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(54) **FIBER BUNDLE CONDENSING DEVICE OF SPINNING MACHINE**

(57) A fiber bundle condensing device (10) of a spinning machine (100) includes a condensing unit, a plurality of countershafts (20), a countershaft driving motor (103), and a shaft coupling (70). The shaft coupling (70) couples the countershafts (20) with a bolt (80). The fiber bundle condensing device (10) further includes a detected portion, a rotational position detector (30), a controller (40), and an operation unit (41). An operational range is defined as a range where a rotational position of the shaft coupling (70) is located and the bolt (80) used for a coupling main body (73) is operable from a front of the fiber bundle condensing device (10). The controller (40), when the stop command is input, controls the driving of the countershaft driving motor (103) such that the shaft coupling (70) is located in the operation range at a time when the countershafts (20) stop rotating.

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Description

BACKGROUND ART

[0001] The present invention relates to a fiber bundle condensing device of a spinning machine.

[0002] A fiber bundle condensing device of a spinning machine is configured to condense fiber bundles, which are drafted by a drafting device in advance, prior to twisting. This condensation improves yarn quality, for example, reducing fluff or increasing yarn strength. The fiber bundle condensing device is mounted on a frame base of the spinning machine. Such a fiber bundle condensing device includes a rotary shaft having a delivery bottom roller that sends fiber bundles and a countershaft that rotates the rotary shaft, as disclosed in European Patent Application Publication No. 1473388, for example. While a driving gear is provided on the countershaft, a driven gear is provided on the rotary shaft. The driving gear is engaged with the driven gear. A rotating force is transmitted from the countershaft to the rotary shaft through the engagement of the gears.

[0003] Generally, the frame base of the spinning machine is quite long, which makes it difficult to drive the fiber bundle condensing device with only one countershaft. For that reason, the fiber bundle condensing device includes a plurality of countershafts. The plurality of countershafts are arranged side by side in an axial direction of the countershafts, and the countershafts arranged side by side in the axial direction are coupled by shaft couplings. In this case, each shaft coupling is fastened with bolts to couple the countershafts.

[0004] For maintenance of the fiber bundle condensing device, or the like, it may be required to uncouple the countershafts by the shaft couplings. In this case, after the operation of the fiber bundle condensing device is stopped to stop the rotation of the countershafts, the bolts are required to be loosened. In addition, after the maintenance of the fiber bundle condensing device, or the like ends, the bolts are required to be tightened up again. However, depending on rotational positions of the shaft couplings when the fiber bundle condensing device is stopped to stop the rotation of the countershafts, the bolt operation may be difficult to perform.

SUMMARY

[0005] In accordance with an aspect of the present invention, there is provided a fiber bundle condensing device of a spinning machine that includes a condensing unit including: a delivery bottom roller mounted on a rotary shaft and delivering a fiber bundle; a suction portion performing a suction operation on the fiber bundle; an air-permeable apron being rotated along the suction portion; and a delivery top roller being in contact with the delivery bottom roller through the air-permeable apron and rotating with the delivery bottom roller, the condensing unit condensing the fiber bundle, which have been drafted, a plurality of countershafts arranged in an axial direction of the countershafts and rotating the rotary shaft, a countershaft driving motor driving the countershafts, and a shaft coupling coupling the countershafts arranged side by side in the axial direction and integrally rotating with the countershafts. The shaft coupling couples the countershafts by fastening a coupling main body disposed over a first end portion of one countershaft and a second end portion of the other countershaft adjacent to the one countershaft with a bolt. The fiber bundle condensing device further includes a detected portion formed in at least one of the countershafts or the shaft coupling and detecting a rotational position of the at least one of the countershafts, a rotational position detector outputting rotational position information of the countershafts by detecting the detected portion, a controller to which the rotational position information output from the rotational position detector is input, the controller controlling the countershaft driving motor, and an operation unit outputting a stop command for stopping the driving of the countershaft driving motor to the controller. An operational range is defined as a range where a rotational position of the shaft coupling is located and the bolt used for the coupling main body is operable from a front of the fiber bundle condensing device. The controller, when the stop command from the operation unit is input to the controller, controls the driving of the countershaft driving motor based on the rotational position information input from the rotational position detector such that the shaft coupling is located in the operation range at a time when the countershafts stop rotating.

[0006] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the embodiments together with the accompanying drawings in which:

FIG. 1 is a front view schematically illustrating a spinning machine and a fiber bundle condensing device according to a first embodiment;
FIG. 2 is a cross-sectional view illustrating a condense unit according to the first embodiment;
FIG. 3 is a perspective view illustrating a shaft coupling according to the first embodiment;
FIG. 4 is a cross-sectional view illustrating the shaft coupling in an operation range;
FIG. 5 is a cross-sectional view illustrating the shaft coupling in the operation range;
FIG. 6 is a perspective view illustrating an attachment jig used for an attachment of the shaft coupling;
FIG. 7 is a front view illustrating a jig main body attached to the countershaft;

FIG. 8 is a side view illustrating the jig main body attached to the countershaft;
FIG. 9 is a side view illustrating the attachment jig;
FIG. 10 is a perspective view partly illustrating a detected surface of a detection shaft according to the first embodiment;
FIG. 11 is a configuration view schematically illustrating a spinning machine according to a second embodiment;
FIG. 12 is a view schematically illustrating an input unit of the spinning machine;
FIG. 13 is a view for explaining a normal stop mode of the spinning machine;
FIG. 14 is a view for explaining a first maintenance mode of the spinning machine;
FIG. 15 is a view for explaining a second maintenance mode of the spinning machine; and
FIG. 16 is a perspective view partly illustrating a detected surface of a shaft coupling according to a modified example.

DETAILED DESCRIPTION OF THE INVENTION

(First embodiment)

[0008] The following will describe a first embodiment of a fiber bundle condensing device of a spinning machine according to the present invention with reference to FIGS. 1 to 10.

<Outline of fiber bundle condensing device of spinning machine>

[0009] The fiber bundle condensing device of the spinning machine is disposed downstream of a drafting device. Hereinafter, "the fiber bundle condensing device of the spinning machine" is simply called "the fiber bundle condensing device". The fiber bundle condensing device is configured to condense fiber bundles, which have been drafted by the drafting device, in advance prior to twisting. The fiber bundle condensing device is also configured to perform a treatment of the condensed fiber bundles, such as by reducing fluff.

<Spinning machine>

[0010] As illustrated in FIG. 1, a spinning machine 100 includes a fiber bundle condensing device 10, an end head 101, a gear head 102, and a plurality of support plates 50. The end head 101 and the gear head 102 are mounted on a frame base (not illustrated). The gear head 102 has therein a countershaft driving motor 103. The countershaft driving motor 103 drives the fiber bundle condensing device 10. The drafting device is located behind the fiber bundle condensing device 10 in a vertical direction of a sheet of FIG. 1. Fiber bundles F are treated by the fiber bundle condensing device 10, and delivered toward the lower front of the fiber bundle condensing device 10 in the vertical direction of the sheet of FIG. 1. The front of the fiber bundle condensing device 10 in the vertical direction of the sheet of FIG. 1 corresponds to a side near a front surface of the fiber bundle condensing device 10. This means that the fiber bundles F, which are treated by the fiber bundle condensing device 10, are delivered toward the front of the fiber bundle condensing device 10. A view of the fiber bundle condensing device 10 seen from the front of the fiber bundle condensing device 10 is referred to as a front side view. A direction in which the end head 101 and the gear head 102 face each other is defined as a longitudinal direction X of the spinning machine 100.

<Support plate>

[0011] The support plates 50 are fixed to a roller stand (not illustrated). The plurality of support plates 50 are disposed between the end head 101 and the gear head 102.

[0012] FIG. 8 schematically illustrates one of the support plates 50. As illustrated in FIG. 8, a shaft groove 53 is formed in the support plate 50. In a side view of the support plate 50 as seen in the longitudinal direction X of the spinning machine 100, the shaft groove 53 has an arc shape and is open toward the front and diagonally upper of the fiber bundle condensing device 10.

<Fiber bundle condensing device>

[0013] As illustrated in FIG. 1, the fiber bundle condensing device 10 is disposed between the end head 101 and the gear head 102. The fiber bundle condensing device 10 includes a plurality of condensing units 11, a plurality of countershafts 20, and shaft couplings 70 coupling the countershafts 20 arranged side by side. The fiber bundle condensing device 10 also includes a rotational position detector 30, a controller 40, an operation unit 41, and a detected surface 60c as a detected portion in the present invention.

<Condensing unit>

[0014] The condensing units 11 condense the fiber bundles F, which have been drafted.

[0015] As illustrated in FIGS. 1 and 2, the condensing units 11 each have a rotary shaft 12, a delivery bottom roller 13, a suction portion 14, an air-permeable apron 15, and a delivery top roller 16. The delivery bottom roller 13 is mounted on the rotary shaft 12 and integrally rotates with the rotary shaft 12. A driven gear 18 is provided on the rotary shaft 12.

[0016] The suction portion 14 includes a plurality of suction holes (not illustrated). The suction portion 14 performs a suction operation on the delivered fiber bundle F through the air-permeable apron 15. The air-permeable apron 15 is made of an endless woven fabric with air permeability. The air-permeable apron 15 is wound

around a set of the delivery bottom roller 13, the suction portion 14, and the guide portion 19. The air-permeable apron 15 is rotated along the suction portion 14. The delivery top roller 16 is in contact with the delivery bottom roller 13 through the air-permeable apron 15, and rotates with the delivery bottom roller 13.

[0017] As illustrated in FIG. 1, the fiber bundle condensing device 10 has eight condensing units 11 as a unit. The fiber bundle condensing device 10 includes a plurality of units of the condensing units 11 between the end head 101 and the gear head 102. One unit of the condensing units 11 is disposed between the support plates 50. Two support plates 50 as a unit are disposed between two units of the condensing units 11 adjacent in the longitudinal direction X. A rotary shaft bearing 51 and a shaft bearing 52 are disposed between the support plates 50 as one unit. The rotary shaft 12 is rotatably supported by the support plates 50 through the rotary shaft bearings 51.

<Countershaft>

[0018] The countershafts 20 rotate the rotary shaft 12. The plurality of countershafts 20 are arranged in an axial direction of the countershafts 20. The countershafts 20 are each rotatably supported by the support plates 50 through the shaft bearing 52. The plurality of countershafts 20 are arranged side by side in the longitudinal direction X of the spinning machine 100. Each of the countershafts 20 includes a shaft main body 20a, a first coupling end portion 20b, and a second coupling end portion 20c. The first coupling end portion 20b corresponds to a first end portion of the shaft main body 20a in the axial direction of the countershaft 20. The second coupling end portion 20c corresponds to a second end portion of the shaft main body 20a in the axial direction of the countershaft 20. An axial length of the first coupling end portion 20b is shorter than that of the second coupling end portion 20c. A diameter of each of the first coupling end portion 20b and the second coupling end portion 20c is smaller than that of the shaft main body 20a.

[0019] As illustrated in FIG. 3, the first coupling end portion 20b of one countershaft 20 faces the second coupling end portion 20c of the other countershaft 20 adjacent to the one countershaft 20. The second coupling end portion 20c is inserted through one unit of the support plates 50, and rotatably supported by the support plates 50 through the shaft bearing 52.

[0020] As illustrated in FIG. 1, the countershafts 20 each includes a driving gear 21. The driving gear 21 is disposed near the first coupling end portion 20b in the axial direction of the countershaft 20. The driven gear 18 and the driving gear 21 may be disposed near the second coupling end portion 20c or a middle position of the countershaft 20 in the axial direction of the countershaft 20. The driving gear 21 is engaged with the driven gear 18 of the rotary shaft 12. When the driving gear 21 is rotated with the countershaft 20, the driven gear 18 of the rotary shaft 12 is rotated. With the rotation of the driven gear 18, the delivery bottom rollers 13 rotate with the rotary shaft 12. The air-permeable aprons 15 are rotated with the rotation of the delivery bottom rollers 13 to deliver the fiber bundles F. Accordingly, the delivery bottom rollers 13 deliver the fiber bundles F.

