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(54) FIBER BUNDLE CONDENSING DEVICE FOR SPINNING MACHINE

(57) A fiber bundle condensing device (100) includes a condensing device (110) configured to condense a fiber bundle (F) and including a delivery bottom roller (112) that is mounted on a rotary shaft (111) and transports the fiber bundle (F), a countershafts (130) configured to drive the rotary shaft (111), a driven gear (113) mounted on the rotary shaft (111), a drive gear (132) mounted on the countershaft (130). A plurality of the countershafts (130) corresponding to a plurality of the condensing devices (110) are connected by a coupling (150). A conditional expression $W > d \geq (1/4) \times W$ is satisfied, where W represents a width of the drive gear (132) and d represents a distance between ends of the plurality of countershafts (130) connected by the coupling (150).

FIG. 1A

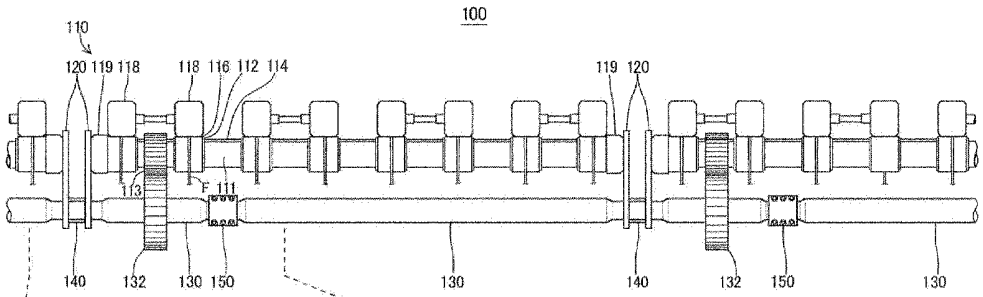
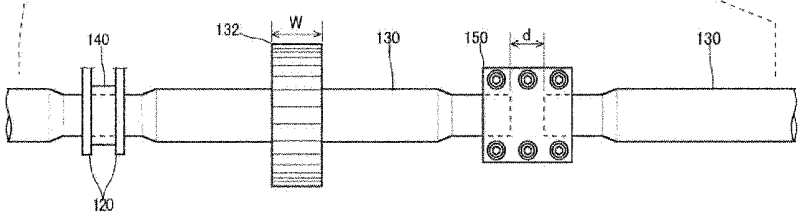


FIG. 1B



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Description

BACKGROUND ART

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

[0002] Various types of fiber bundle condensing devices have been proposed for condensing fiber bundles, which are drafted by a draft device prior to twisting, to improve yarn quality, for example, by reducing fluff, adjusting yarn strength, and the like.

[0003] Such fiber bundle condensing devices include a countershaft for rotating a rotary shaft on which a delivery bottom roller delivering fiber bundles is mounted. A rotational force of the countershaft is transmitted to the rotary shaft with a drive gear mounted on the countershaft engaged with a driven gear mounted on the rotary shaft.

[0004] European Patent Application Publication No. 1473388 discloses a relationship between a rotary shaft on which a delivery bottom roller is mounted and a countershaft transmitting a rotating force to the rotary shaft in a fiber bundle condensing device.

[0005] In a spinning machine, a plurality of fiber bundle condensing devices are arranged in parallel to each other to form a unit, and a plurality of units of the fiber bundle condensing devices are arranged in parallel to each other. The spinning machine includes a plurality of countershafts each having a drive gear connected in a series so as to correspond to the plurality of the units of fiber bundle condensing devices.

[0006] The drive gears mounted on the countershafts need to be replaced temporarily or periodically due to damage or wear caused by catching foreign objects, or the like, during operation.

[0007] There is a method of replacing a drive gear in which replacing the drive gear after a series of the plurality of countershafts for the plurality of units of the fiber bundle condensing devices are pulled out from the spinning machine. In this case, the series of the countershafts are pulled out from the spinning machine, and the countershafts need to be placed back after the drive gear is replaced. This requires a significant amount of time to replace the drive gear. As a result, the productivity of the spinning machine is reduced due to an increase of the downtime of the spinning machine.

