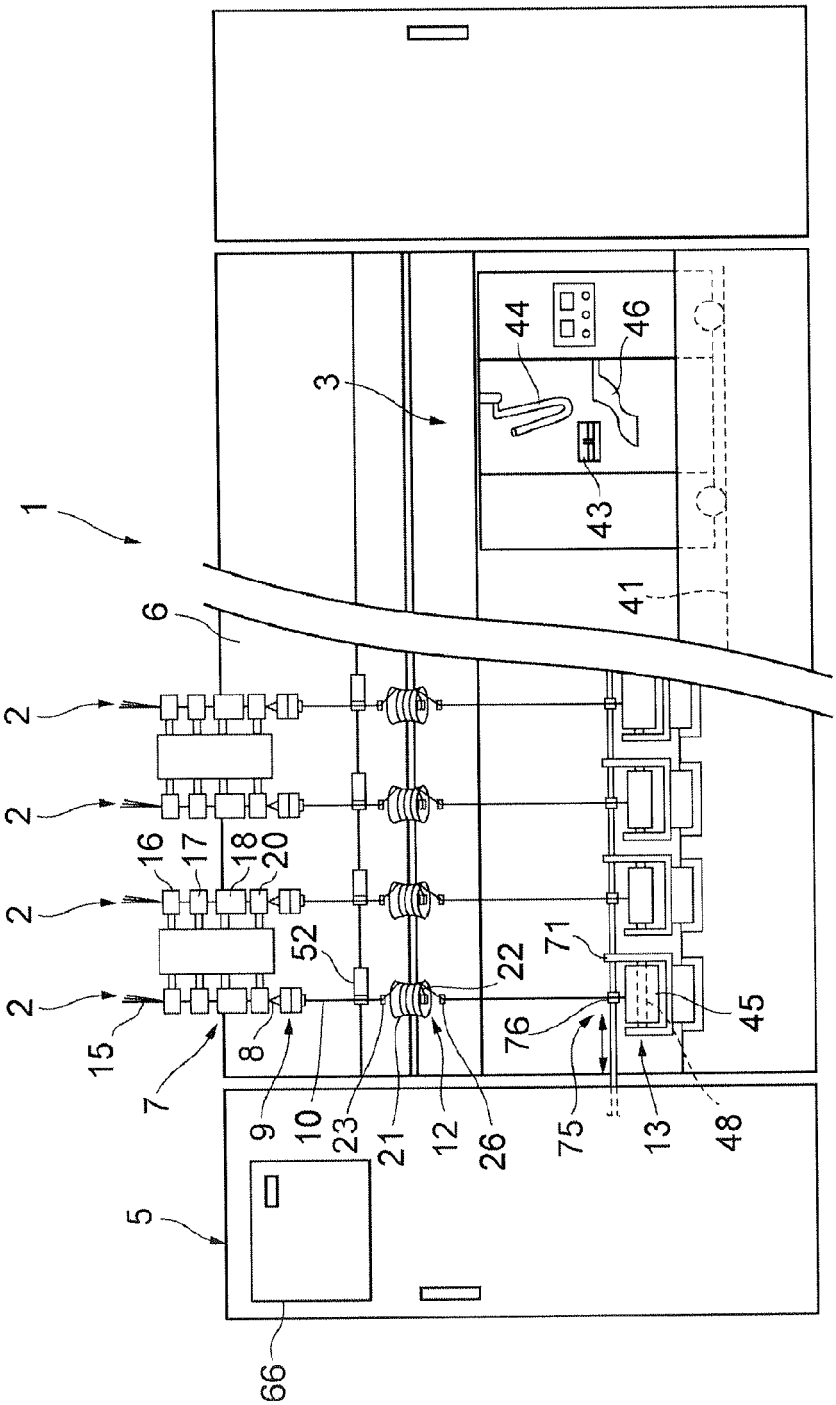

1
2
2
2
2
3
41
43
44
46
6
16
17
18
20
52
22
71
45
76
15
7
8
9
10
23
21
12
26
75
13
48
5
66