[0021] The fiber bundles F are sandwiched between the delivery top rollers 16 and the delivery bottom rollers 13, which rotate according to the rotation of the rotary shaft 12 driven by the countershafts 20, and delivered while being sucked to the suction portions 14 through the air-permeable aprons 15.

<Detection shaft>

[0022] A detection shaft 60, which also serves as a countershaft, is coupled to an endmost countershaft 20 of the plurality of the countershafts 20. More specifically, the detection shaft 60 is coupled to the countershaft 20 closest to the end head 101. The detection shaft 60 rotates, serving as the countershaft. An axial length of the detection shaft 60 is shorter than that of each countershaft 20.

[0023] A first end portion 60a of the detection shaft 60 is coupled to the second coupling end portion 20c of the countershaft 20 through the shaft coupling 70. A second end portion 60b of the detection shaft 60 protrudes outside the end head 101, and is rotatably supported by a bearing 105. The detected surface 60c serving as a detected portion is formed in the second end portion 60b of the detection shaft 60. Accordingly, the countershaft 20 includes the detected surface 60c serving as the detected portion. The detected surface 60c is formed to detect a rotational position of the countershaft 20. As illustrated in FIG. 10, the detected surface 60c is a plane extending in an axial direction and a radial direction of the detection shaft 60.

<Shaft coupling>

[0024] As illustrated in FIGS. 3, 4, and 5, the shaft coupling 70 includes a coupling main body 73 and a plurality of bolts 80. The coupling main body 73 has a first coupling member 71 and a second coupling member 72. The axial direction of the shaft coupling 70 is defined as respective axial directions of the first coupling member 71 and the second coupling member 72, and the radial direction of the shaft coupling 70 is defined as respective radial directions of the first coupling member 71 and the second coupling member 72. The first coupling member 71 and the second coupling member 72 are each formed in a half-cylinder shape. The first coupling member 71 and the second coupling member 72 each have an accommodation recess portion 79. The accommodation recess portion 79 is used for accommodating the first coupling end portion 20b and the second coupling end portion 20c. The first coupling member 71 and the second coupling member 72 each have matching surfaces 74 between

which the accommodation recess portion 79 is disposed in the radial direction.

[0025] The first coupling member 71 has bolt head accommodation portions 75 and insertion holes 76 communicating with the bolt head accommodation portions 75. The bolt head accommodation portions 75 are open at an arc-shaped surface of outer surfaces of the first coupling member 71. The insertion holes 76 are open at the matching surfaces 74 of the first coupling member 71. The bolt head accommodation portions 75 and the insertion holes 76 are arranged along the accommodation recess portion 79 in a line in the axial direction of the first coupling member 71. The bolt head accommodation portions 75 and the insertion holes 76 are arranged on the opposite sides of the accommodation recess portion 79 such that the accommodation recess portion 79 is interposed in the radial direction of the first coupling member 71.

[0026] The second coupling member 72 has internal threads 77. The internal threads 77 provide communication between the arc-shaped surface of the outer surfaces of the second coupling member 72 and the matching surfaces 74 of the second coupling member 72. The internal threads 77 are arranged along the accommodation recess portion 79 in a line in the axial direction of the second coupling member 72. The internal threads 77 are arranged on the opposite sides of the accommodation recess portion 79 such that the accommodation recess portion 79 is interposed in the radial direction of the second coupling member 72.

[0027] Each of the bolts 80 includes a bolt head 80a and a bolt shank 80b. An operation socket 80c is formed in the bolt head 80a. The operation socket 80c is a hexagon socket. The bolt 80 is operated with an operational tool 90 inserted to the operation socket 80c. The operational tool 90 is a long hexagonal column stick.

[0028] The shaft coupling 70 couples the countershafts 20 adjacent in the axial direction of the countershafts 20, and integrally rotates with the countershafts 20. The bolt shanks 80b of the bolts 80 are inserted into the insertion holes 76 through the bolt head accommodation portions 75 of the first coupling member 71, and screwed into the internal threads 77 of the second coupling member 72. The first coupling member 71 and the second coupling member 72 approach each other by screwing the bolt shanks 80b into the internal threads 77, and the coupling main body 73 is fastened. The shaft coupling 70 is formed by fastening the coupling main body 73 with the bolts 80.

[0029] The coupling main body 73 is disposed over the first coupling end portion 20b of one countershaft 20 and the second coupling end portion 20c of the other countershaft 20 adjacent to the one countershaft 20 in the longitudinal direction X. A part of the bolt head 80a is accommodated in the bolt head accommodation portion 75. The first coupling end portion 20b and the second coupling end portion 20c are held between the accommodation recess portion 79 of the first coupling member 71 and the accommodation recess portion 79 of the second coupling member 72. This configuration couples the countershafts 20 arranged side by side. Accordingly, the shaft coupling 70 couples the end portions of the adjacent countershafts 20 by fastening the coupling main body 73 disposed over the adjacent countershafts 20 with the bolts 80. All of the countershafts 20 and the detection shaft 60 in the fiber bundle condensing device 10 are coupled by the shaft couplings 70. As a result, all of the countershafts 20 and the detection shaft 60 integrally rotates.

[0030] In each of the countershafts 20, a position of the countershaft 20 in a circumferential direction thereof, that is, a rotational position of the countershaft 20, changes in a rotational direction of the countershaft 20 with the rotation of the countershaft 20. A position of each shaft coupling 70 in a circumferential direction thereof, that is, a rotational position of the shaft coupling 70, changes in the rotational direction of the countershaft 20 with the rotation of the countershaft 20. All of the shaft couplings 70 couple the countershafts 20 with the positions of the bolt head accommodation portions 75 aligned in the rotational direction of the countershafts 20. That is, the rotational positions in the plurality of shaft couplings 70 are all aligned.

[0031] As illustrated in FIG. 1, in all of the shaft couplings 70, using the detected surface 60c of the detection shaft 60 as a reference, the positions of the bolt head accommodation portions 75 in the rotational direction of the countershafts 20, that is, the rotational positions of the shaft couplings are aligned. More specifically, a direction to which the detected surface 60c is oriented is the same as that to which the bolt head accommodation portions 75 are oriented. As a result, when the detected surface 60c is oriented to the front of the fiber bundle condensing device 10 at a rotational position of the detection shaft 60, the bolt head accommodation portions 75 of each shaft coupling 70 are set to be oriented to the front of the fiber bundle condensing device 10.

[0032] Therefore, in a case where a worker can see the bolt head accommodation portions 75 of one shaft coupling 70 in the front view of the fiber bundle condensing device 10, the worker can also see the bolt head accommodation portions 75 in all of the other shaft couplings 70.

[0033] In order to couple the countershafts 20 with the shaft couplings 70, after each bolt shank 80b is inserted into the insertion hole 76 through the bolt head accommodation portion 75, the operational tool 90 is inserted into the operation socket 80c of the bolt head 80a. In addition, the operational tool 90 is required to be operated to screw the bolt shank 80b into the internal thread 77. On the other hand, in order to uncouple the countershafts 20 by the shaft couplings 70, after the operational tool 90 is inserted into the operation socket 80c of each bolt head 80a, the operational tool 90 is required to be operated to remove the bolt shank 80b from the internal thread 77.

[0034] When the bolt head accommodation portions

75 are not disposed in a predetermined operation range, the worker cannot operate the bolts 80 from the side near the front surface of the fiber bundle condensing device 10 with the operational tool 90. This happens in a case where the bolt head accommodation portions 75 hide behind the rotary shaft 12. Accordingly, as illustrated in FIG. 4, one end of the operation range is located at a position where the bolt head accommodation portions 75 do not hide behind the rotary shaft 12 and are open toward the front of the fiber bundle condensing device 10 under the rotary shaft 12. Here, the direction indicated by the expression of "toward the front" is not limited to the horizontal direction, and includes a direction slightly upward from the horizontal direction in a range where the operational tool 90 does not interfere with the rotary shaft 12. As illustrated in FIG. 5, the other end of the operation range is set at a position where the bolt head accommodation portions 75 are open toward the front and diagonally lower of the fiber bundle condensing device 10. Compared to FIG. 4 with FIG. 5, the rotational position of the shaft coupling 70 is shifted by 90 degree. The other end of the operation range may be set as appropriate in a range where the operational tool 90 does not interfere with an object located in the lower of the operational tool 90, such as a suction cleaner. The operation range corresponds to a range where the bolts 80 used for the coupling main body 73 are operated from the front of the fiber bundle condensing device 10.

<Attachment jig>

[0035] As illustrated in FIG. 7, when the adjacent countershafts 20 are coupled by the shaft coupling 70, an attachment jig 83 is used. The attachment jig 83 is used for attaching the shaft couplings 70 in such a manner that the positions of the shaft couplings 70 are aligned in the circumferential direction of the countershafts 20. The attachment jig 83 is attached to each countershaft 20 in use. The attachment jig 83 includes a jig main body 84, a first protrusion 85, and a second protrusion 86. The jig main body 84 has a first end surface 84a and a second end surface 84b. The first end surface 84a and the second end surface 84b are end surfaces of the jig main body 84 in an axial direction thereof.

[0036] As illustrated in FIG. 6, the jig main body 84 has an attachment recess portion 84c extending in the axial direction of the jig main body 84. The attachment recess portion 84c is a recess extending in the axial direction of the jig main body 84. The attachment recess portion 84c is open at opposite ends in the axial direction of the jig main body 84. When the jig main body 84 is seen from the axial direction thereof, the first end surface 84a and the second end surface 84b are each formed in a substantially C-shape. The jig main body 84 has a pair of open ends 84d extending in the axial direction of the jig main body 84 with the attachment recess portion 84c interposed between the open ends 84d. The pair of open ends 84d is in parallel with each other. A direction in which the pair of open ends 84d faces each other with the attachment recess portion 84c interposed therebetween is defined as a width direction of the jig main body 84. A direction in which the jig main body 84 extends from one of the open ends 84d to the other of the open ends 84d along the first end surface 84a and the second end surface 84b is defined as a circumferential direction of the jig main body 84. A position at the middle between the open ends 84d in the circumferential direction of the jig main body 84 is defined as a middle position P.

[0037] The first protrusion 85 is formed in the first end surface 84a of the jig main body 84. The first protrusion 85 is, in the first end surface 84a, disposed closer to the one of the open ends 84d than the middle position P. The first protrusion 85 is formed in a cylindrical shape protruding from the first end surface 84a in the axial direction of the jig main body 84. The attachment recess portion 84c is attached from above the shaft main body 20a, and the first protrusion 85 is brought into contact with the shaft groove 53. Then, the attachment jig 83 is positioned such that the attachment recess portion 84c is open downward, and rotation of the attachment jig 83 relative to the countershaft 20 is restricted.

[0038] The second protrusion 86 is formed in the second end surface 84b of the jig main body 84 and disposed at the middle position P. The second protrusion 86 is formed in a plate shape. A thickness direction of the second protrusion 86 is the same as the width direction of the jig main body 84.

<Using attachment jig>

[0039] Firstly, as illustrated in FIGS. 7 and 8, the attachment recess portion 84c is attached from above the second coupling end portion 20c of one of the countershafts 20 arranged side by side. Here, the second coupling end portion 20c faces the first coupling end portion 20b of the other of the countershafts 20. The attachment jig 83 is attached to the second coupling end portion 20c, and the first protrusion 85 is brought into contact with a surface of the support plate 50 in which the shaft groove 53 is formed. Then, the attachment jig 83 is positioned such that the attachment recess portion 84c is open downward. At the same time, the rotation of the attachment jig 83 relative to the countershaft 20 is restricted. The second protrusion 86 is located in the top of the second end surface 84b, and the thickness direction of the second protrusion 86 coincides with the front and rear direction of the spinning machine 100.