[0008] There is another method of replacing a drive gear in which the drive gear dividable into two parts are used and the drive gear to be replaced is removed by dividing it into two. In this case, using the drive gear dividable into two parts increases the cost of the drive gear, it becomes difficult to balance the rotation of the drive gear, and the reliability of the drive gear decreases due to loosening of the fastening screws.

[0009] The device disclosed in the above-cited Publication lacks consideration for the replacement of the drive gears. Therefore, there is a demand for replacing the drive gears mounted on the countershafts quickly without reducing the productivity of the spinning machine and without using special parts.

[0010] The present invention is directed to providing a fiber bundle condensing device for a spinning machine in which a drive gear, which is mounted on a countershaft driving to rotate a rotary shaft of a delivery bottom roller that transports fiber bundles, can be replaced quickly without using special parts and without reducing productivity of the spinning machine.

SUMMARY

[0011] In accordance with present invention, there is provided a fiber bundle condensing device for a spinning machine including a condensing device configured to condense a fiber bundle which has been drafted, the condensing device including a delivery bottom roller that is mounted on a rotary shaft and transports the fiber bundle, a suction portion that exerts suction acting on the fiber bundle, an air-permeable apron that rotates along the suction portion, and a delivery top roller that is pressed against and in contact with the delivery bottom roller with the air-permeable apron interposed between the delivery top roller and the delivery bottom roller and rotates together with the delivery bottom roller, a countershaft configured to drive the rotary shaft, a driven gear mounted on the rotary shaft and configured to receive a driving force from the countershaft, and a drive gear mounted on the countershaft and configured to be engaged with the driven gear. The fiber bundle condensing device includes a plurality of the countershafts corresponding to a plurality of the condensing devices, the plurality of the countershafts being connected by a coupling. A conditional expression $W > d \geq (1/4) \times W$ is satisfied, where W represents a width of the drive gear and d represents a distance between ends of the plurality of countershafts connected by the coupling.

[0012] 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 DRAWINGS

[0013] 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:

FIGS. 1A and 1B are configuration views of a fiber bundle condensing device for a spinning machine according to an embodiment of the present invention; and

FIGS. 2A. 2B, 2C and 2D are views for describing replacement of a drive gear mounted on a countershaft in the fiber bundle condensing device for the spinning machine according to the first embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0014] The following will describe a fiber bundle condensing device for a spinning machine according to an embodiment of the present invention with reference to the accompanying drawings. It is noted that same reference numerals are used for the same components in the drawings.

Embodiment

[0015] Firstly, a basic configuration of a fiber bundle condensing device of a spinning machine according to the present embodiment will be described with reference to FIGS. 1A and 1B. FIG. 1A illustrates a fiber bundle condensing device 100, and FIG. 1B illustrates a countershaft 130 of the fiber bundle condensing device 100.

[Configuration of fiber bundle condensing device]

[0016] The fiber bundle condensing device 100 is disposed downstream of a draft device (not illustrated), and is configured to condense fiber bundles drafted by the draft device for reducing fluff or the like prior to twisting. The draft device is disposed on a rear of the fiber bundle condensing device 100 of the illustration of FIG. 1A. The fiber bundles are processed by the fiber bundle condensing device 100, and delivered to a lower front of the fiber bundle condensing device 100 in the illustration of FIG. 1A.

[0017] As illustrated in FIG. 1A, the fiber bundle condensing device 100 includes a plurality of condensing devices 110, a plurality of support plates 120, and the countershaft 130 as main components.

[0018] The condensing devices 110 cooperate to include a rotary shaft 111, a plurality of delivery bottom rollers 112, a plurality of suction portions 114, a plurality of air-permeable aprons 116, a plurality of delivery top rollers 118, and end plugs 119.

[0019] The plurality of the delivery bottom rollers 112 and a driven gear 113 are mounted on the rotary shaft 111. A drive gear 132 is mounted on the countershaft 130. The drive gear 132 mounted on the countershaft 130 drive to rotate the driven gear 113 of the rotary shaft 111. In other words, the driven gear 113 that is configured to receive a driving force from the countershaft 130 is mounted on the rotary shaft 111. With rotation of the driven gear 113, the delivery bottom rollers 112 rotate together with the rotary shaft 111, which rotates the air-permeable aprons 116 and transports fiber bundles F.

