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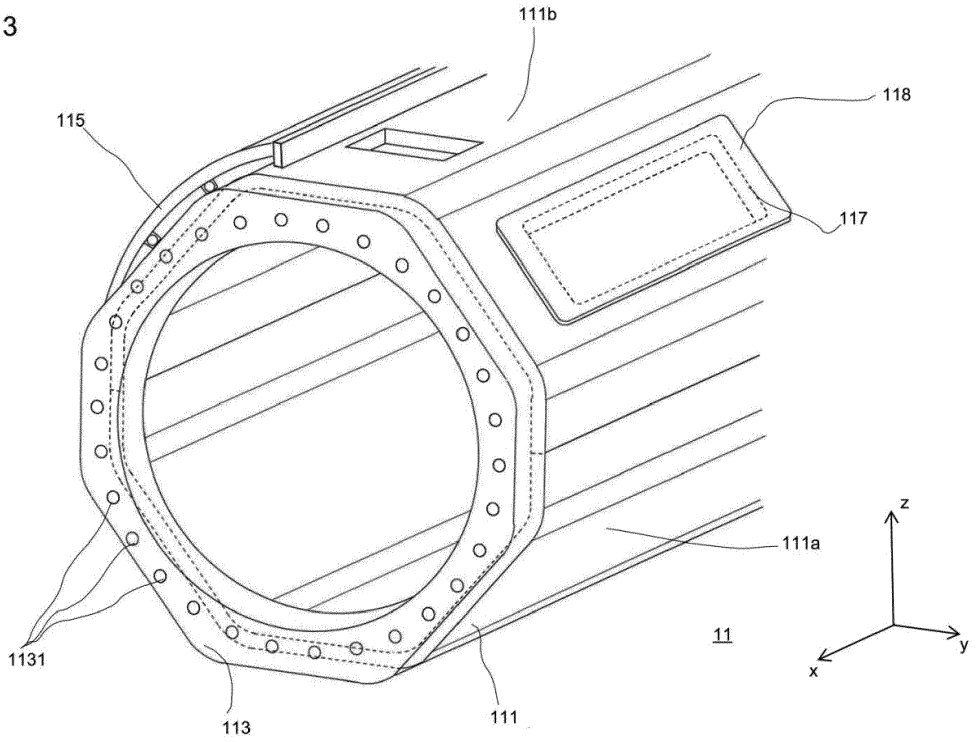
(54) AXLE BEAM FOR A ROLL OF A FIBER WEB FORMING MACHINE

(57) An axle beam (11) for a roll of a paper or board making machine, comprises an axle beam body (111) comprising a hollow profile having rigidity, a head portion (113) configured to attach an axle stub (13) to the axle beam (11), and a sliding surface (115) extending in a length direction of and detachably mounted to the axle beam (11).

Fig. 3



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Description

[0001] The invention pertains to an axle beam. Such a kind of axle beam is used for a roll of a fiber web forming machine such as paper, board, tissue or pulp machine, such as a sleeve roll, which in general is provided in a forming section of the fiber web forming machine.

[0002] Prior art sleeve rolls are for instance known from document DE 31 42 045 A1. Here, a sleeve arrangement with a stationary sector support shoe/beam is arranged in a forming section of a paper or board making machine. The forming section comprises two wires, each of them forming a closed loop. The two wires are guided such that they run along a portion of the sleeve arrangement with the stationary sector support shoe/beam circumference in an adjacent manner, thereby forming a fabric wrap where the web is sandwiched between the fabrics. Thus, the sleeve arrangement with the stationary sector support shoe/beam causes a minimum distance between the two wires, thereby causing dewatering of a web located between the two wires. Within the fabric wrap the curvature of the shoe element changes from straight portion to the constant smaller radius of the sleeved shoe element.

[0003] Another forming section similar to the one of DE 31 42 045 A1, but comprising a sleeve roll with a cross section having a changing radius of curvature is known from document EP 2 350 385 B1. This shape enables an improved dewatering pressure caused by the change of the sleeve roll's radius of curvature.

[0004] In paper and board making machines, using the same type of roll, e.g. a sleeve roll, in differently designed machine concepts leads to different boundary conditions to be considered in dependency of the position of the roll as well as of its posture. For example, a resulting force direction can vary depending on the assembly position of the roll and with different tensions of the fabric (e.g. wire) guided about at least a portion of the roll.

[0005] Moreover, in a case where the length of the roll exceeds a certain length, deflection of the roll due to gravity is another matter to be considered. Such deflection is problematic, since it might deteriorate the quality of the web in particular with regard to the pressure applied onto the same for dewatering.

[0006] There is need for an axle beam for a roll of a fiber web forming machine enabling a higher amount of flexibility for varying dewatering parameters and suitable to all kinds of former types and former concepts making different types of webs.

[0007] According to the invention, an axle beam (11) for a roll of a fiber web forming machine, comprises an axle beam body (111) comprising a hollow profile having rigidity, a head portion (113) configured to attach an axle stub (13) to the axle beam (11), and a sliding surface (115) extending in a length direction and curving in a cross direction of the axle beam (11) and mounted to or formed with the axle beam (11).

[0008] Such a sliding surface remarkably reduces the friction coefficient between a belt surrounding the roll and made to rotate with the wire running about a portion of the roll. Thereby, a torque acting on the axle beam from the rotation and tension of the belt can be remarkably reduced. The sliding surface is integrated to the axle beam and acts as supporting structural part. Moreover, even if there is a slight deflection of the axle beam, such deflection can be compensated for the sliding surface leading to that the properties of a formed fabric tension wrap can be maintained within the set parameters.