[0040] Secondly, as illustrated in FIG. 9, the first coupling member 71 is disposed in the front of the second protrusion 86, and the second coupling member 72 is disposed in the rear of the second protrusion 86, which holds the second protrusion 86 between the first coupling member 71 and the second coupling member 72. Here, the second coupling end portion 20c and the first coupling end portion 20b are held between the first coupling member 71 and the second coupling member 72. When the

matching surfaces 74 of the first coupling member 71 are brought into contact with a front surface of the second protrusion 86, the first coupling member 71 is positioned such that the bolt head accommodation portions 75 of the first coupling member 71 are oriented to the front of the fiber bundle condensing device 10. When the matching surfaces 74 of the second coupling member 72 are brought into contact with a rear surface of the second protrusion 86, the second coupling member 72 is positioned such that the internal threads 77 of the second coupling member 72 are oriented to the rear of the fiber bundle condensing device 10.

[0041] One end surfaces of the first coupling member 71 and the second coupling member 72 in the axial direction thereof are brought into contact with the second end surface 84b. Here, the accommodation recess portions 79 of the first coupling member 71 face the accommodation recess portions 79 of the second coupling member 72, and the matching surfaces 74 of the first coupling member 71 face the matching surfaces 74 of the second coupling member 72. Accordingly, the insertion holes 76 of the first coupling member 71 also face the internal threads 77 of the second coupling member 72.

[0042] When the bolt shanks 80b are inserted into the insertion holes 76 through the bolt head accommodation portions 75, and screwed into the internal threads 77, the first coupling member 71 is coupled to the second coupling member 72 by the bolts 80. As a result, the first coupling end portion 20b and the second coupling end portion 20c that are accommodated in the accommodation recess portions 79 are held by the coupling main body 73, and the countershafts 20 are coupled by the shaft couplings 70. The countershafts 20 are coupled with the rotational positions of all of the shaft couplings 70 aligned by repeating this work.

<Rotational position detector>

[0043] As illustrated in FIG. 1, the rotational position detector 30 is disposed proximate to the end head 101. The rotational position detector 30 faces the second end portion 60b of the detection shaft 60. The rotational position detector 30 is, for example, a proximity sensor. The rotational position detector 30 detects the detected surface 60c of the detection shaft 60 that approaches without any physical contact. The rotational position detector 30 outputs a detection signal every detection of the detected surface 60c. That is, the rotational position detector 30 outputs a detection signal including one pulse every rotation of the detection shaft 60. In the detection signals output by the rotational position detector 30, a rotational speed of the countershafts 20, that is, the rotational speed of the countershaft driving motor 103, decreases, which makes the output interval of the detection signals longer, whereas the rotational speed of the countershaft driving motor 103 increases, which makes an output interval of the detection signals shorter. Accordingly, the detection signals output by the rotational position detector 30 indicate rotational position information of the countershafts 20. That is, the rotational position detector 30 outputs the rotational position information of the countershafts 20 by detecting the detected surface 60c.

[0044] As described above, in the rotational position of the detection shaft 60, when the detected surface 60c is oriented toward the front of the fiber bundle condensing device 10, the bolt head accommodation portions 75 of each shaft coupling 70 are also oriented toward the front of the fiber bundle condensing device 10. Thus, at a time when the rotational position detector 30 outputs the detection signals, the bolt head accommodation portions 75 of each shaft coupling 70 are located in a position where the bolt head accommodation portions 75 are oriented toward the front of the fiber bundle condensing device 10. That is, the rotational position of the shaft coupling 70 is the position where the bolt head accommodation portions 75 are oriented toward the front of the fiber bundle condensing device 10, and is located in the operation range.

<Controller>

[0045] The controller 40 includes a processor and memory (not illustrated). As an example of the processor, a CPU (Central Processing Unit), a GPU (Graphics Processing Unit), and a DSP (Digital Signal Processor) may be used. The memory includes a RAM (Random Access Memory) and a ROM (Read Only Memory). The memory stores program codes or commands configured to cause the processor to execute processes. The memory, that is, a computer readable medium, includes any available medium that is accessible by a general-purpose computer or a dedicated computer. The controller 40 may include a hardware circuit such as an ASIC (Application Specific Integrated Circuit) or an FPGA (Field Programmable Gate Array). The controller 40, which is a processing circuit, may include one or more processors for operating in accordance with computer programs, one or more hardware circuits such as the ASIC or the FPGA, or a combination thereof.

[0046] When the detection signals output by the rotational position detector 30 are input to the controller 40, the controller 40 controls the driving of the countershaft driving motor 103. The controller 40 outputs the driving signals to the countershaft driving motor 103 to drive the countershaft driving motor 103. The driving of the countershaft driving motor 103 rotates the countershafts 20, which drives the fiber bundle condensing device 10.

[0047] The operation unit 41 is connected to the controller 40. As an example of the operation unit 41, a dial, a physical button, and a touch panel may be used. In the present embodiment, the operation unit 41 is a physical button. The operation unit 41 is operated to suspend or completely stop the operation of the fiber bundle condensing device 10, which stops the operation of the countershafts 20. The operation unit 41 outputs a stop com-

mand for stopping the operation of the countershaft 20, that is, the driving of the countershaft driving motor 103, to the controller 40. The operation unit 41 may be provided on the gear head 102, the end head 101, or a host controller of the spinning machine 100 as long as the operation unit 41 is to be operated for the purpose of stopping the operation of the countershafts 20.

[0048] While the fiber bundle condensing device 10 operates, detection signals from the rotational position detector 30 are periodically input to the controller 40. The controller 40 controls the rotational speed of the countershaft driving motor 103 based on the detection signals.

[0049] When a stop command is output from the operation unit 41, and then, input to the controller 40, the controller 40 switches the control of the countershaft driving motor 103 from the rotational speed control to the position control. In detail, the controller 40, when the stop command from the operation unit 41 is input to the controller 40, controls the operation of the countershafts 20 based on the detection signals input from the rotational position detector 30 such that the shaft couplings 70 are located in the operation range at the time when the rotation of the countershafts 20 stops. More specifically, the controller 40, when the stop command is input to the controller 40, detects the rotational position of the countershaft 20 based on the rotational position detector 30 and performs the position control to stop the countershafts 20 at a predetermined rotational position. Furthermore specifically, the controller 40 controls the driving of the countershaft driving motor 103 such that the shaft couplings 70 stop in the operation range.

[0050] In the present embodiment, the controller 40 controls the driving of the countershaft driving motor 103 in such a manner that as illustrated in FIGS. 4 and 5, the bolt head accommodation portions 75 under the rotary shaft 12 are located in a range from the position where the bolt head accommodation portions 75 are open toward the front of the fiber bundle condensing device 10 to the position where the bolt head accommodation portions 75 are open toward the front and diagonally lower than the fiber bundle condensing device 10, that is, in a range from the one end of the operation range to the other end of the operation range.

[Operation of the first embodiment]

[0051] For example, for maintenance of the fiber bundle condensing device 10, after the fiber bundle condensing device 10 is suspended, the driving gears 21, the shaft bearings 52, or the countershafts 20 may be replaced, or some other operation may be performed.

[0052] The worker operates the operation unit 41. When a stop command from the operation unit 41 is input to the controller 40, the controller 40 switches the control of the countershaft driving motor 103 from the rotational speed control to the position control. The controller 40 performs the position control to stop the countershafts 20 at the predetermined rotational position based on the detection signals from the rotational position detector 30. Then, when the countershafts 20 stop rotating, the bolt head accommodation portions 75 of all of the shaft couplings 70 are located in the operation range. For that reason, the worker can operate the bolt heads 80a accommodated in the bolt head accommodation portions 75 of one of the shaft couplings 70 with the operational tool 90 from the front of the fiber bundle condensing device 10. The worker operates the bolts 80 with the operational tool 90 to remove the bolts 80 from the internal threads 77, and completely removes the bolts 80 from the coupling main body 73 through the insertion holes 76 and the bolt head accommodation portions 75. As a result, the coupling main body 73 is divided into the first coupling member 71 and the second coupling member 72, so that the coupling of the countershafts 20 by the shaft coupling 70 is uncoupled. The same process as described above goes for the others of the shaft couplings 70. Afterwards, the countershaft 20 is movable in the longitudinal direction X, and the driving gears 21, the shaft bearings 52, or the countershafts 20 are replaceable, or some other operation is performed.

[0053] After the maintenance ends, the countershafts 20, which have been moved, are returned to the original positions, and are coupled by the shaft couplings 70 again. Since the countershafts 20 stop with the detected surface 60c oriented toward the front of the fiber bundle condensing device 10, the bolt head accommodation portions 75 of the shaft couplings 70 other than the uncoupled shaft couplings 70 are oriented toward the front of the fiber bundle condensing device 10.

[0054] Subsequently, the shaft couplings 70 are attached to the countershafts 20 using the attachment jig 83 to couple the countershafts 20. Here, the worker can use the operational tool 90 from the front of the fiber bundle condensing device 10. The worker operates each bolt 80 with the operational tool 90, inserts the bolt shank 80b into the insertion hole 76 through the bolt head accommodation portion 75, and screws the bolt shank 80b into the internal thread 77. As a result, the bolts 80 are screwed into the coupling main body 73, and thus, the countershafts 20 are coupled by the shaft coupling 70.

[0055] According to the above-described first embodiment, advantageous effects are provided as described below.

[0056] (1-1) When a stop command is input to the controller 40 by operating the operation unit 41, the controller 40 controls the driving of the countershaft driving motor 103 to stop the operation of the fiber bundle condensing device 10. Then, when the countershafts 20 stop rotating, the shaft couplings 70 are located in the operation range. That is, when the operation of the fiber bundle condensing device 10 stops, each of the shaft couplings 70 is positioned at a position in which the bolts 80 are easily operated. As a result, after the operation of the fiber bundle condensing device 10 is stopped, the bolts 80 used for the coupling main body 73 are easily operated.

[0057] (1-2) The fiber bundle condensing device 10 in-

cludes the plurality of shaft couplings 70. The rotational positions of the plurality of the shaft couplings 70 are set to be all aligned. Accordingly, when a stop command is output from the operation unit 41 and the countershafts 20 stop rotating, all of the shaft couplings 70 are located in the operation range. In any one of the shaft couplings 70, the bolts 80 used for the coupling main body 73 are operable.

[0058] (1-3) The detected surface 60c is formed in the detection shaft 60. For example, as compared to a case where another countershaft 20 including the detected surface is coupled to the countershaft 20 closest to the end head 101, the fiber bundle condensing device 10 is decreased in size in the longitudinal direction X.

[0059] (1-4) When the operation of the fiber bundle condensing device 10 is stopped by the controller 40, each of the shaft couplings 70 is positioned in the operation range. That is, while the operation of the fiber bundle condensing device 10 stops, the bolts 80 used for the coupling main body 73 are operable. Even when the operation of the fiber bundle condensing device 10 is stopped for a reason other than the maintenance of the fiber bundle condensing device 10, the bolts 80 are operable. As a result, in a case where the maintenance of the fiber bundle condensing device 10 is required while the operation of the fiber bundle condensing device 10 is stopped, the maintenance may be performed without rotating the countershafts 20 again.

[0060] (1-5) The usage of the attachment jig 83 makes the work of aligning the rotational positions of the shaft couplings 70 easier.

(Second embodiment)

[0061] The following will describe a second embodiment of a fiber bundle condensing device of a spinning machine according to the present invention with reference to FIGS. 11 to 14. In the second embodiment, detail description of the same parts as those of the first embodiment will be omitted.

[0062] As illustrated in FIG. 11, the spinning machine 100 includes a spindle driver 111, a lifting unit 120, and a drafting device 130.

[0063] The spindle driver 111 drives spindles 110 in order to wind up the fiber bundles F condensed by the fiber bundle condensing device 10. The spindle driver 111 includes a spindle driving motor 112, a driving pulley 113, a driven pulley 114, and a tangential belt 115 wound around both the driving pulley 113 and the driven pulley 114. The spindles 110 are driven by the spindle driving motor 112. The spindle driving motor 112 is a variable speed motor that is driven through an inverter 116. The controller 40 controls the inverter 116.