[0020] Each of the suction portion 114 includes a plurality of suction holes. The suction portions 114 exert suction acting on the fiber bundles F transported from the delivery bottom rollers 112 through the air-permeable aprons 116. The air-permeable aprons 116 are made of air-permeable woven cloth having no ends. The air-permeable aprons 116 are wound on their associated delivery bottom rollers 112, the suction portions 114, and guide portions (not illustrated). Each of the delivery top rollers 118 is pressed against and in contact with its associated one of the delivery bottom roller 112 with the air-permeable apron 116 interposed therebetween. The delivery top rollers 118 rotate together with the delivery bottom rollers 112, thereby transporting the fiber bundles F.

[0021] The condensing devices 110 for eight spindles are arranged between the support plates 120. A group of the condensing devices 100 for the eight spindles (i.e., a condensing device group) serves as a unit. A plurality of the units formed of the condensing device group are disposed along a longitudinal direction of the spinning machine. The rotary shaft 111 has a predetermined length corresponding to the condensing device group for the eight spindles. The end plugs 119 are disposed on opposite ends of the rotary shaft 111. The end plugs 119 allow the rotary shaft 111 to be supported rotatably by the pair of support plates 120. The support plates 120 are fixed to a roller stand (not illustrated).

[0022] The countershaft 130 has a predetermined length corresponding to the condensing device group for the eight spindles. The countershafts 130 is supported by the roller stand (not illustrated) via a bearing 140. The drive gear 132 to be engaged with the driven gear 113 of the rotary shaft 111 is mounted on the countershaft 130. The countershafts 130 drives the rotary shaft 111 through the drive gear 132 and the driven gear 113. A plurality of the countershafts 130 corresponding to the units of the condensing device group are connected to each other by couplings 150 in the longitudinal direction of the spinning machine.

[0023] The fiber bundles F are transported while being held between the delivery bottom rollers 112 and the delivery top rollers 118, which rotate with rotation of the rotary shaft 111 driven by the associated countershaft 130, and being drawn by suction of the suction portions 114 through the air-permeable aprons 116.

[0024] A reaction force of the drive gear 132 may increase depending on the spinning condition. Therefore, a position of the drive gear 132 to be mounted on the countershaft 130 needs to be set at a position between the first spindle and the second spindle from the roller stand or the support plate 120. In this case, the coupling 150 may be disposed at a position between the second spindle and the third spindle from the roller stand or the support plate 120. In the countershaft 130, selecting the position of the coupling 150 or the position of the drive gear 132 and the position of the coupling 150 as described above reduces unbalanced rotation and bending of the countershaft 130, which minimizes influences on the yarn quality.

[0025] In the embodiment, reference characters W and d in FIG. 1B represent a width of the drive gear 132, and a distance between the ends of the countershafts 130 connected to each other by the coupling 150, respectively. By fastening and unfastening bolts or the like, the coupling 150 connects and disconnects the countershafts

130 disposed adjacently to each other.

[0026] In the embodiment, the fiber bundle condensing device 100 is configured to satisfy a conditional expression W > d ≥ (1/n). In a case where n representing the number of couplings 150 to be removed from the countershafts 130 is 4, the fiber bundle condensing device 100 satisfies W > d ≥ (1/4) x W4. Preferably, the fiber bundle condensing device 100 is configured to satisfy a conditional expression W > d ≥ (1/3) x W, in a case where the number of the couplings 150 to be removed from the countershafts 130 is 3. More preferably, the fiber bundle condensing device 100 is configured to satisfy the conditional expression W > d ≥ (1/2) x W, in a case where the number of the couplings 150 to be removed from the countershafts 130 is 2.