[0009] Advantageously, the axle beam (11) can have a hollow polygonal and/or round beam structure.

[0010] Polygonal in the sense of the invention means that angled line segments form a closed structure inside a circle or a curved portion. The length of the line segments as well as the angles between two adjacent ones of the line segments can vary. Alternatively, polygonal can be also understood as a box shape or as a tubular shape forming an enclosed tube with plural walls. Applying such a polygonal structure remarkably improves rigidity with regard to the axial length of the sleeve roll and over conventional inadequate square beam solutions.

[0011] Advantageously, at least one portion of the axle beam body (111) can have a polygonal cross section having six to twelve corners or corresponding angles, the corners being preferably rounded, or at least one portion of the axle beam body (111) has a round cross section. Surprisingly very rigid and high I and square beams developed for belt roll press nips are not suitable for sleeve roll with fabric tension wrap because those are poor for even moderate multi-directional loading or turning the beam to different driving positions.

[0012] Thus, rigidity of individual portions of the axle beam can be enhanced where necessary, while other portions of the axle beam can be manufactured with less effort.

[0013] Advantageously, the axle beam body (111) can be made of at least two bended metal sheets which are joined together.

[0014] For example, the metal sheets can be joined by welding. Thereby, in particular at the joining portions, rigidity of the axle beam structure can be enhanced.

[0015] Advantageously, a thickness of a wall of the axle beam body (111) can be 30 mm to 60 mm.

[0016] A wall thickness in the above range still enables manufacturing e.g. by bending of the sheets, while the rigidity properties of the manufactured axle beam body are outstanding. Moreover, if the thickness of the wall (the sheets forming the axle beam) is too large, roundness of the corner portions would be affected.

[0017] Advantageously, in the axle beam body (111) one or more openings (117) can be provided.

[0018] Such openings enable access to the inner portions of the axle beam where piping for lubrication oil and other fluids and/or various actuators e.g. for lifting mechanisms can be provided. Moreover, despite the openings, the rigidity of the axle beam is not affected due to the polygonal or round cross section. It is possible to close

the openings by e.g. hatches or other suitable means.

[0019] Advantageously, the head portion (113) can comprise an annular element fit adjacent to the axle beam body (111) and having plural mounting bores (1131).

[0020] Such an arrangement provides the possibility to combine the axle beam with different axle stubs, leading to an increased number of variations of rolls that can be manufactured.

[0021] Advantageously, a cross section of the axle beam body (111) can be symmetric in different planes, and/or in a cross section of the axle beam body (111) an extension in at least one direction exceeds an extension in a direction being orthogonal to the one direction. That is, in the cross section of the axle beam, a height dimension can be different to a width dimension.

[0022] Moreover, advantageously, the axle beam body (111) can comprise a movable forming element (119), which is arranged adjacent to the sliding surface.

[0023] Such a forming element can be used to change the cross section of the roll, that is, of the belt running about the axle beam in order to change the properties of the fabric tension wrap formed by the roll. Since the forming element is movable, various cross section shapes can be set.

[0024] Advantageously, the axle beam body (111) can comprise a piping system configured to supply lubrication fluid to the sliding surface (115).

[0025] In the following, presently preferred embodiments of the invention will be described based on the figures, in which

Fig. 1 is a schematic view of forming section of a paper or board making machine employing a sleeve roll according to the invention;

Fig. 2 is a perspective view of a bearing structure supporting an axle stub of the sleeve roll according to the invention;

Fig. 3 is a perspective view of an axle beam of the sleeve roll according to the invention;

Fig. 4 is a section view along a length axis of the sleeve roll according to the invention; and

Fig. 5 is a cross section view perpendicular to the length axis of the sleeve roll according to the invention.

[0026] An example of a schematic structure of a forming section 1000 of a paper or board making machine applying a sleeve roll 1 according to the invention is shown in Fig. 1. A head box 1001 serves to supply a pulp suspension between the wires 1009, 1015 which are guided as closed loops. The wire loop 1015 is guided by guiding rolls, a forming roll 1005 and the sleeve roll 1. A second wire 1009 is guided in another closed loop by dedicated guiding rolls 1007, the forming roll 1005 and the sleeve roll 1. Between the forming roll 1005 and a guiding roll 1007a of the guiding rolls 1007 dedicated to the second wire 1009, both wires 1015 and 1009 run in a parallel manner sandwiching the thereby formed web.

[0027] A forming gap with constant radius fabric tension wrap on the forming roll and a changing radius fabric tension wrap on the sleeve roll is formed between the two wires 1015 and 1009 at circumferential portions of each of the forming roll 1005 and the sleeve roll 1 where both wires 1015 and 1009 run along the circumferential portions of the two rolls. Due to a slight elongation of the wires 1009 and 1015 in the portions not affected by a roll, in these forming nips? a pressure acting on the web is higher than in the portions where the wires are not supported.

[0028] A forming gap and a fabric tension wrap formed at the forming roll 1005 serve to receive the pulp suspension from the headbox 1001. To provide this fabric forming gap and tension wrap at the forming roll 1005, the second wire is guided towards the forming roll by means of a breast roll 1007b, which is arranged close to the forming roll 1005 in a manner that a diffusor portion of the headbox 1 is arranged between the forming roll 1005 and the breast roll 1007b. Thus, a first dewatering of the web is performed at the forming roll 1005.

[0029] Another fabric tension wrap is formed at the sleeve roll 1. Since this description is mainly directed to the sleeve roll 1, in the following the fabric tension wrap formed at the sleeve roll 1 will be described as "the fabric tension wrap" while, if necessary, the fabric tension wrap formed at the forming roll 1005 will be described as "the constant radius fabric tension wrap" or simply as "fabric tension wrap" (at the forming roll 1005".