FIG. 2

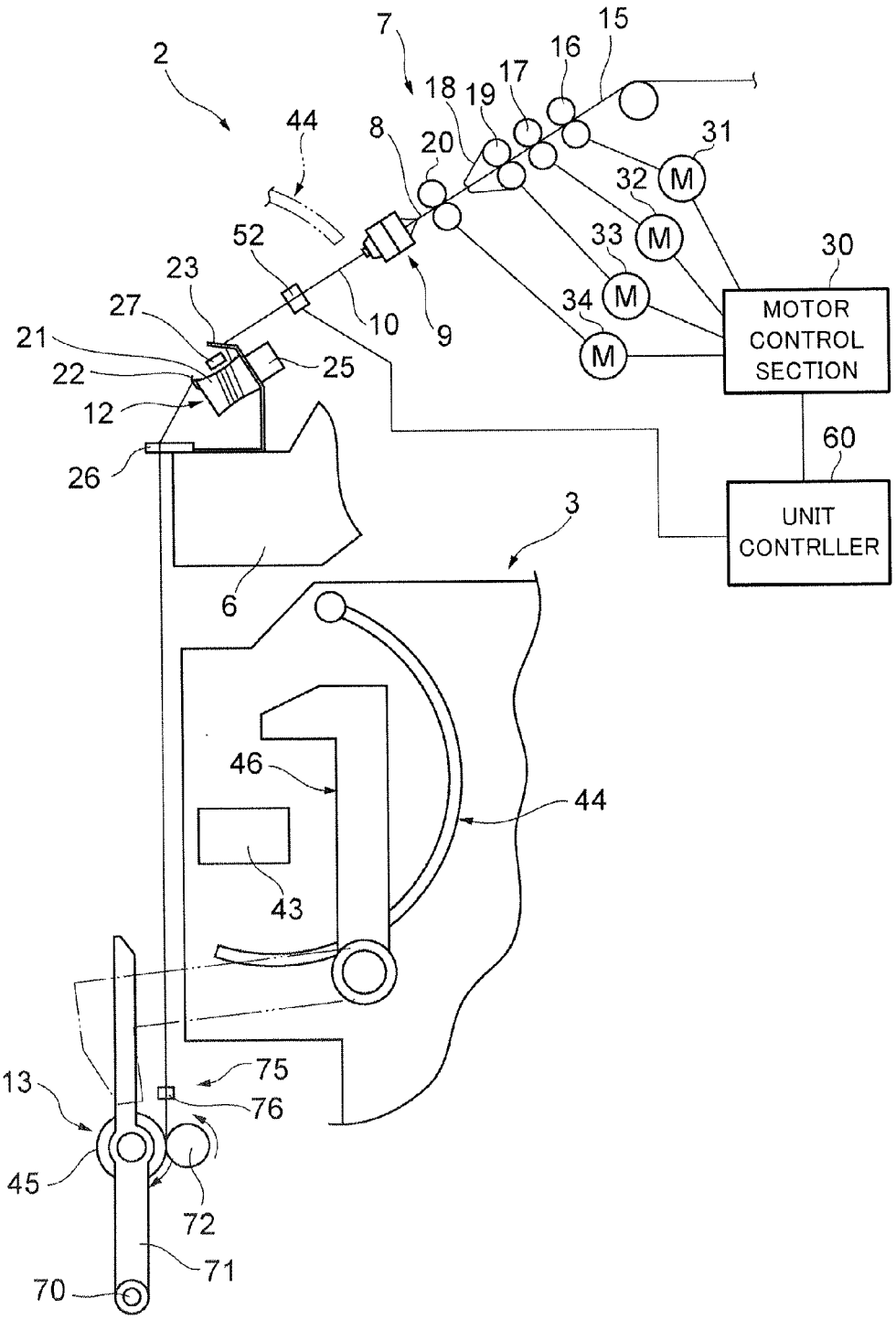

2
7
15
16
17
18
19
44
8
20
31
32
M
52
33
M
30
23
27
34
M
MOTOR
CONTROL
SECTION
21
10
9
22
25
12
60
26
UNIT
CONTRLLER
3
6
46
44
43
13
75
76
45
72
71
70