[Drive gear replacement procedure]

[0027] The following will describe the replacement of the drive gear 132 mounted on the countershaft 130 with reference to FIG. 2A through 2D. FIGS. 2A through 2D are views for describing the replacement of the drive gear 132 mounted on the countershaft 130 in the fiber bundle condensing device 100 for the spinning machine according to the embodiment.

[0028] FIG. 2A, illustrates a state where three countershafts 130a, 130b, 130c are connected by couplings 150a, 150b. A drive gear 132a is mounted on the countershaft 130a.

[0029] The following will describe a specific example of the replacement of the drive gear 132a when the number n of the couplings 150 to be removed from the countershafts 130 in the conditional expression is 2. In this example, the drive gear 132a to be replaced is removed at a position where the coupling 150a is positioned, and two of the couplings 150a, 150b are subjected to unfastening.

[0030] FIG. 2B illustrates a state where the three countershafts 130a , 130b, 130c are disconnected by unfastening the couplings 150a, 150b. Broken lines in FIG. 2B indicate a state where the couplings 150a, 50b are removed from the three countershafts 130a, 130b, 130c.

[0031] In FIG. 2C, the countershaft 130b is disconnected by unfastening the two couplings 150a and 150b. The position of the disconnected countershaft 130b is moved in an axial direction of the countershaft 130b toward a side opposite to the drive gear 132a to be replaced. In other words, the position of the countershaft 130b is moved in the axial direction so as to decrease the distance d in an area where the coupling 150b has been positioned.

[0032] As a result, the distance d existed in the area where the coupling 150b has been positioned is added to the distance d in an area where the coupling 150a is positioned. In other words, an extended distance 2d (d + d = 2d) is provided between the countershafts 130a and 130b.

[0033] Now, the conditional expression W > d ≥ (1/2) x W may be resolved into W > d and W ≤ 2d.

[0034] In other words, a dimension of the width W of the drive gear 132a is greater than a dimension of the distance d between the ends of the countershafts 130a and 130b connected to each other by the coupling 150a. Therefore, the drive gear 132a cannot pass a gap formed of the distance d when only the coupling 150a is removed, so that the drive gear 132a cannot be removed.

[0035] On the other hand, when the distance between the countershafts 130a and 130b is extended to the extended distance 2d, as illustrated in FIG. 2C, the width W is equal to or greater than the distance 2d (W ≤ 2d). Thus, the drive gear 132a having the width W can pass the gap formed of the distance 2d between the countershafts 130a and 130b, which has been extended.

[0036] As specific values for the width W and the distance d in this case, the width W is 20 mm and the distance d is 17 mm, for example. The drive gear 132a having the width of 20 mm can pass the gap formed of the distance 2d of 34 mm, which is doubled.

[0037] Accordingly, when the couplings 150a and 150b are unfastened and the position of the countershaft 130b is moved in the axial direction, only the drive gear 132a may be removed through the gap of the extended distance 2d after the drive gear 132a is moved in a direction toward the countershaft 130b, as illustrated in FIG. 2D.

[0038] A new drive gear 132a may be mounted on the countershaft 130a at the position where the previous drive gear 132a is mounted by performing the above procedure in a reversed order such as in order of FIGS. 2D, 2C, 2B, 2A, so that the fiber bundle condensing device 100 for the spinning machine may return to an operable state quickly. Accordingly, only a minimum of two couplings 150 need be removed and mounted for the replacement of the drive gear, which offers excellent workability.

[0039] That is, in the countershaft 130 configured to drive to rotate the rotary shaft 111 of the delivery bottom rollers 112 transporting the fiber bundles F, the drive gear may be replaced quickly by removing only the drive gear 132a without using special parts, such as a dividable drive gear, without pulling out all the connected plurality of the countershafts 130 from the spinning machine, and without reducing the productivity of the spinning machine.

[0040] In the above-described example, the conditional expression W > d ≥ (1/2) x W in which the number of couplings to be removed is the minimum of 2 has been described. In addition to that, the number of couplings to be removed may be 3 with the conditional expression W > d ≥ (1/3) x W, or the number of the couplings to be removed may be 4 with the conditional expression W > d ≥ (1/4) x W.