[0030] Moreover, in the forming section other means for dewatering of the web such as dewatering elements 1003 or suction boxes 1011 are arranged. It will be understood that the above description of the forming section based on Fig. 1 is merely an example and does not at all limit the forming section to the wire arrangement and elements shown in Fig. 1 and described above. That is, next to the described elements or additional dewatering elements and suction boxes can be provided. On the other side, one or more of the shown dewatering elements and/or suction boxes can be omitted. Moreover different type of web forming concepts being suitable for all types of formers, head boxes, layouts and webs can be chosen. Likewise the function of the sleeve roll and its place within the former can vary according to specific needs of the particular web to be formed.

[0031] In order to form a web, pulp suspension is supplied from the headbox 1001 into the forming gap and the fabric tension wrap at the forming roll 1005 where a first dewatering takes place. From there, the web is guided between the two wires 1015 and 1009 towards the sleeve roll 1 and the fabric tension wrap. Thereby, the web passes dewatering means 1003, which improves the dryness content of the web. In the fabric tension wrap, a second dewatering takes place. As will be described

below, by means of the sleeve roll 1 according to the invention, parameters of the fabric tension wrap such as its length, its exerted pressure, the running time of the web to pass the fabric tension wrap and others can be set. Thus, an effective dewatering takes place before the web is guided further via suction boxes 1011 to be taken over to be transferred to the next section such as a press section of the fiber web forming machine.

[0032] A sleeve roll 1 according to the invention comprises an axle beam 11 and an axle stub 13. As can be seen from Fig. 2, the axle stub 13 is supported in a pedestal (example for a bearing structure) 21. Moreover, as can be seen from Fig. 4, the sleeve roll 1 comprises a roll head 31 that supports a belt 41. The belt 41 is tensioned about and is rotatable about and relative to the axle beam 11. In particular, rotation of the belt 41 is caused by the wire 1015 directly contacting the belt 41 due wire tension during common path when passing the sleeve roll 1.

[0033] Back to Fig. 2, the pedestal 21 comprises an annular flange 25 mounted onto the axle stub 13 in such a manner that a torque can be transferred from the flange 25 to the axle stub 13.

[0034] In order to provide a torque, the flange 25 is connected with a rigging screw 23 by means of a joint 22. That is, one end of the rigging screw 23 is attached to the flange 25 by means of the joint 22. The other end of the rigging screw 23 opposite to the one end being attached to the joint is fixed to the pedestal 21. Thus, by turning the rigging screw 23, it length can be extended or shortened, thereby causing a rotation of the flange 25. The rotation of the flange 25 is transferred to the axle stub 13, thereby rotating the axle stub and the axle beam 11 of the sleeve roll 1. The flange 25 and the joint 22 form a moving means according to the invention, and the rigging screw 23 is one example of an actuating means according to the invention.

[0035] That is, instead of the rigging screw, the actuating means can comprise a screw, a gear, a worm gear, a hydraulic cylinder or other means suitable for providing a longitudinal movement which is then transferred to the rotational movement of the flange 25.

[0036] As can be seen from Fig. 3, the axle beam 11 is made of a hollow polygonal structure with (in the embodiment, eight) rounded corners. Moreover, a cross section of the axle beam body 111 is symmetric in different planes, and the width (in a y-direction in the figures) of the axle beam 11 is larger than its height (in a z-direction in the figures). The thickness of the plates forming the axle beam body 111 is between 30 and 60 mm. This geometry of the axle beam effects outstanding rigidity in its axial direction (rotation axis A direction), while forming of the desired cross sectional shape is still possible.

[0037] Rounded corners in the sense of the invention is to be understood that the corners have an arc like, convex, curved portion having a certain radius of curvature.

[0038] A head portion 113 of the axle beam 11 has a flange like shape and is provided with plural mounting bores 1131. The head portion 113 is surrounded by an axle beam body 111 which is comprised of two bended metal sheets 111a, 111b. The two metal sheets 111a, 111b are welded together at their edges to form a hollow body. The edges are arranged in a parallel manner to a rotation axis A of the sleeve roll 1.

[0039] Moreover, in the axle beam 11 a maintenance opening 117 and other openings are provided to enable access to the inner space of the axle beam 11. Some or all of these openings can be closed with hatches.

[0040] As can be seen from Fig. 4, the axle stub 11 is mounted to the head portion 113. The roll head 31 is provided on the axle stub 11 in a sliding manner. Thus, the roll head 31 can move in an axial direction of the sleeve roll 1. In order to effect such a movement of the roll head 31, hydraulic cylinders (only one of them is shown in Fig. 4) 35 are fixed inside of the axle beam. A piston rod of each hydraulic cylinder 35 extend through the head portion 113 of the axle beam 11 and is fixed to the roll head. Thus, the roll head 31 can be moved in a sliding manner in the direction of the rotation axis A, that is, in Fig. 4 to the left and to the right. Thereby, on the one side an axial position of the roll head 31 can be determined, and on the other side, the tension of a belt 41 fixed to the roll head 31 and surrounding the axle beam 11 can be adjusted. The plural hydraulic cylinders 35 are arranged in such a manner, that the belt 41 is tensioned by a symmetric tensioning force.

[0041] For accurately determining the roll head's 31 position, and/or to prevent an excessive stretching of the belt 41, indexing means (not shown) are provided to inform a user of the roll head's amount of movement. In the embodiment, the indexing means show the distance from the inner side (right side in Fig. 4) of the pedestal 21 to the roll head 31.