FIG. 3

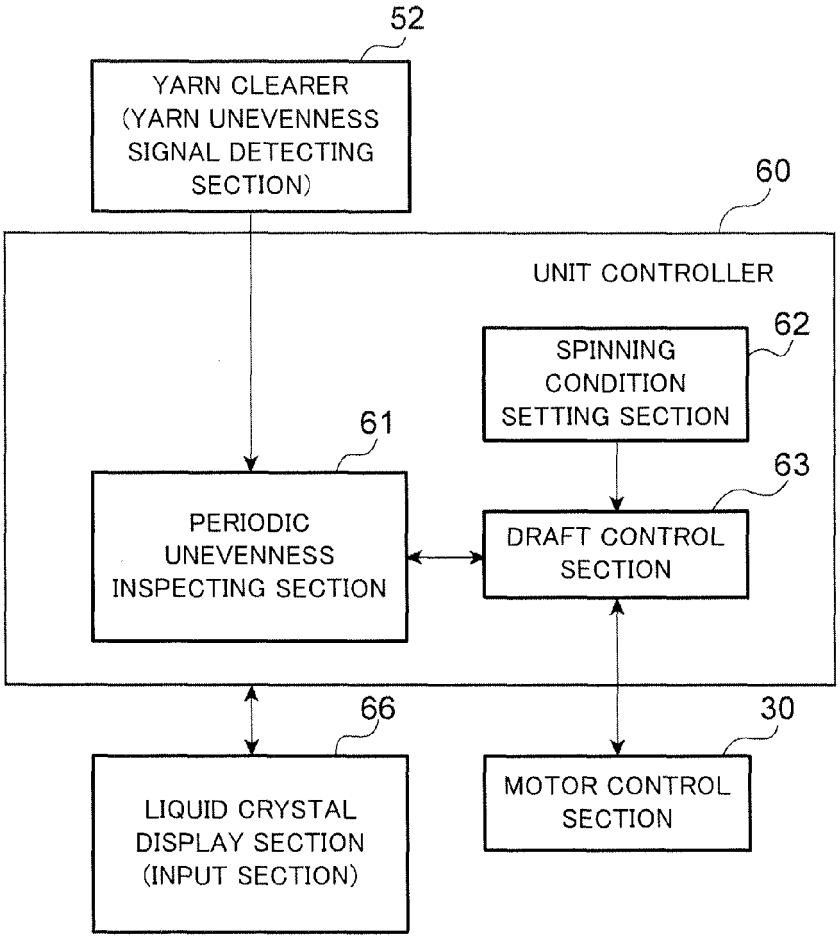

52
YARN CLEARER (YARN UNEVENNESS SIGNAL DETECTING SECTION)
60
UNIT CONTROLLER
62
SPINNING CONDITION SETTING SECTION
61
63
PERIODIC UNEVENNESS INSPECTING SECTION
DRAFT CONTROL SECTION
66
30
LIQUID CRYSTAL DISPLAY SECTION (INPUT SECTION)
MOTOR CONTROL SECTION