[0041] The following will describe a case where the conditional expression is W > d ≥ (1/3) x W. In this case, three couplings 150 connected to two countershafts 130 are unfastened. Then, positions of the two countershafts 130 disconnected by unfastening the three couplings 150 are moved in the axial direction so as to extend an area

where the drive gear 132 to be replaced is removed.

[0042] As a result, a dimension of the distance 2d provided by moving the positions of the two countershafts 130 is added to a dimension of the distance d in an area adjacent to the drive gear 132 to be removed. In other words, a gap formed of a distance 3d is formed in the area where the drive gear 132 to be replaced is removed.

[0043] When the distance between the countershafts 130 is extended to the distance 3d, the width W is equal to or greater than the distance 3d ($W \leq 3d$). Thus, the drive gear 132a having the width W can pass the gap of the distance 3d between the countershafts 130a and 130b.

[0044] As specific values for the width W and the distance d in this case, the width W is 20 mm and the distance d is 8 mm, for example. The drive gear 132 having the width of 20 mm cannot pass the originally provided gap of 8 mm, but can pass the gap of the distance 3d of 24 mm, which is tripled.

[0045] Although the detailed description is omitted, in a case where the conditional expression $W > d \geq (1/4) \times W$ in which the number n of couplings 150 to be unfastened is 4, the drive gear 132 can be easily replaced similarly. As specific values for the width W and the distance d in this case, the width W is 20 mm and the distance d is 6 mm, for example. Therefore, it is effective for a configuration in which a difference in dimension between the width W and the distance d is great, a configuration in which the dimension of the distance d is small, or the like. The drive gear 132 having the width of 20 mm cannot pass the originally provided gap of 6 mm, but can pass the gap of the distance 4d of 24 mm, which is quadrupled.

[0046] By determining values or coefficient so as to satisfy one of the above conditional expressions $W > d \geq (1/2) \times W$, $W > d \geq (1/3) \times W$, and $W > d \geq (1/4) \times W$, the drive gear 132 can be replaced quickly, without using special parts and without reducing the productivity, in the fiber bundle condensing device 100 having the countershafts 130 driving the rotary shaft 111 rotatably on which the delivery bottom rollers 112 transporting the fiber bundles F are mounted.

[0047] In other words, the drive gear 132 may be replaced only by removing two to four couplings 150 and moving one to three countershafts 130, which hardly affects areas other than the area where these parts are positioned.

[0048] Therefore, the drive gears 132 may be replaced only by removing four couplings 150 at most and moving positions of the countershafts 130 in the axial direction, which significantly improves workability, as compared to a case where a series of the countershafts 130 for a plurality of the units of the condensing device group is pulled out from the spinning machine.

[Other embodiments]

[0049] The coupling 150 may have unbalanced rotation characteristics due to its structural features. Such unbalanced rotation characteristics of the coupling 150 may cause unbalanced rotation of the countershafts 130. Therefore, it is desirable to dispose the coupling 150 near the bearing 140 that supports the countershafts 130. On the other hand, a yarn path corresponding to a passage of the fiber bundle F is positioned about ± 30 mm from the roller stand to which the bearings 140 are fixed due to the restriction on the layout of the spinning machine. Thus, the coupling 150 need be arranged at a position avoiding the position of the yarn path. The coupling 150 may be positioned between the first spindle and the second spindle when the unbalance rotating force of the couplings 150 is greater than the reaction force of the drive gear 132.

[Advantageous effects offered by the present embodiment]

[0050] The above-described embodiment offers the following effects.

[0051] The fiber bundle condensing device 100 for the spinning machine according to the present embodiment includes the plurality of condensing devices 110 and the plurality of countershafts 130. Each of the condensing device 110 includes the delivery bottom roller 112 that is mounted on the rotary shaft 111 and transports the fiber bundle F, the suction portion 114 that exerts suction acting on the fiber bundle F, and the air-permeable apron 116 that rotates along the suction portion 114. The condensing device 110 is configured to condense the fiber bundle F which has been drafted. The countershaft 130 is configured to drive the corresponding rotary shaft 111. The driven gear 113 to receive the driving force from the countershaft 130 is mounted on the rotary shaft 111. The drive gear 132 to be engaged with the driven gear 113 is mounted on the countershaft 130. The countershafts 130 are connected to each other by the couplings 150. The plurality of countershafts 130 correspond to the plurality of the condensing devices 110. The fiber bundle condensing device 100 is configured to satisfy the conditional expression $W > d \geq (1/4) \times W$, where W represents the width of the drive gear 132 and d represents the distance between the ends of the countershafts 130 adjacent to each other connected via the coupling 150.