[0064] The lifting unit 120 causes the spindles 110 to move up and down. The lifting unit 120 includes a line shaft 121, a ring rail 122, a lappet angle (not illustrated) having snail wires 123, a poker pillar 124, a nut body 125, a lifting motor 126, and a driver 127. The line shaft 121 is rotatably disposed along a line of the spindles. A screw gear 121a is formed in the line shaft 121. The lifting motor 126 is coupled to the line shaft 121 through a gear mechanism (not illustrated). The poker pillar 124 supports the ring rail 122 having rings 122a. A screw portion 124a is formed in a lower portion of the poker pillar 124. The nut body 125 is screwed to the screw portion 124a, and engaged to the screw gear 121a.

[0065] The lifting motor 126 rotates in a normal direction or a reverse direction to rotate the line shaft 121, thereby causing the ring rail 122 to move up and down through the screw gear 121a, the nut body 125, and the screw portion 124a. The driver 127 drives the lifting motor 126. The controller 40 controls the driver 127.

[0066] During the operation of the spinning machine 100, the controller 40 controls the inverter 116 and the driver 127 to control the driving of the spindle driving motor 112 and the lifting motor 126. The lifting unit 120 is driven by the driving of the lifting motor 126 to cause the ring rail 122 to repeatedly move up and down, and the spindle driver 111 is driven by the driving of the spindle driving 112 to rotate the spindles 110. With these mechanisms, the fiber bundles F, which have passed through the fiber bundle condensing device 10, are wound onto bobbins B supported by the spindles 110.

[0067] The drafting device 130 drafts the fiber bundles F. The drafting device 130 includes a front roller 131, a first draft motor 132, a middle roller 133, a second draft motor 134, and a back bottom roller 135. The back bottom roller 135 is coupled to the middle roller 133 through a gear train 136. The middle roller 133 has an apron 133a. A first driver 132a drives the first draft motor 132. A second driver 134a drives the second draft motor 134. The controller 40 controls the first driver 132a and the second driver 134a. The first draft motor 132 and the second draft motor 134 drives the drafting device 130. The drafting device 130 is driven by the driving of the first draft motor 132 and the second draft motor 134.

[0068] The fiber bundle condensing device 10 is disposed in front of the drafting device 130. The fiber bundle condensing device 10 condenses the fiber bundles F, which have been drafted by the drafting device 130. The countershaft driving motor 103 drives the fiber bundle condensing device 10. A countershaft driving motor driver 128 drives the countershaft driving motor 103. The controller 40 controls the countershaft driving motor driver 128.

[0069] The spinning machine 100 includes an input unit 44.

[0070] As illustrated in FIG. 12, the operation unit 41 and a start button 46 are disposed in the input unit 44, and the operation unit 41 is of a physical button type. The operation unit 41 is operated to suspend or completely stop the operation of the spinning machine 100. The start button 46 is operated to start up the spinning machine 100 in stop.

[0071] A display unit 45 is disposed in the input unit 44. The display unit 45 displays an operation screen IM.

The operation screen IM serves as a mode setting unit in the present invention. The operation screen IM is a screen on which an operator selects a first maintenance mode M1 or a second maintenance mode M2 as a maintenance mode of the spinning machine 100. On the operation screen IM, an ON-button B1 for setting the first maintenance mode M1 to be selected and an OFF-button B2 for setting the first maintenance mode M1 to be unselected are displayed.

[0072] When the first maintenance mode M1 is set to be selected by operating the ON-button B1, the controller 40 sets the first maintenance mode M1 to be executed. When the first maintenance mode M1 is set to be unselected by operating the OFF-button B2, the controller 40 sets a normal stop mode M3 to be executed. Accordingly, on the operation screen IM serving as the mode setting unit, the first maintenance mode M1 or the normal stop mode M3 are selected, and set to be executed.

[0073] In addition, on the operation screen IM, an ON-button B3 for setting the second maintenance mode M2 to be selected and an OFF-button B4 for setting the second maintenance mode M2 to be unselected are displayed. When the second maintenance mode M2 is set to be selected by operating the ON-button B3, the controller 40 sets the second maintenance mode M2 to be executed. Accordingly, on the operation screen IM serving as the mode setting unit, the second maintenance mode M2 is selected, and set to be executed. When the OFF-button B4 is operated, the controller 40 sets the second maintenance mode M2 to OFF. Accordingly, on the operation screen IM serving as the mode setting unit, the second maintenance mode M2 is selected, and set to be executed.

[0074] The input unit 44 has a parameter input unit 47. The parameter input unit 47 is used for inputting a spinning parameter of the spinning machine 100 by the operator. The parameter input unit 47 is of a dial type. The parameter input unit 47 may be displayed on the operation screen IM or may be of a physical button type other than the dial type.

[0075] As illustrated in FIG. 11, while the spinning machine 100 is operated, the controller 40 controls the spindle driving motor 112 through the inverter 116, and controls the drivers 127, 128, 132a, and 134a to drive the respective motors 103, 126, 132, and 134. While the spinning machine 100 is operated, according to the spinning parameter input from the parameter input unit 47, the controller 40 controls the fiber bundle condensing device 10, the spindle driver 111, the lifting unit 120, and the drafting device 130 in synchronization with each other. More specifically, according to the spinning parameter input from the parameter input unit 47, the controller 40 controls the motors 103, 112, 126, 132, and 134 in synchronization with each other. Accordingly, the spinning machine 100 includes the spindle driving motor 112 that drives the spindles 110 onto which the fiber bundles F condensed by the fiber bundle condensing device 10 are wound. In the present embodiment, the spinning machine 100 includes the first draft motor 132 and the second draft motor 134, the above-described spindle driving motor 112, and the lifting motor 126. The first draft motor 132 and the second draft motor 134 drive the drafting device 130 that drafts the fiber bundles F. The lifting motor 126 drives the lifting unit 120 that causes the spindles 110 to move up and down.

[0076] The controller 40 includes the operation screen IM serving as the above-described mode setting unit, a synchronization controller 401, a detection speed setting unit 402, and a display controller 403. The display controller 403 instructs the display unit 45 to display the operation screen IM.

[0077] The synchronization controller 401 controls the countershaft driving motor 103, the spindle driving motor 112, the lifting motor 126, the first draft motor 132, and the second draft motor 134 in synchronization with each other. The word of "synchronize" means not setting the rotational speeds of the motors 103, 112, 126, 132, and 134 to the same rotational speed, but setting speed ratios of these motors to be constant. That is, the wording of "control in synchronization" means that the synchronization controller 401 drives the countershaft driving motor 103, the spindle driving motor 112, the lifting motor 126, the first draft motor 132, and the second draft motor 134 at appropriate rotational speeds so that the fiber bundles F are spun according to the spinning parameter input from the parameter input unit 47.

[0078] The synchronization controller 401, when the first maintenance mode M1 is executed, drives the fiber bundle condensing device 10 and the spindle driver 111 in synchronization with each other, that is, the synchronization controller 401 drives the spindle driving motor 112 in synchronization with the countershaft driving motor 103. The synchronization controller 401 controls the countershaft driving motor driver 128 and the inverter 116 to cause the countershaft driving motor 103 to be in synchronization with the spindle driving motor 112.

[0079] The detection speed setting unit 402 sets a detection speed V2c of the countershaft driving motor 103 and a detection speed V2s of the spindle driving motor 112 for the synchronization controller 401. Each of the detection speeds V2c, V2s corresponds to a constant rotational speed predetermined in advance. The detection speed V2c of the countershaft driving motor 103 is set to a sufficiently small value so that the detection speed V2c is lower than a rotational speed V1c of the countershaft driving motor 103 at a time when a stop command is input from the operation unit 41. The detection speed V2s of the spindle driving motor 112 is set to a sufficiently small value so that the detection speed V2s is lower than a rotational speed V1s of the spindle driving motor 112 at a time when the stop command is input from the operation unit 41. In addition, the detection speeds V2c, V2s are lower rotational speeds that allow the countershaft driving motor 103 and the spindle driving motor 112 to be stopped quickly. More preferably, the detection speed V2s of the spindle driving motor 112 is set to much

lower rotational speed. As an example of the detection speed V2s of the spindle driving motor 112, the lowest rotational speed at which the spindle driving motor 112 is controllable by the inverter 116 may be set.

[0080] The detection speed V2c of the countershaft driving motor 103 is lower than the detection speed V2s of the spindle driving motor 112. The detection speed V2c of the countershaft driving motor 103 is a rotational speed that allows the countershafts 20 to stop at a predetermined rotational position after the detection signals are output from the rotational position detector 30 with a slight rotation. The predetermined rotational position is a position at which the shaft couplings 70 stop in the operational range.

[0081] For example, when the rotational position detector 30 detects, of opposite edges of the detected surface 60c, one edge of the detected surface 60c on a leading side of the rotational direction of the countershafts 20, the rotational position detector 30 outputs the detection signals. While the countershafts 20 rotate at the detection speed V2c, the detection signals are output, and then, the countershafts 20 stop rotating immediately after the other edge of the detected surface 60c on a following side of the rotational direction passes across the rotational position detector 30.

[0082] The detection speed V2c of the countershaft driving motor 103 and the detection speed V2s of the spindle driving motor 112 are stored in the memory of the controller 40.

<First maintenance mode>

[0083] The first maintenance mode M1 is executed during the operation of the spinning machine 100. The first maintenance mode M1 is a mode that causes the shaft couplings 70 to be positioned in the operational range when the countershafts 20 stop rotating by stopping the operation of the spinning machine 100.

[0084] On the operation screen IM of the display unit 45, when the ON-button B1 for setting the first maintenance mode M1 is pushed, the controller 40 sets the first maintenance mode M1 to be executed. When the first maintenance mode M1 is set to be executed, the detection speed setting unit 402 obtains the detection speed V2c of the countershaft driving motor 103 and the detection speed V2s of the spindle driving motor 112 from the memory and sets the detection speeds V2c, V2s for the synchronization controller 401.

[0085] In the first maintenance mode M1, the synchronization controller 401 drives the countershaft driving motor 103 and the spindle driving motor 112 in synchronization with each other such that the rotational speeds of the countershaft driving motor 103 and the spindle driving motor 112 are decreased from the rotational speed during the operation of the spinning machine 100 to the respective detection speeds V2c, V2s. After the rotational speeds decrease, the synchronization controller 401 drives the countershaft driving motor 103 and the spindle driving motor 112 in synchronization at the detection speeds V2c, V2s.

[0086] In the first maintenance mode M1, at the time when the rotational position detector 30 detects the detected surface 60c, the synchronization controller 401 stops the driving of the countershaft driving motor 103 and the spindle driving motor 112. In the first maintenance mode M1, when the synchronization controller 401 stops the driving of the countershaft driving motor 103, the operation of the fiber bundle condensing device 10 stops and the countershafts 20 slightly and inertially rotate. When the countershafts 20 stop rotating, the shaft couplings 70 are located at the positions where the bolts 80 are easily operated. That is, the shaft couplings 70 are located in the operational range.

[0087] In addition, when the synchronization controller 401 stops the driving of the spindle driving motor 112, the spindles 110 slightly and inertially rotate, and stop. Accordingly, when the first maintenance mode M1 is executed, the countershafts 20 stop such that the shaft couplings 70 are positioned in the operational range, and soon afterwards, the spindles 110 stop, following the countershafts 20.

<Normal stop mode>

[0088] The normal stop mode M3 is executed during the operation of the spinning machine 100.

[0089] In the normal stop mode M3, when the stop command is output from the operation unit 41, the synchronization controller 401 decreases the rotational speeds of the countershaft driving motor 103 and the spindle driving motor 112 in synchronization with each other. The synchronization controller 401 controls the countershaft driving motor driver 128 together with the inverter 116. Then, after stopping the spindle driving motor 112 by controlling the inverter 116, the synchronization controller 401 controls the countershaft driving motor driver 128 to stop the countershaft driving motor 103. That is, in the normal stop mode M3, the controller 40 stops the spindle driving motor 112 and the countershaft driving motor 103 in such a manner that the countershaft driving motor 103 follows the spindle driving motor 112. On the operation screen IM of the display unit 45, when the OFF-button B2 of the first maintenance mode M1 is operated, the controller 40 sets the normal stop mode M3 to be executed.