[0042] Moreover in the roll head 31 an opening through the axle stub 13 is provided. The opening can be closed in an airtight manner and serves to arrange e.g. inlet and outlet pipes for fluids such as lubrication oil. Since the opening can be closed in an airtight manner, a pressure inside of the belt 41 can be maintained.

[0043] As shown in Fig. 5, the axle beam has a sliding surface 115. The sliding surface extends in a length direction and curves in a cross direction of the axle beam 11. In the embodiment, the sliding surface is an individual component mounted to the axle beam 11, but instead it can be integrally formed with the axle beam 11.

[0044] Moreover, a movable forming element 119 is arranged adjacent to the sliding surface 115 in the axle beam body 111. That is, the forming element is provided such that the belt 41 passing the sliding surface 115 thereafter goes over the forming element 119. In cross section, a surface 1195 of the forming element 119, which is in abutment against the belt 41 has a curved, convex shape. A radius of curvature of the curved, convex shape of the surface 1195 gets smaller in the rotating direction of the belt 41. Said curvature of the forming element gets

smaller in radius than the radius of the sleeve roll. The forming element is movable to that regard that its protruding height from the axle beam body 111 can be altered. In the axle beam body 111, a piping system is provided to supply lubrication fluid to the sliding surface 115.

[0045] Since the movable forming element 119 is configured to protrude from the axle beam 11, it abuts against the belt 41 which is rotating about the axle beam 11. By altering the forming element's 119 protrusion height, a cross sectional shape of the loop formed by the belt 41 is altered.

[0046] In order to protrude or to retract, the movable forming element 119 is made to move forwards and backwards in its protruding direction z. This is effected by means of a piston 1192 accommodated in a cylinder 1193. The piston 1192 is capable of acting in both directions. Thus, the movable forming element can be made to protrude a desired height. Protrusion of the forming element affects to the belt when exceeding the sleeve roll radius in operation position. So good lubrication must be arranged before the forming element to ensure smooth gliding of the belt over said element which tensions the belt outwards. During start up of the fiber web forming machine, the forming element can be retracted inside of the roll head circle to reduce friction.

[0047] Protrusion/outstroke of the forming element out of the roll head/ belt circle can be 10-120 mm advantageously 20-70 mm. Also belt indent/inwards bulging before the forming element is possible while the sliding surface is arranged some (tens) of millimeters below the head/belt but has the same radius. This helps to reduce the required outstroke which is to extend the life of the belt.

[0048] The movable forming element 119 is supported at the axle beam 11 by means of a hinge 1191. Thus, the position of the movable forming element 119 cannot only be changed in a linear manner, but it can also be tilted. The moving means of the hinged forming element is favorable also tiltable/hinged.

[0049] In the running direction of the belt 41, arranged before the movable forming element 119 is the sliding surface 115. The sliding surface 115 in a cross section has the same radius of curvature than the sleeve roll/roll head 31. Moreover, the sliding surface is surface treated and preferably can be provided with depressions such as dimples. In addition, lubricating means 1151 are arranged before the sliding surface 115 in a rotation direction of the belt 41. Thus, a coefficient of friction of the sliding surface 115 can be remarkably reduced, resulting in a smooth run of the belt 41 over the sliding surface 115 before it gets to the movable forming element 119.

[0050] As will be understood, due to the movable forming element 119, the cross section shape of the sleeve roll 1 can be altered depending on the requirements of the web being formed. Moreover, this alterations can be performed while the paper or board making machine is running. And in addition, not only the cross section of the sleeve roll 1 can be altered, but by rotating the axle stub 13 via the rigging screw 23 and the flange 25, the rotational position of the movable forming element can be changed. Thereby, it is possible to effect changes of the fabric tension wrap parameters in a high variety which leads to an improved dewatering and forming of the web. Reference signs 116 indicate additional sliding elements, one of them being provided close behind the movable forming element 119.

[0051] In addition, Figs. 4 and 5 show pipes 110, 112, 114 used for supply and discharge of lubricant (see the arrows in the pipes in Fig. 4). Supply and discharge is performed via bores in the axle stub 13. Moreover, these pipes are supported in the inner of the axle beam 11. A main discharge pipe 120 serves for return lubricant which needs to be cooled and filtered before being newly fed to the sleeve roll. In addition to the lubricant feed pipes smaller hydraulic pipes such as the ones referred to by 118, 118a, 118b are also shown. These latter hydraulic pipes 118, 118a, 118b serve for actuating the piston 1192. Connections to the hydraulic actuators, lubricant collector devices and lubricant feeding/spraying pipes are performed by means of steel enforced hoses for allowing thermal movements and bending.

[0052] While the invention has been described based on a presently preferred embodiment thereof, the scope of the invention is not limited by the above description and the figures, but is defined by the claims.

[0053] Accordingly, alterations to the embodiment are possible. For instance, the described cross sectional shape is not necessarily provided for the whole axle beam body, but merely a portion of the axle beam body can have a polygonal cross section. The other portion(s) can have a different cross section.

[0054] The polygonal cross section can have six to twelve corners or corresponding angles. While it is preferred that the corners are rounded, such rounding is not unambiguously necessary, for instance in a case where the metal sheets are not bended but plural metal stripes are welded together to form the axle beam body.

[0055] Also, at least one portion of the axle beam body can have a round cross section.

[0056] Instead of changing continuously, the radius of curvature of the curved shape of the surface of the forming element abutting against the belt can change stepwise. A number of steps can be 3 to 12.