[0052] As a result, in the countershaft 130 configured to drive to rotate the rotary shaft 111 of the delivery bottom rollers 112 transporting the fiber bundles F, the drive gear may be replaced quickly by removing only the drive gear 132a without using special parts and without reducing the productivity. Since the drive gears 132 may be replaced only by removing four couplings 150 at most and moving positions of the countershafts 130 in the axial direction, which significantly improves workability, as compared to a case where a series of the countershafts 130 for a plurality of units of the condensing device group is pulled out from the spinning machine.

[0053] In the fiber bundle condensing device 100 of

the spinning machine according to the present invention, preferably, the fiber bundle condensing device 100 is configured to satisfy the conditional expression $W > d \geq (1/2) \times W$, where W represents the width of the drive gear 132 and d represents the distance between the ends of the countershafts 130 adjacent to each other connected by the coupling 150. In this case, since the drive gear 132 may be replaced by removing the minimum of two couplings 150 and moving a position of only one of the countershafts 130 in the axial direction, the workability is significantly improved, as compared to the case where the series of the countershafts 130 corresponding to the plurality of units of the condensing device group is pulled out from the spinning machine. Therefore, the drive gear 132 is quickly replaced without using special parts and without reducing the productivity. In the fiber bundle condensing device 100 of the spinning machine, the replacement of the drive gear 132 hardly affects the areas other than the area where the countershafts 130 are disconnected by removing the couplings 150.

[0054] A fiber bundle condensing device (100) includes a condensing device (110) configured to condense a fiber bundle (F) and including a delivery bottom roller (112) that is mounted on a rotary shaft (111) and transports the fiber bundle (F), a countershafts (130) configured to drive the rotary shaft (111), a driven gear (113) mounted on the rotary shaft (111), a drive gear (132) mounted on the countershaft (130). A plurality of the countershafts (130) corresponding to a plurality of the condensing devices (110) are connected by a coupling (150). A conditional expression $W > d \geq (1/4) \times W$ is satisfied, where W represents a width of the drive gear (132) and d represents a distance between ends of the plurality of countershafts (130) connected by the coupling (150).

Claims

1. A fiber bundle condensing device (100) for a spinning machine, the fiber bundle condensing device (100) comprising:

   a condensing device (110) configured to condense a fiber bundle (F) which has been drafted, the condensing device (110) including a delivery bottom roller (112) that is mounted on a rotary shaft (111) and transports the fiber bundle (F), a suction portion (114) that exerts suction acting on the fiber bundle (F), an air-permeable apron (116) that rotates along the suction portion (114), and a delivery top roller (118) that is pressed against and in contact with the delivery bottom roller (112) with the air-permeable apron (116) interposed between the delivery top roller (118) and the delivery bottom roller (112) and rotates together with the delivery bottom roller (112);
   a countershaft (130) configured to drive the rotary shaft (111);
   a driven gear (113) mounted on the rotary shaft (111) and configured to receive a driving force from the countershaft (130); and
   a drive gear (132) mounted on the countershaft (130) and configured to be engaged with the driven gear (113),
   characterized in that
   the fiber bundle condensing device (100) includes a plurality of the countershafts (130) corresponding to a plurality of the condensing devices (110), the plurality of the countershafts (130) being connected by a coupling (150), and a conditional expression $W > d \geq (1/4) \times W$ is satisfied, where W represents a width of the drive gear (132) and d represents a distance between ends of the plurality of countershafts (130) connected to each other by the coupling (150).