[0090] The graph in FIG. 13 shows a relation between the number of rotations of the spindles 110 and time, and a relation between the number of rotations of the countershafts 20 and time in the normal stop mode M3. The number of rotations [rpm] of the spindles 110 and the number of rotations [rpm] of the countershafts 20 are shown in the vertical axis of the graph, and time t is shown in the transverse axis of the graph. In addition, a solid line in FIG. 13 shows a behavior of the spindles 110. A dashed line in FIG. 13 shows a behavior of the countershafts 20.

[0091] As shown in FIG. 13, in the normal stop mode M3, when a stop command is output from the operation unit 41 at a time t1 during the operation of the spinning machine 100, the synchronization controller 401 controls the inverter 116 to start decreasing the rotational speed of the spindle driving motor 112 from the rotational speed V1s at the time t1. In addition, the synchronization controller 401 controls the countershaft driving motor driver 128 to start decreasing the rotational speed of the countershaft driving motor 103 from the rotational speed V1c at the time t1. Then, the number of rotations of the spindles 110 and the number of rotations of the countershafts 20 gradually decrease. The synchronization controller 401 controls the countershaft driving motor driver 128 and the inverter 116 to stop the countershaft driving motor 103 at the same time or almost the same time as the stopping of the spindle driving motor 112. As a result, at the same time or almost the same time as the stopping of the rotation of the spindles 110, the countershafts 20 stop rotating. Therefore, this control causes the rotation of the countershafts 20 to follow the rotation of the spindles 110 so that the fiber bundles F are not broken at the time when the spindles 110 stop rotating.

[Operation of the second embodiment]

[0092] The graph in FIG. 14 shows a relation between the number of rotations of the spindles 110 and time and a relation between the number of rotations of the countershafts 20 and time in the first maintenance mode M1. The number of rotations [rpm] of the spindles 110 and the number of rotations [rpm] of the countershafts 20 are shown in the vertical axis of the graph, and time t is shown in the transverse axis of the graph. A solid line in FIG. 14 shows a behavior of the spindles 110. A dashed line in FIG. 14 shows a behavior of the countershafts 20.

[0093] As shown in FIG. 14, in the spinning machine 100 in which the first maintenance mode M1 is set to be the executed on the operation screen IM, when a stop command is output from the operation unit 41 at the time t1 during the operation of the spinning machine 100, the synchronization controller 401 controls the inverter 116 to start decreasing the rotational speed of the spindle driving motor 112 from the rotational speed V1s at the time t1. In addition, the synchronization controller 401 controls the countershaft driving motor driver 128 to start decreasing the rotational speed of the countershaft driving motor 103 from the rotational speed V1c at the time t1. Then, the number of rotations of the spindles 110 and the number of rotations of the countershafts 20 gradually decrease. Here, the synchronization controller 401 may drive the other motor in synchronization with the countershaft driving motor 103 and the spindle driving motor 112 to decrease the rotational speed of the other motor.

[0094] As the number of rotations of the countershaft driving motor 103 and the number of rotations of the spindle driving motor 112 decrease, an interval between the detection signals output from the rotational position detector 30 gradually becomes longer. After that, when the rotational speed V1c of the countershaft driving motor 103 and the rotational speed V1s of the spindle driving motor 112 decrease to the detection speeds V2c, V2s of the respective motors 103, 112, the synchronization controller 401 drives the countershaft driving motor 103 and the spindle driving motor 112 in synchronization with each other at the detection speeds V2c, V2s. Then, the countershaft driving motor 103 and the spindle driving motor 112 rotate at the respective detection speeds V2c, V2s, which are constant rotational speeds.

[0095] After the countershaft driving motor 103 starts driving at the detection speed V2c, when the detection signal from the rotational position detector 30 is input to the controller 40 at the time t2 for the first time, the synchronization controller 401 stops the countershaft driving motor 103 and the spindle driving motor 112 in synchronization with each other. Then, the countershaft driving motor 103 and the spindle driving motor 112 slightly and inertially rotate, and stop. The countershafts 20 and the spindles 110 also slightly and inertially rotate, and stop. When the spindles 110 stop rotating, following the countershafts 20, the shaft couplings 70 stop to be positioned in the operational range.

[0096] According to the above-described second embodiment, advantageous effects are provided as described below.

[0097] (2-1) When the first maintenance mode M1 is executed, while the shaft couplings 70 are positioned in the operational range by stopping the countershafts 20 based on the rotational position of the countershaft 20, the spindles 110 are stopped, following the countershafts 20. The rotational speeds of the countershaft driving motor 103 and the spindle driving motor 112 decrease to the respective detection speeds V2c, V2s before the countershaft driving motor 103 and the spindle driving motor 112 stop, thereby reducing the rotation of the countershaft driving motor 103 and the spindle driving motor 112 due to inertia after the detection signal from the rotational position detector 30 is input to the controller 40 for the first time. As a result, even when the countershafts 20 stop at any desired positions, a relative difference in the number of rotations between the countershafts 20 and the spindles 110 is made small, thereby preventing the fiber bundles F from being broken.

[0098] (2-2) Each of the detection speeds V2c, V2s is set to a constant rotational speed. With this setting, while the countershaft driving motor 103 and the spindle driving motor 112 are driven at the respective detection speeds V2c, V2s, even when a detection signal is output from the rotational position detector 30 at any time, it is possible to stop the countershaft driving motor 103 and the spindle driving motor 112 after a constant and slight rotation. This control prevents the amounts of rotation of the countershafts 20 and the spindles 110 from being varied, depending on the time when the detection signal is output, for example, as in a case where a detection signal is output while the respective rotational speeds of

the countershaft driving motor 103 and the spindle driving motor 112 gradually decrease. As a result, the fiber bundles F are prevented from being broken when the first maintenance mode M1 is executed.

[0099] (2-3) The detection speeds V2c, V2s are rotational speeds that enable the countershafts 20 to stop, following few rotations due to inertia after the countershaft driving motor 103 is stopped. For that reason, after the countershaft driving motor 103 is stopped, the shaft couplings 70 are easily positioned in the operational range.

[0100] (2-4) The first maintenance mode M1 or the normal stop mode M3 is set to be executed by the operation on the operation screen IM serving as the mode setting unit. Thus, for example, while the spinning machine 100 is stopped in the normal stop mode M3 when the maintenance of the fiber bundle condensing device 10 is not required, the spinning machine 100 is stopped in the first maintenance mode M1 when the maintenance of the fiber bundle condensing device 10 is required. How the spinning machine 100 stops is selectable according to the state of the fiber bundle condensing device 10, thereby meeting the operator needs for the usage of the spinning machine 100.

(Third embodiment)

[0101] The following will describe a third embodiment of a fiber bundle condensing device of a spinning machine according to the present invention with reference to FIG. 15. In the third embodiment, detail description of the same parts as those of the first embodiment and the second embodiment will be omitted.

[0102] In the third embodiment, the second maintenance mode M2 will be described.

<Second maintenance mode>

[0103] The second maintenance mode M2 is executed while the operation of the spinning machine 100 is stopped. That is, the second maintenance mode M2 is executed when the maintenance of the fiber bundle condensing device 10 is required. The second maintenance mode M2 is a mode that causes the shaft couplings 70 to be positioned in the operational range when the countershafts 20 stop rotating by stopping the spinning machine 100 after starting up the spinning machine 100 in stop.

[0104] When the ON-button B3 for setting the second maintenance mode M2 is pushed on the operation screen IM of the display unit 45, the controller 40 sets the second maintenance mode M2 to be executed. When the second maintenance mode M2 is set to be executed, the detection speed setting unit 402 obtains the detection speeds V2c, V2s of the countershaft driving motor 103 and the spindle driving motor 112 from the memory, and sets the detection speeds V2c, V2s for the synchronization controller 401.

[0105] As shown in FIG. 15, also in the third embodiment, the detection speeds V2c, V2s are the respective rotational speeds of the countershaft driving motor 103 and the spindle driving motor 112, and set for the countershaft driving motor 103 and the spindle driving motor 112, respectively. The detection speeds V2c, V2s are each set to a value sufficiently small so as to be lower rotational speeds than the rotational speeds V1c, V1s at the time when a stop command is input from the operation unit 41 during the operation of the spinning machine 100.

[0106] In the second maintenance mode M2, when the start button 46 is pushed at a time ts, a command for executing the second maintenance mode M2 is input to the controller 40. Then, the synchronization controller 401 starts up the countershaft driving motor 103 and the spindle driving motor 112, and drives the countershaft driving motor 103 and the spindle driving motor 112 in synchronization with each other. The synchronization controller 401, after starting up the spinning machine 100, drives the countershaft driving motor 103 and the spindle driving motor 112 in synchronization with each other at the respective detection speeds V2c, V2s. In the second maintenance mode M2, the synchronization controller 401, at a time t2 when the rotational position detector 30 detects the detected surface 60c, stops the driving of the countershaft driving motor 103 and the spindle driving motor 112. In the second maintenance mode M2, when the driving of the countershaft driving motor 103 is stopped by the synchronization controller 401, the operation of the fiber bundle condensing device 10 is stopped, and the countershafts 20 slightly and inertially rotate. When the countershafts 20 stop rotating, the shaft couplings 70 are located at the positions where the bolts 80 are easily operated. That is, the shaft couplings 70 are located in the operational range.

[0107] In addition, when the synchronization controller 401 stops the driving of the spindle driving motor 112, the spindles 110 slightly and inertially rotate, and stop. Accordingly, when the second maintenance mode M2 is executed, the countershafts 20 stop such that the shaft couplings 70 are located in the operational range, and soon afterwards, the spindles 110 stop, following the countershafts 20.

[0108] The graph in FIG. 15 shows a relation between the number of rotations of the spindles 110 and time and a relation between the number of rotations of the countershafts 20 and time in the second maintenance mode M2. The number of rotations [rpm] of the spindles 110 and the number of rotations [rpm] of the countershafts 20 are shown in the vertical axis of the graph, and time t is shown in the transverse axis of the graph. A solid line in FIG. 15 shows a behavior of the spindles 110. A dashed line in FIG. 15 shows a behavior of the countershafts 20.

[Operation of the third embodiment]

[0109] As shown in FIG. 15, in the spinning machine 100 after stopping in the normal stop mode M3, when

the second maintenance mode M2 is set to be executed on the operation screen IM, at the time ts, the start button 46 is pushed to input the command for executing the second maintenance mode M2. The synchronization controller 401 drives the countershaft driving motor 103 and the spindle driving motor 112 in synchronization with each other, and accelerates the countershaft driving motor 103 and the spindle driving motor 112 such that the respective rotational speeds reach the detection speeds V2c, V2s. When the respective rotational speeds of the countershaft driving motor 103 and the spindle driving motor 112 reach the respective detection speeds V2c, V2s, the synchronization controller 401 drives the countershaft driving motor 103 and the spindle driving motor 112 in synchronization with each other at the detection speeds V2c, V2s.

[0110] After the countershaft driving motor 103 and the spindle driving motor 112 start driving at the detection speeds V2c, V2s, when a detection signal from the rotational position detector 30 is input to the controller 40 at the time t2 for the first time, the synchronization controller 401 stops the countershaft driving motor 103 and the spindle driving motor 112 in synchronization with each other. Then, the countershaft driving motor 103 and the spindle driving motor 112 slightly and inertially rotate, and stop. The countershafts 20 and the spindles 110 also slightly and inertially rotate, and stop. When the spindles 110 stop rotating, following the countershafts 20, the shaft couplings 70 stop to be positioned in the operational range.

[0111] According to the above-described third embodiment, advantageous effects are provided as described below.

[0112] (3-1) The shaft couplings 70 are positioned in the operation range by executing the second maintenance mode M2. For that reason, even in the case where the maintenance of the fiber bundle condensing device 10 is required while the operation of the spinning machine 100 is stopped, the countershafts 20 are positioned in the position where the maintenance of the countershafts 20 is easily performed by executing the second maintenance mode M2. Even when the countershafts 20 stop at any desired position, a relative difference in the number of rotations between the countershafts 20 and the spindles 110 is made small, thereby preventing the fiber bundles F from being broken when the second maintenance mode M2 is executed.

[0113] The embodiments may be modified as described below. The embodiments and the following modifications may be combined with each other as long as they do not technically contradict each other.