[0057] While a certain range of the wrap is not mentioned above, the sliding surface can cover a sector of 30° to 120° of the sleeve roll so that the wires having the common wrap on the sleeve roll can drive the belt with help of the supporting sliding surface.

[0058] While in the embodiment lubricating means are arranged before the sliding surface in a rotation direction of the belt, lubricating means can alternatively or additionally be provided through the sliding surface. The arrangement of the lubrication means depends on the assembly before forming of the sliding surface.

[0059] While in cross section of the axle beam a po-

lygonal structure has been described, more complex shapes to dimension such as a T-beam, Y-beam or X-beam cross section can be used for forming the axle beam in certain cases.

Claims

1. Axle beam (11) for a roll of a fiber web forming machine, comprising
an axle beam body (111) comprising a hollow profile having rigidity,
a head portion (113) configured to attach an axle stub (13) to the axle beam (11), and
a sliding surface (115) extending in a length direction and curving in a cross direction of the axle beam (11) and mounted to or formed with the axle beam (11).

2. Axle beam (11) for a roll of a fiber web forming machine, wherein the axle beam (11) has a hollow polygonal and/or round beam structure.

3. Axle beam (11) according to claim 2, wherein
at least one portion of the axle beam body (111) has a polygonal cross section having six to twelve corners or corresponding angles, the corners being preferably rounded, or
at least one portion of the axle beam body (111) has a round cross section.

4. Axle beam (11) according to claim 1 or 3, wherein
the axle beam body (111) is made of at least two bended metal sheets which are joined together.

5. Axle beam (11) according to any of the preceding claims, wherein
a thickness of a wall of the axle beam body (111) is 30 mm to 60 mm.

6. Axle beam (11) according to any of the preceding claims, wherein
in the axle beam body (111) one or more openings (117) are provided.

7. Axle beam (11) according to any of the preceding claims, wherein the head portion (113) comprises an annular element fit adjacent to the axle beam body (111) and having plural mounting bores (1131).

8. Axle beam (11) according to any of the preceding claims, wherein
a cross section of the axle beam body (111) is symmetric in different planes.

9. Axle beam (11) according to any of the preceding claims, wherein
in a cross section of the axle beam body (111) an extension in at least one direction exceeds an extension in a direction being orthogonal to the one direction.

10. Axle beam (11) according to any of the preceding claims, wherein
the axle beam body (111) comprises a movable forming element (119) arranged adjacent to the sliding surface.

11. Axle beam (11) according to any of the preceding claims, wherein
the axle beam body (111) comprises a piping system configured to supply lubrication fluid to the sliding surface (115).

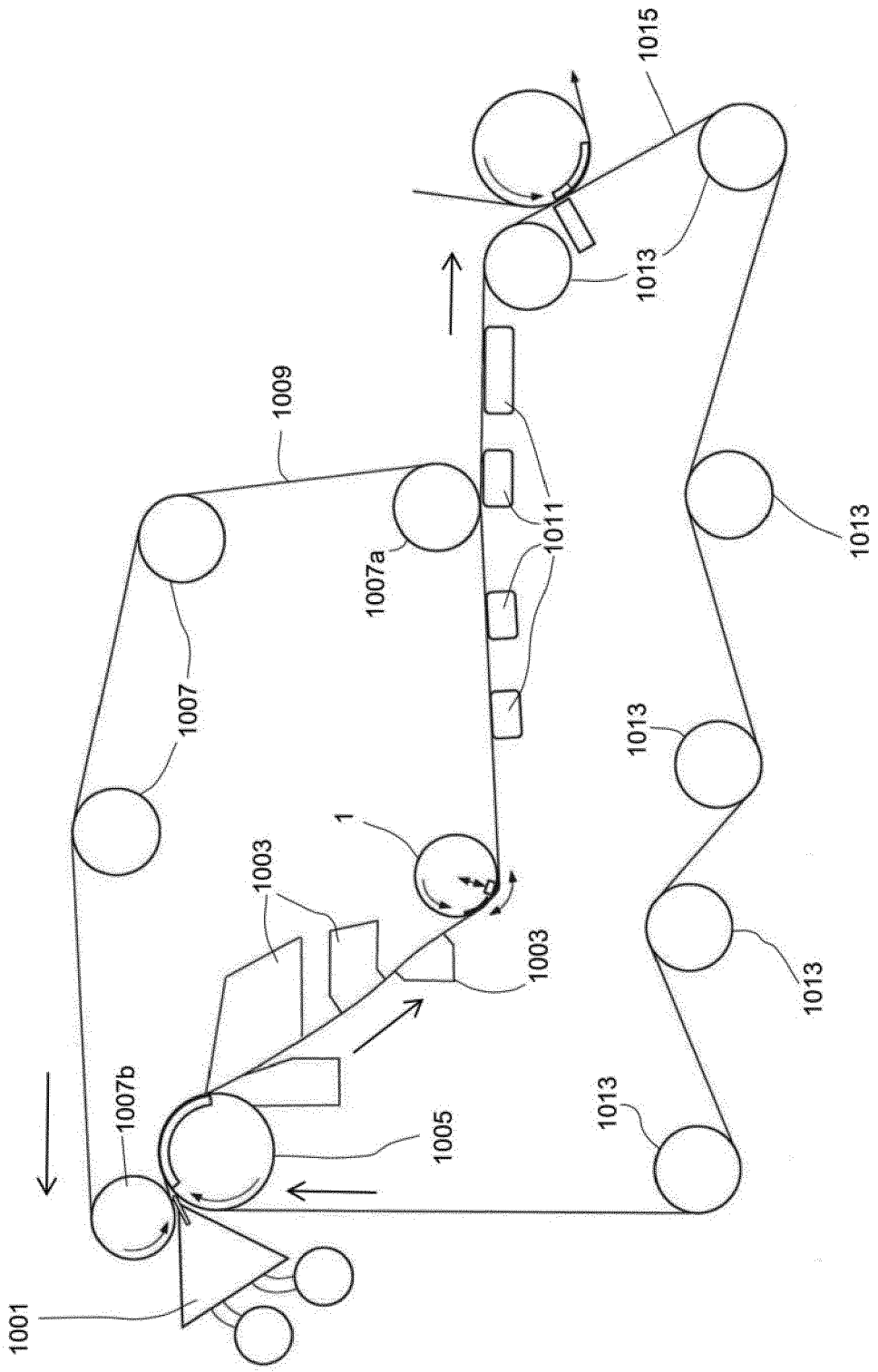
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Fig. 1