2. The fiber bundle condensing device (100) for the spinning machine according to claim 1, **characterized in that**
   a conditional expression $W > d \geq (1/2) \times W$ is satisfied, where W represents the width of the drive gear (132) and d represents the distance between the ends of the plurality of the countershafts (130) connected by the coupling (150).

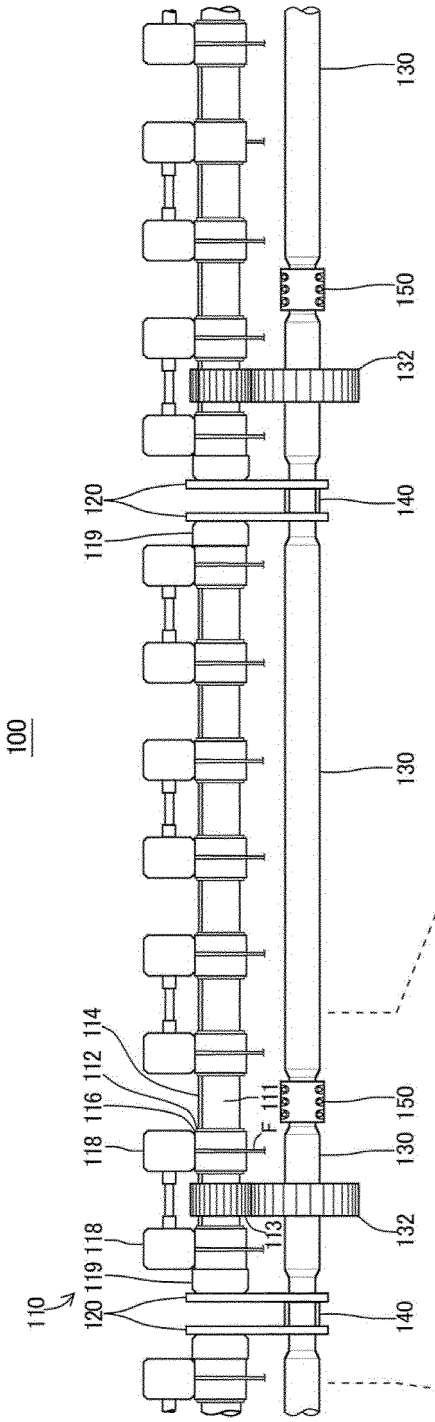
100
110
120
119
118
114
112
116
118
119
120
F
111
113
130
132
150
140