[0114] As illustrated in FIG. 16, a detected surface 71c may be formed in any one of the shaft couplings 70. The detected surface 71c may be a plane formed in the outer surface of the first coupling member 71, or may be a plane formed in the outer surface of the second coupling member 72.

[0115] The detected portion need not be a surface, such as the detected surface 60c. For example, a groove or a hole formed in any one of the countershafts 20 or the detection shaft 60 may be used as the detected portion. In short, as long as the rotational position of the countershaft 20 is detectable by the rotational position detector 30, types of the rotational position detector 30 and the detected portion may be changed.

[0116] When the fiber bundle condensing device 10 includes two countershafts 20, the number of the shaft couplings 70 may be one.

[0117] The coupling main body 73 of each shaft coupling 70 need not be divided into the first coupling member 71 and the second coupling member 72. For example, the coupling main body 73 may be formed in a C-shape in the axial direction of the shaft coupling 70.

[0118] The detection shaft 60 may be replaced with any one of the countershafts 20. In this case, the detected portion is provided in the second coupling end portion 20c of the countershaft 20. The detected portion may be set to any suitable position in the longitudinal direction X, such as an end or a middle of the countershaft 20 in the longitudinal direction X. In this case, a position of the rotational position detector 30 is changed depending on the position of the detected portion.

[0119] The operational range may be changed as appropriate. As an example of the operational range, a range from the position illustrated in FIG. 4 to a position where the bolt head accommodation portion 75 is rotated downward by 45 degree therefrom may be used. That is, as long as the operator can operate the bolts 80 at any position in the operational range, the operational range may be changed as appropriate.

[0120] The number of fiber bundle condensing devices 10 and the number of the countershafts 20 may be changed as appropriate. In this case, the spinning machine 100 may include a middle head depending on the number of the fiber bundle condensing devices 10.

[0121] The fiber bundle condensing device 10 may include a plurality of detected portions. In this case, the rotational position detector 30 is disposed in each of the detected portions. For example, the plurality of the shaft couplings 70 have different rotational positions. The detected portions are formed in the respective countershafts 20 or the respective shaft couplings 70, and the rotational position detectors 30 are provided in correspondence with the respective detected portions.

[0122] The axial lengths of the first coupling end portion 20b and the second coupling end portion 20c of each countershaft 20 may be changed as appropriate.

[0123] As long as the rotational position detector 30 detects the detected surface 60c, a method of supporting the detection shaft 60, a method of arranging the rotational position detector 30, a position of the detected surface 60c, and a position of the rotational position detector 30 may be changed as appropriate.

[0124] In the first maintenance mode M1 and the second maintenance mode M2, during the driving of the countershaft driving motor 103 and the spindle driving

motor 112 at the detection speeds V2c, V2s, the time when the driving of the countershaft driving motor 103 and the spindle driving motor 112 is stopped is not limited to the time when the rotational position detector 30 detects the detected surface 60c for the first time, and may be changed as appropriate. For example, the time when the rotational position detector 30 detects the detected surface 60c for the second time may be used.

[0125] In the spinning machine 100, the drafting device 130 and the lifting unit 120 may be driven by the driving of the spindle driving motor 112. In this case, the drafting device 130 does not include the first draft motor 132 and the second draft motor 134, and the lifting unit 120 does not include the lifting motor 126.

A fiber bundle condensing device (10) of a spinning machine (100) includes a condensing unit, a plurality of countershafts (20), a countershaft driving motor (103), and a shaft coupling (70). The shaft coupling (70) couples the countershafts (20) with a bolt (80). The fiber bundle condensing device (10) further includes a detected portion, a rotational position detector (30), a controller (40), and an operation unit (41). An operational range is defined as a range where a rotational position of the shaft coupling (70) is located and the bolt (80) used for a coupling main body (73) is operable from a front of the fiber bundle condensing device (10). The controller (40), when the stop command is input, controls the driving of the countershaft driving motor (103) such that the shaft coupling (70) is located in the operation range at a time when the countershafts (20) stop rotating.

Claims

1. A fiber bundle condensing device (10) of a spinning machine (100) comprising:

a condensing unit (11) including:

a delivery bottom roller (13) mounted on a rotary shaft (12) and delivering a fiber bundle (F);
a suction portion (14) performing a suction operation on the fiber bundle (F);
an air-permeable apron (15) being rotated along the suction portion (14); and
a delivery top roller (16) being in contact with the delivery bottom roller (13) through the air-permeable apron (15) and rotating with the delivery bottom roller (13),

the condensing unit (11) condensing the fiber bundle (F), which have been drafted;
a plurality of countershafts (20) arranged in an axial direction of the countershafts (20) and rotating the rotary shaft (12);
a countershaft driving motor (103) driving the countershafts (20); and
a shaft coupling (70) coupling the countershafts (20) arranged side by side in the axial direction and integrally rotating with the countershafts (20), and
the shaft coupling (70) coupling the countershafts (20) by fastening a coupling main body (73) disposed over a first end portion (20b) of one countershaft (70) and a second end portion (20c) of the other countershaft (70) adjacent to the one countershaft (70) with a bolt (80), **characterized in that**
the fiber bundle condensing device (10) further includes:

a detected portion (60c) formed in at least one of the countershafts (20) or the shaft coupling (70) and detecting a rotational position of the at least one of the countershafts (20);
a rotational position detector (30) outputting rotational position information of the countershafts (20) by detecting the detected portion (60c);
a controller (40) to which the rotational position information output from the rotational position detector (30) is input, the controller (40) controlling the countershaft driving motor (103); and
an operation unit (41) outputting a stop command for stopping the driving of the countershaft driving motor (103) to the controller (40),

an operational range is defined as a range where a rotational position of the shaft coupling (70) is located and the bolt (80) used for the coupling main body (73) is operable from a front of the fiber bundle condensing device (10), and
the controller (40), when the stop command from the operation unit (41) is input to the controller (40), controls the driving of the countershaft driving motor (103) based on the rotational position information input from the rotational position detector (30) such that the shaft coupling (70) is located in the operation range at a time when the countershafts (20) stop rotating.

2. The fiber bundle condensing device (10) of the spinning machine (100) according to claim 1, **characterized in that**

the fiber bundle condensing device (10) includes a plurality of shaft couplings (70), and
rotational positions of all of the plurality of shaft couplings (70) are all aligned.

3. The fiber bundle condensing device (10) of the spinning machine (100) according to claim 1 or 2, **char-**

acterized in that

the detection shaft (60) is coupled to an endmost countershaft (20) of the plurality of countershafts (20) arranged,
the detection shaft (60) rotates, serving as the countershafts (20),
the detection shaft (60) has an axial length shorter than an axial length of each of the countershafts (20), and
the detected portion (60c) is formed in the detection shaft (60).

4. The fiber bundle condensing device (10) of the spinning machine (100) according to claim 1 or 2, **characterized in that**

the spinning machine (100) includes a spindle driving motor (112) driving a spindle (110) onto which the fiber bundle (F) condensed by the fiber bundle condensing device (10) is wound,
the controller (40) includes:

a synchronization controller (401) driving the countershaft driving motor (103) and the spindle driving motor (112) in synchronization with each other;
a detection speed setting unit (402) setting respective detection speeds of the countershaft driving motor (103) and the spindle driving motor (112), the detection speeds corresponding to rotational speeds set for the respective countershaft driving motor (103) and the spindle driving motor (112), the detection speeds being lower than rotational speeds of the countershaft driving motor (103) and the spindle driving motor (112) at a time when the stop command is input from the operation unit (41); and
a mode setting unit (IM) that sets a first maintenance mode (M1) to be executed, the first maintenance mode (M1) causing the shaft coupling (70) to be positioned in the operational range when the rotation of the countershafts (60) is stopped by stopping an operation of the spinning machine (100), and

when the stop command is input from the operation unit (41) during the operation of the spinning machine (100) in a case where the first maintenance mode (M1) is set to be executed, by the mode setting unit (IM),
the synchronization controller (401) drives the countershaft driving motor (103) and the spindle driving motor (112) in synchronization with each other such that the rotational speeds of the countershaft driving motor (103) and the spindle driving motor (112) are decreased to the detection speeds, drives the countershaft driving motor (103) and the spindle driving motor (112) in synchronization at the respective detection speeds, and stops the driving of the countershaft driving motor (103) and the spindle driving motor (112) at a time when the rotational position detector (30) detects the detected portion (60c).

5. The fiber bundle condensing device (10) of the spinning machine (100) according to claim 1 or 2, **characterized in that**

the spinning machine (100) includes a spindle driving motor (112) driving a spindle (110) onto which the fiber bundle (F) condensed by the fiber bundle condensing device (10) is wound,
the controller (40) includes:

a synchronization controller (401) driving the countershaft driving motor (103) and the spindle driving motor (112) in synchronization with each other;
a detection speed setting unit (402) setting respective detection speeds of the countershaft driving motor (103) and the spindle driving motor (112), the detection speeds corresponding to rotational speeds set for the respective countershaft driving motor (103) and the spindle driving motor (112), the detection speeds being lower than rotational speeds of the countershaft driving motor (103) and the spindle driving motor (112) at a time when the stop command is input from the operation unit (41); and
a mode setting unit (IM) that sets a second maintenance mode (M2) to be executed, the second maintenance mode (M2) causing the shaft coupling (70) to be positioned in the operational range when the rotation of the countershafts (20) is stopped by stopping the spinning machine (100) after starting up the spinning machine in stop, and

when a command for executing the second maintenance mode (M2) is input to the spinning machine (100) in stop in a case where the second maintenance mode (M2) is set to be executed, by the mode setting unit (IM),
the synchronization controller (401) drives the countershaft driving motor (103) and the spindle driving motor (112) in synchronization with each other at the respective detection speeds, and stops the driving of the countershaft driving motor (103) and the spindle driving motor (112) at a time when the rotational position detector (30) detects the detected portion (60c).

6. The fiber bundle condensing device (10) of the spinning machine (100) according to claim 4, **characterized in that**
the mode setting unit (IP) sets a normal stop mode (M3) to be executed, the normal stop mode (M3) causing the spindle driving motor (112) and the countershaft driving motor (103) to be stopped in such a manner that the countershaft driving motor (103) follows the spindle driving motor (112).

FIG. 1

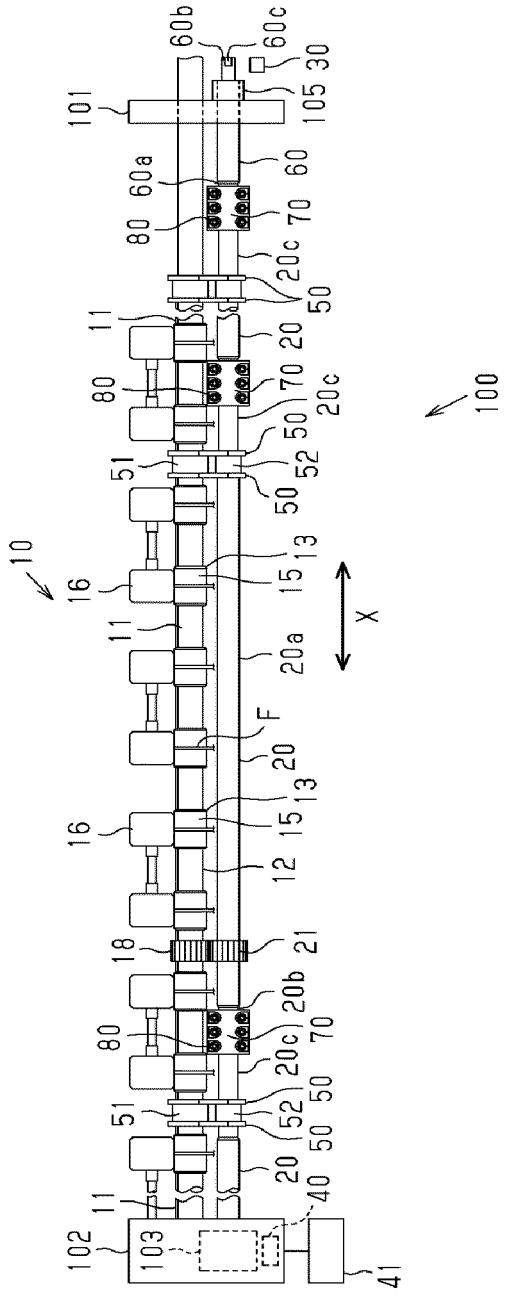

60b
60c
30
105
101
60a
60
80
70
20c
50
11
20
80
70
20c
50
51
52
50
10
13
16
15
X
11
20a
F
20
13
16
15
12
18
21
20b
80
70
20c
51
52
50
50
20
40
11
102
103
41
100