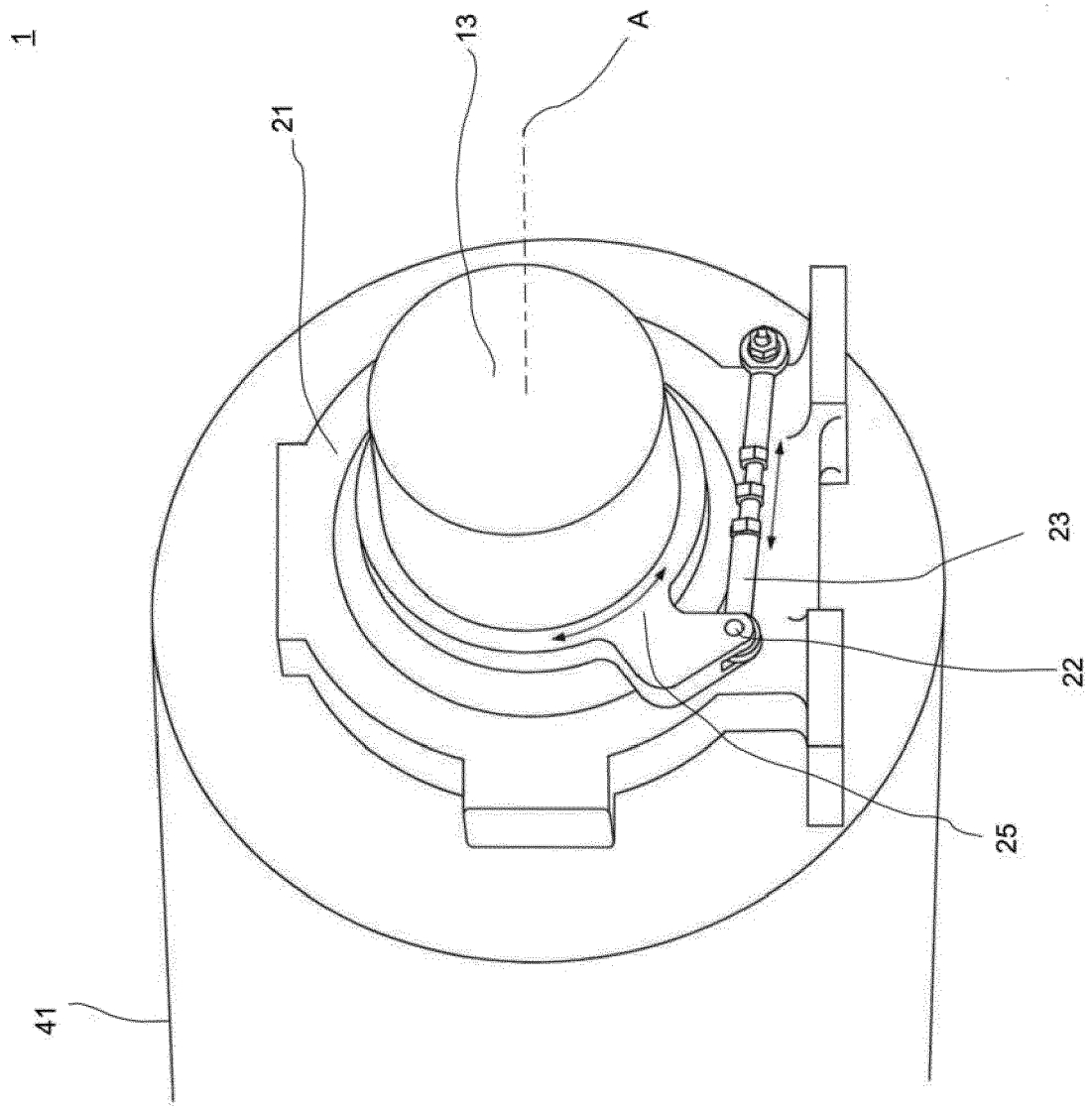

Fig. 2

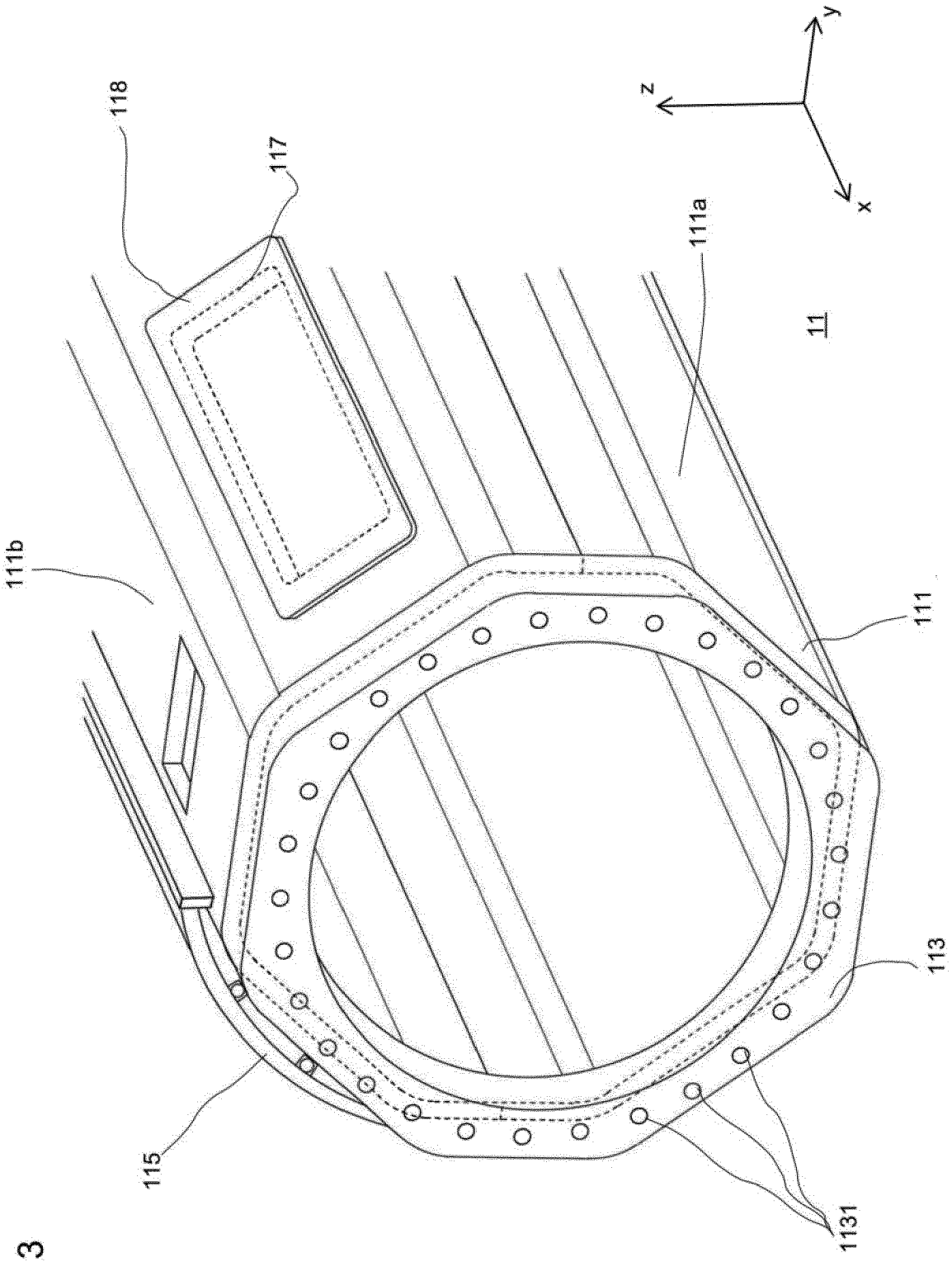

Fig. 3