FIG. 4

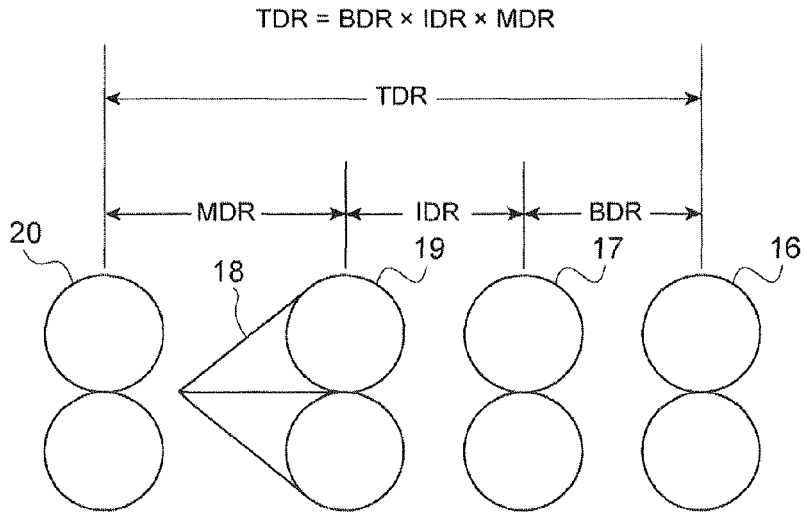

TDR = BDR × IDR × MDR
TDR
MDR
IDR
BDR
20
18
19
17
16

FIG. 5

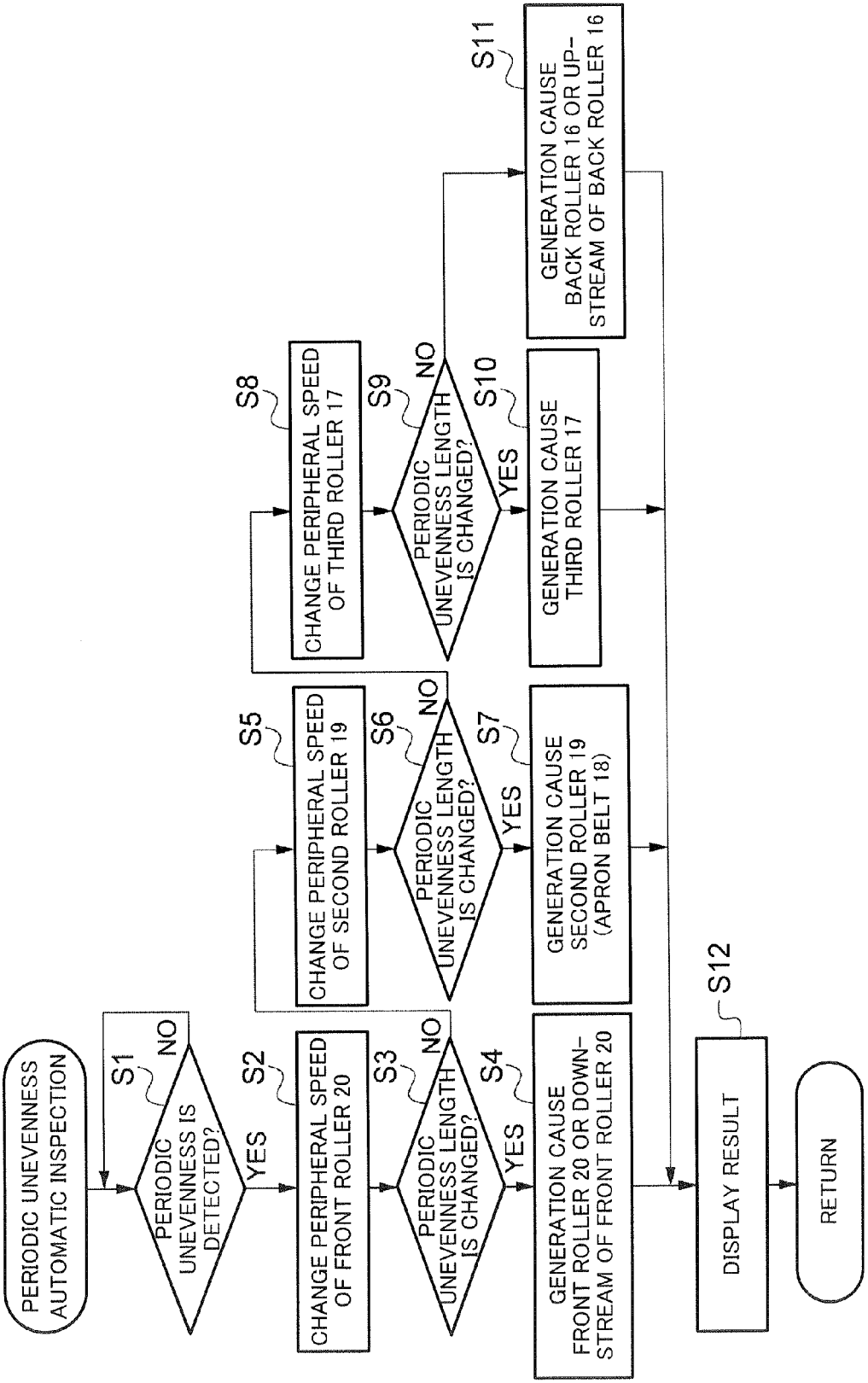

PERIODIC UNEVENNESS AUTOMATIC INSPECTION
S1
PERIODIC UNEVENNESS IS DETECTED?
NO
YES
S2
CHANGE PERIPHERAL SPEED OF FRONT ROLLER 20
S3
PERIODIC UNEVENNESS LENGTH IS CHANGED?
NO
YES
S4
GENERATION CAUSE FRONT ROLLER 20 OR DOWN-STREAM OF FRONT ROLLER 20
S5
CHANGE PERIPHERAL SPEED OF SECOND ROLLER 19
S6
PERIODIC UNEVENNESS LENGTH IS CHANGED?
NO
YES
S7
GENERATION CAUSE SECOND ROLLER 19 (APRON BELT 18)
S8
CHANGE PERIPHERAL SPEED OF THIRD ROLLER 17
S9
PERIODIC UNEVENNESS LENGTH IS CHANGED?
NO
YES
S10
GENERATION CAUSE THIRD ROLLER 17
S11
GENERATION CAUSE BACK ROLLER 16 OR UP-STREAM OF BACK ROLLER 16
S12
DISPLAY RESULT
RETURN

FIG. 6

PERIPHERAL SPEED OF WHICH ROLLER IS CHANGED	GENERATION CAUSE OF PERIODIC UNEVENNESS (WHETHER OR NOT THERE IS CHANGE IN FREQUENCY)			
	FRONT ROLLER 20 OR DOWNSTREAM OF FRONT ROLLER 20	SECOND ROLLER 19 (APRON BELT 18)	THIRD ROLLER 17	BACK ROLLER 16 OR UPSTREAM OF BACK ROLLER 16
FRONT ROLLER 20	N	Y	Y	Y
SECOND ROLLER 19	N	Y	N	N
THIRD ROLLER 17	N	N	Y	N
BACK ROLLER 16	N	N	N	Y

Y : THERE IS CHANGE IN FREQUENCY
N : THERE IS NO CHANGE IN FREQUENCY

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EUROPEAN SEARCH REPORT

Application Number
EP 13 17 3783

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 10 2005 019760 A1 (RIETER INGOLSTADT SPINNEREI [DE]) 22 December 2005 (2005-12-22) * the whole document *	1-7,9-13	INV. D01H5/32 D01H13/22
A	US 4 491 831 A (SAKAI SHOJO [JP] ET AL) 1 January 1985 (1985-01-01) * column 1, line 25 - line 32 * * column 4, line 17 - line 55; figure 5 *	1,9	
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D01H
G05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 December 2013	Pollet, Didier

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 17 3783

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REFERENCES CITED IN THE DESCRIPTION

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