FIG. 2

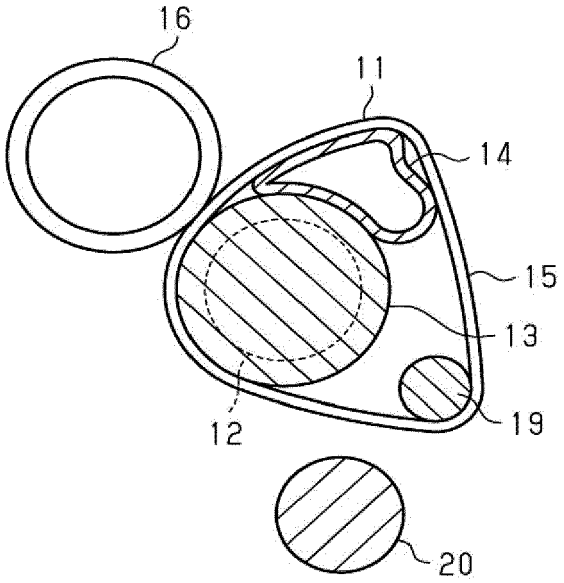

16
11
14
15
13
19
12
20

FIG. 3

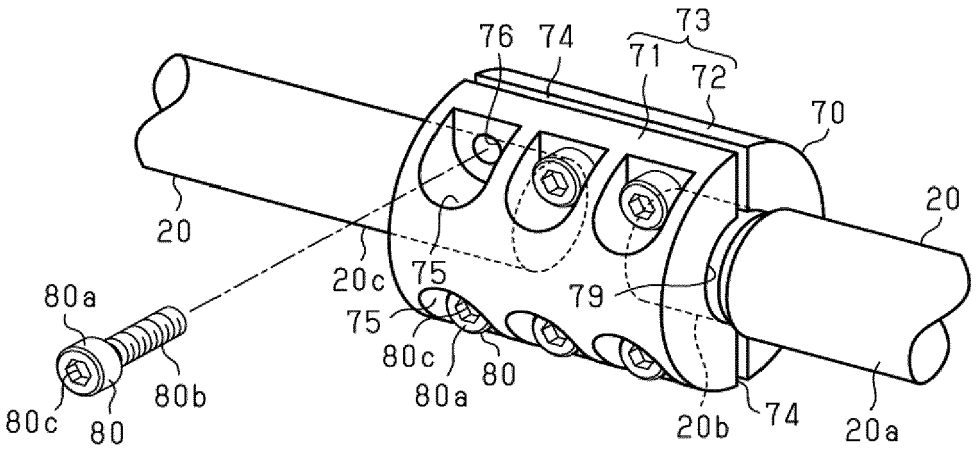
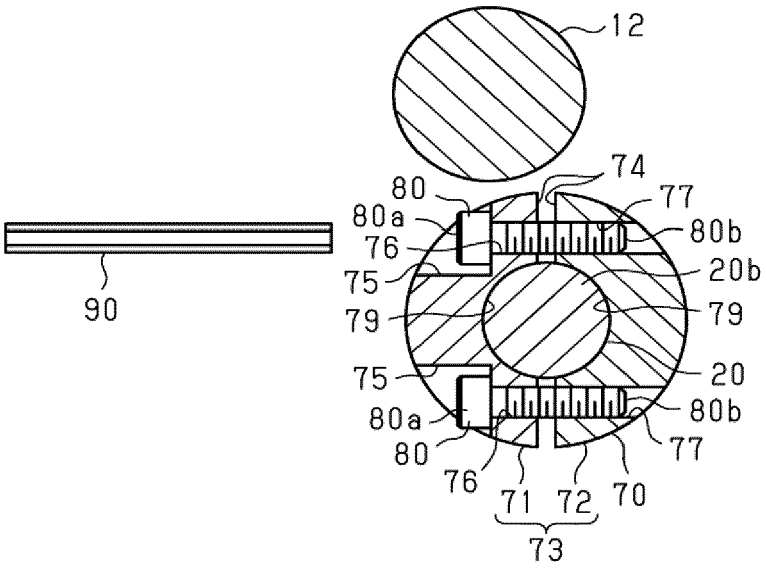

76
74
73
71
72
70
20
20
20c
75
79
80a
75
80c
80
80a
80b
80c
80
20b
74
20a

FIG. 4


12
74
80
77
80a
80b
76
20b
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79
79
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20
80a
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77
76
71
72
70
73
90