FIG. 1A

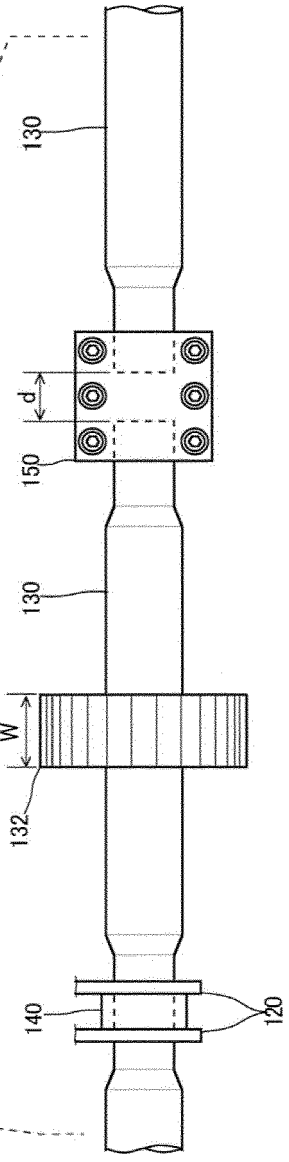
130
d
150
130
W
132
140
120

FIG. 1B

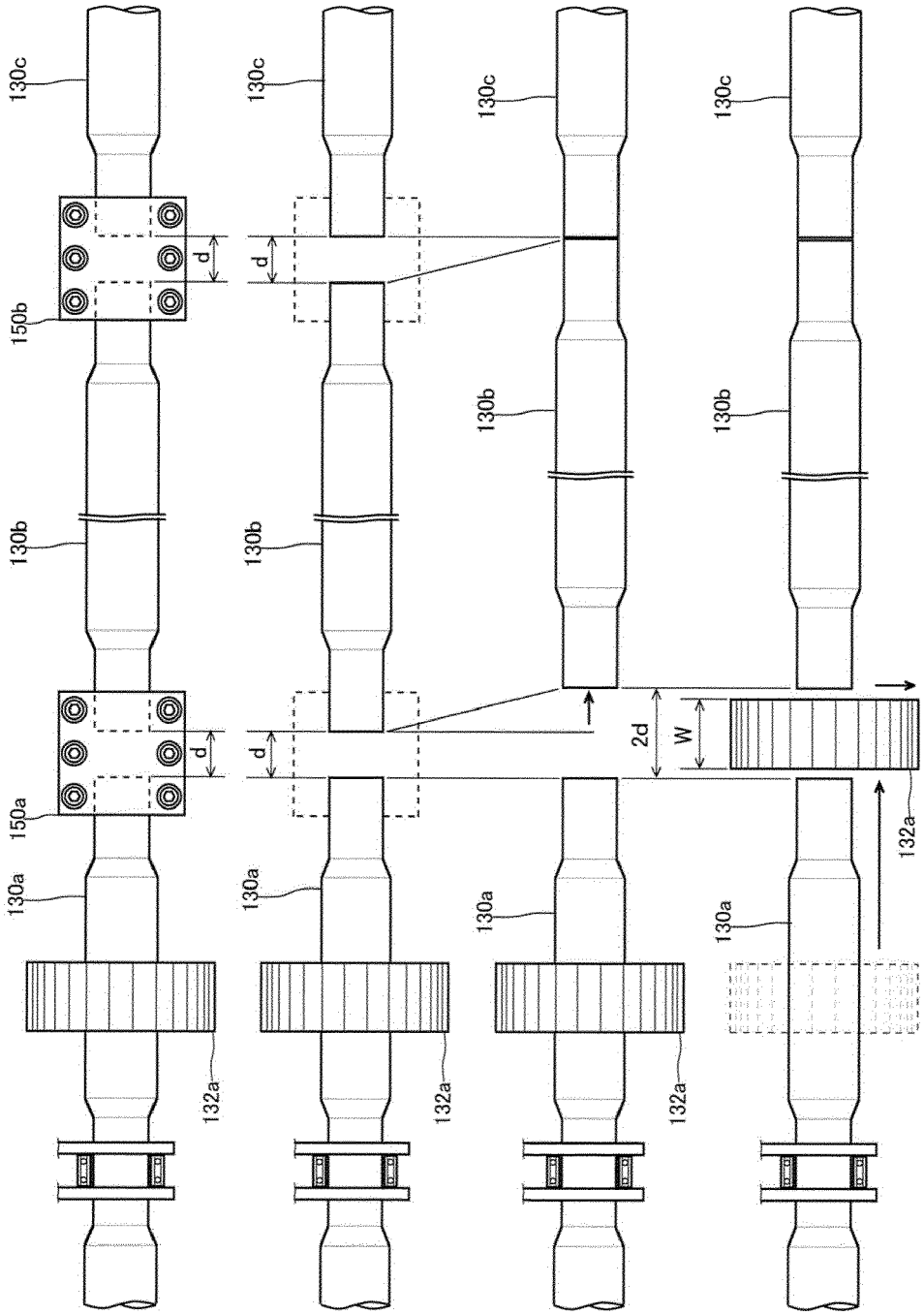

FIG. 2A FIG. 2B FIG. 2C FIG. 2D

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 9964

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,D	EP 1 473 388 A2 (PINTER SA [ES]) 3 November 2004 (2004-11-03) * paragraph [0014] - paragraph [0016]; figures 2-5 *	1,2	INV. D01H1/02 D01H1/22 D01H5/72
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A	EP 1 300 495 A1 (TOYOTA JIDOSHOKKI KK [JP]) 9 April 2003 (2003-04-09) * paragraph [0016] - paragraph [0022]; claim 1; figures 1, 8 *	1,2	

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	9 May 2023	Todarello, Giovanni

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 19 9964

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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09-05-2023

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