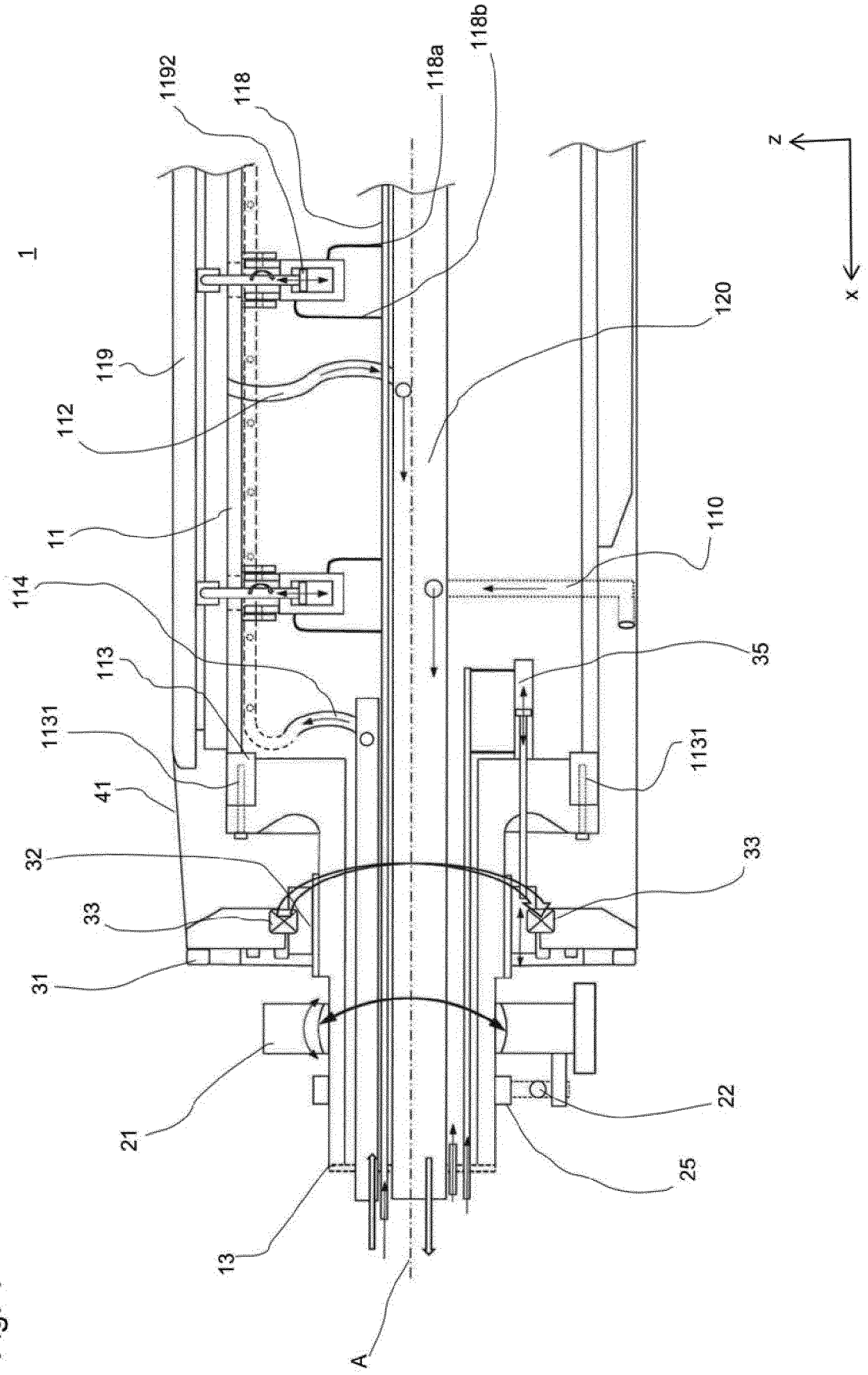
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Fig. 4