FIG. 5

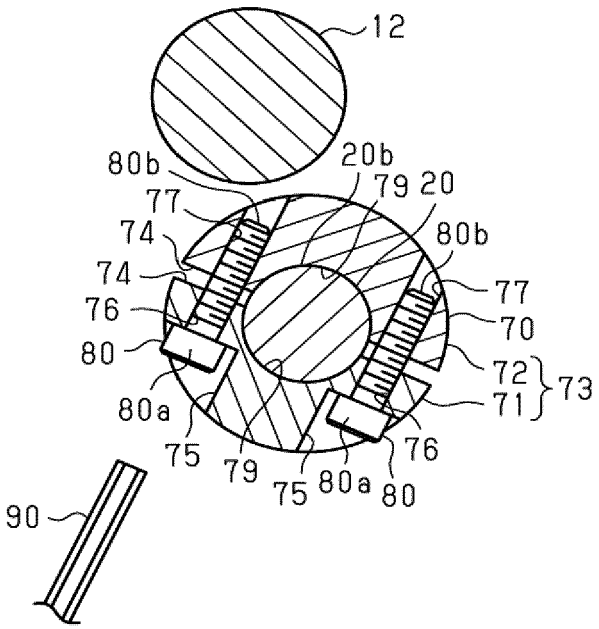

12
80b
20b
79
20
77
74
80b
74
77
76
70
80
72
73
71
80a
75
79
75
80a
80
76
90

FIG. 6

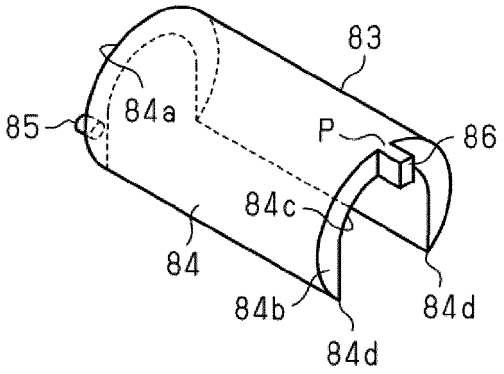


FIG. 7

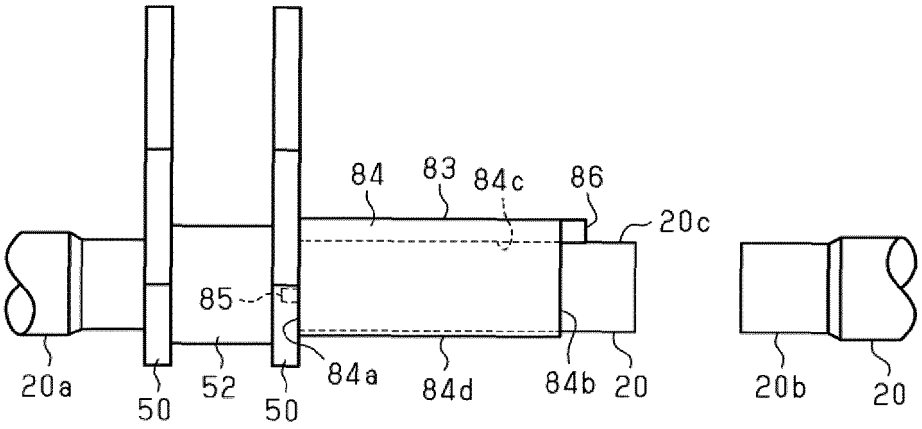


FIG. 8

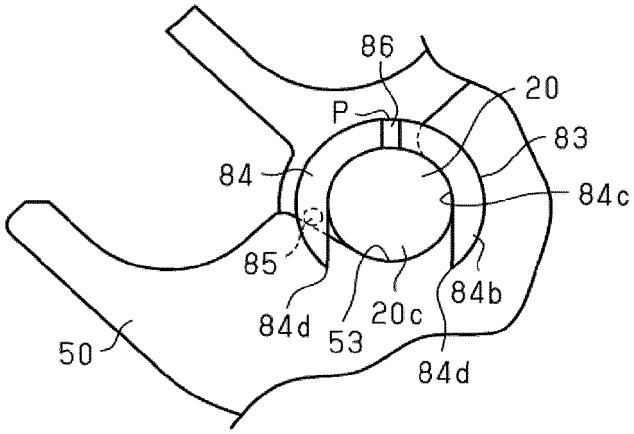


FIG. 9

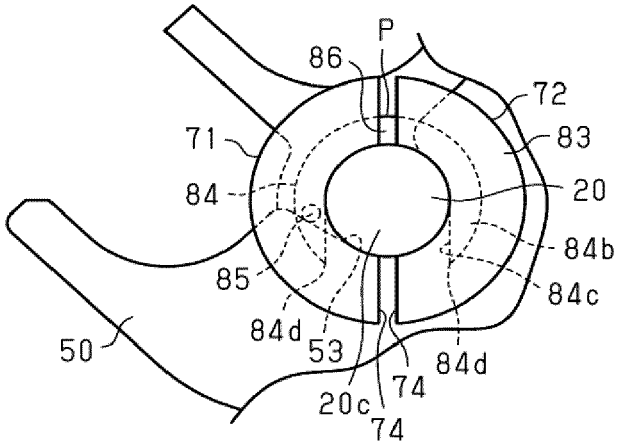


FIG. 10

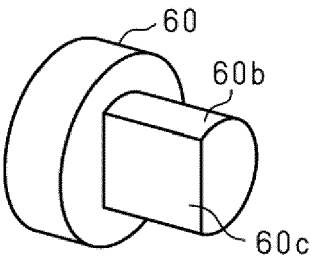


FIG. 11

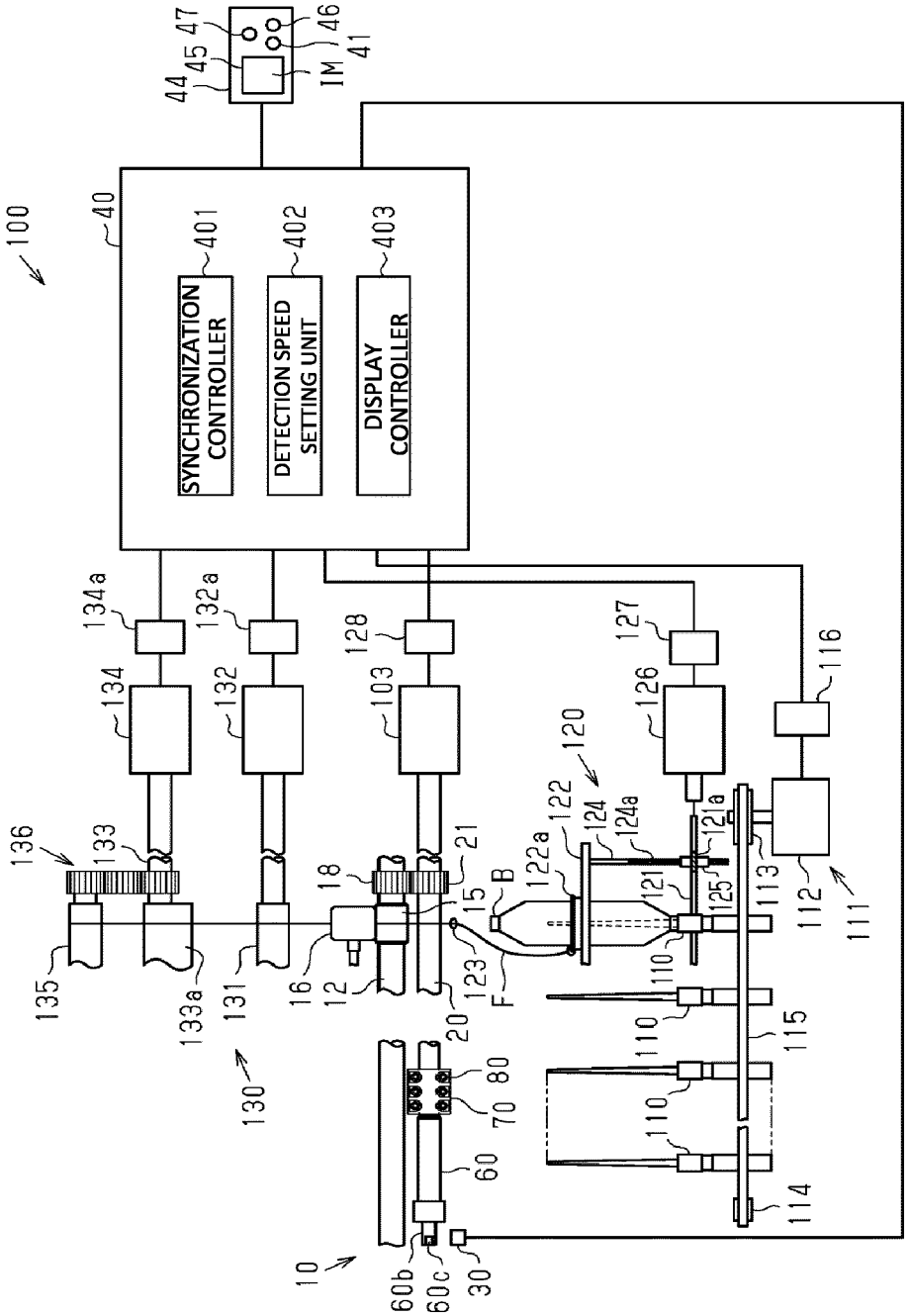

100
40
401
SYNCHRONIZATION CONTROLLER
402
DETECTION SPEED SETTING UNIT
403
DISPLAY CONTROLLER
41
IM
44
45
47
46
134a
132a
128
127
116
134
132
103
126
120
136
133
18
21
122a
122
124
124a
121a
B
15
121
125
113
112
111
135
133a
131
16
12
123
F
110
115
20
130
80
70
60
114
10
60b
60c
30

FIG. 12

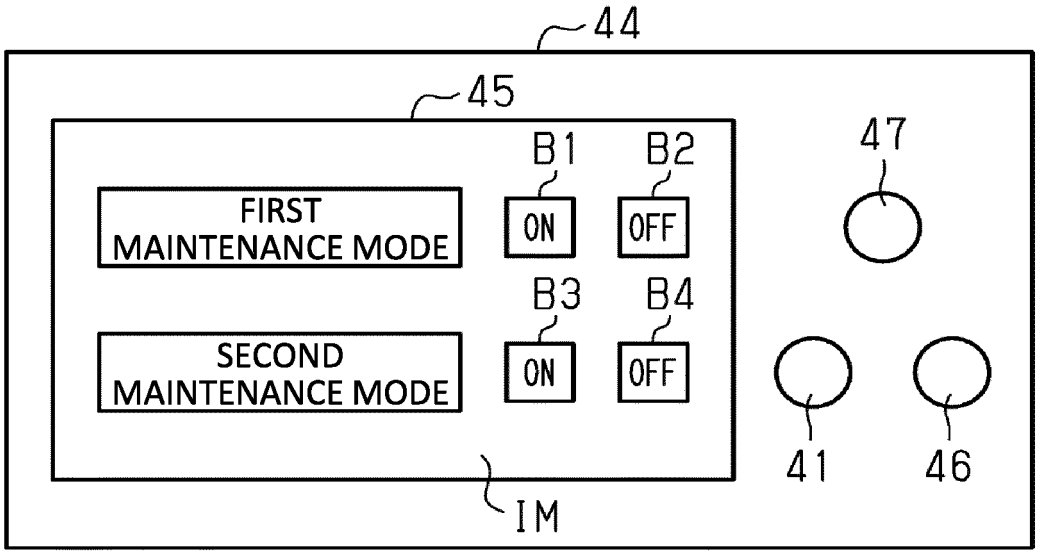

44
45
B1
B2
47
FIRST MAINTENANCE MODE
ON
OFF
B3
B4
SECOND MAINTENANCE MODE
ON
OFF
41
46
IM

FIG. 13

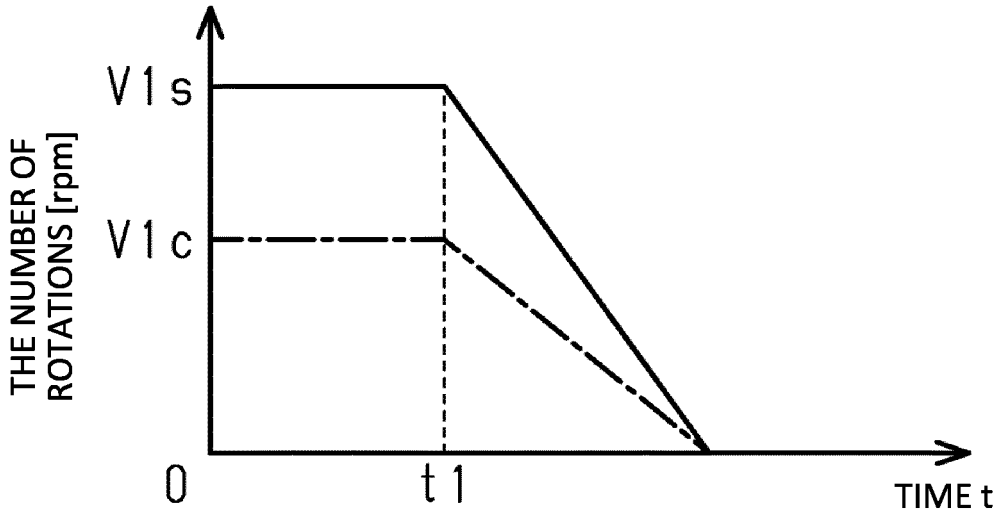

V1s
V1c
THE NUMBER OF ROTATIONS [rpm]
0
t1
TIME t

FIG. 14

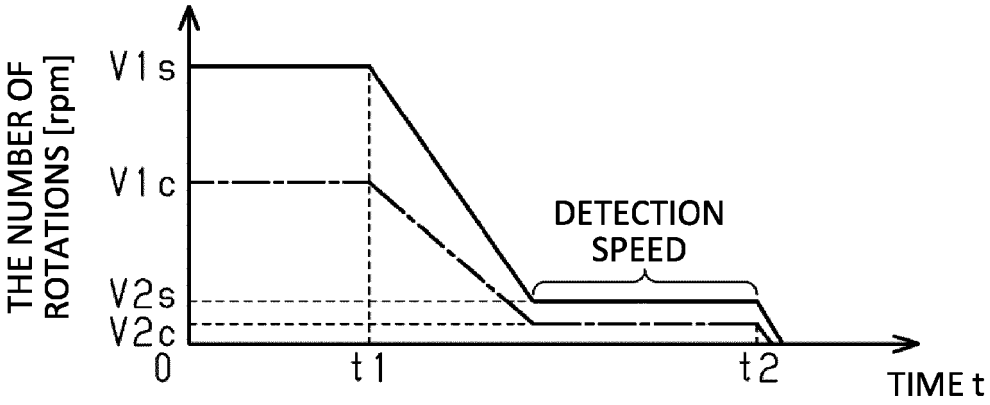


FIG. 15

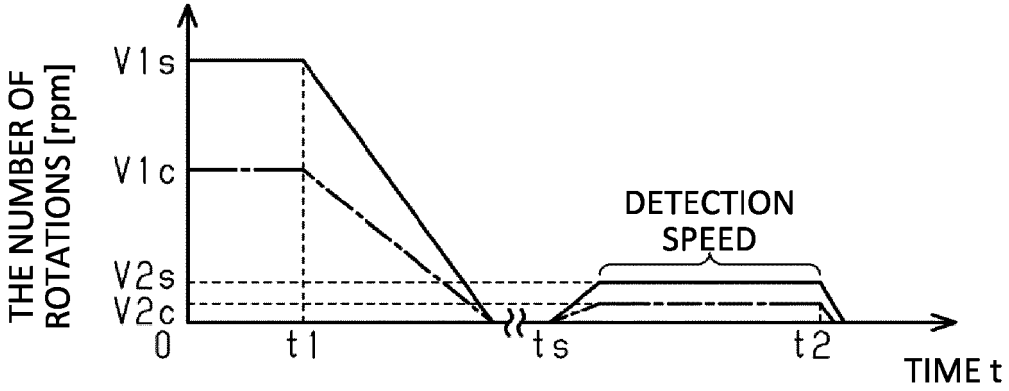
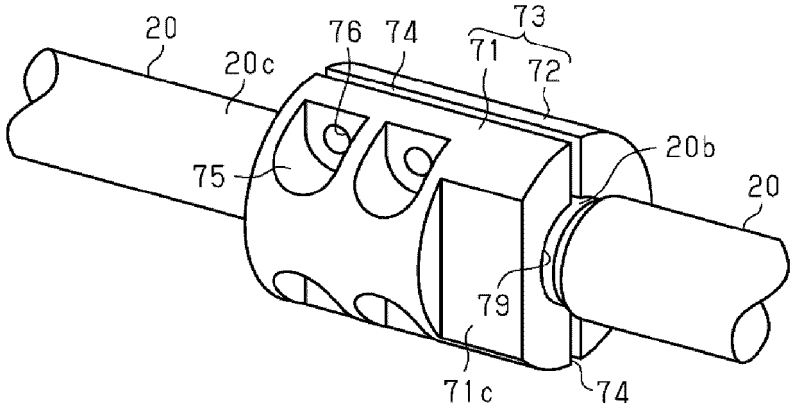


FIG. 16



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EUROPEAN SEARCH REPORT

Application Number
EP 23 16 9388

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 2019 148045 A (MURATA MACHINERY LTD) 5 September 2019 (2019-09-05) * abstract * * paragraph [0050] - paragraph [0068] * * figures 1-8 *	1-6	INV. D01H5/72 D01H13/32 D01H1/22
A	JP 2020 100931 A (SAURER SPINNING SOLUTIONS GMBH & CO KG) 2 July 2020 (2020-07-02) * abstract * * paragraph [0041] - paragraph [0051] * * figures 4-6 *	1-6	
A	DE 27 35 799 A1 (ZINSER TEXTILMASCHINEN GMBH) 22 February 1979 (1979-02-22) * the whole document *	1-6	
A	US 2 875 645 A (JACOB KEYSER JOHANN) 3 March 1959 (1959-03-03) * the whole document *	1-6	
			TECHNICAL FIELDS SEARCHED (IPC)
			D01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 September 2023	Humbert, Thomas

CATEGORY OF CITED DOCUMENTS

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15-09-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2019148045 A	05-09-2019	CN 210104152 U	21-02-2020
		JP 2019148045 A	05-09-2019
JP 2020100931 A	02-07-2020	CN 111334905 A	26-06-2020
		DE 102018132951 A1	25-06-2020
		EP 3670718 A1	24-06-2020
		ES 2946340 T3	17-07-2023
		JP 2020100931 A	02-07-2020
DE 2735799 A1	22-02-1979	NONE	
US 2875645 A	03-03-1959	CH 360328 A	15-02-1962
		DE 1111547 B	20-07-1961
		FR 1181442 A	16-06-1959
		GB 828484 A	17-02-1960
		US 2875645 A	03-03-1959

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Patent documents cited in the description

- EP 1473388 A **[0002]**