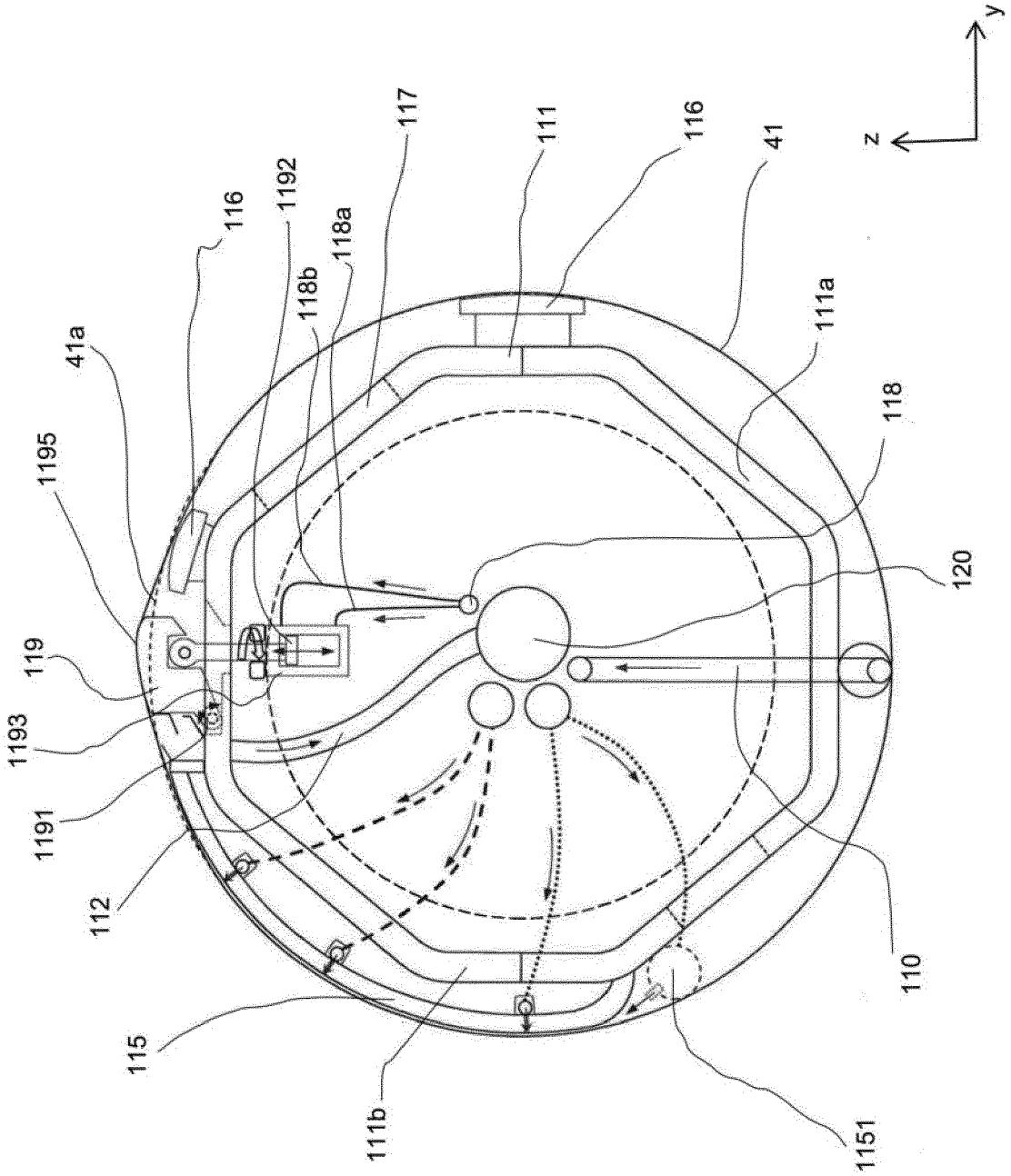
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Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 20 17 5729

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2020/076204 A1 (VALMET OY [SE]) 16 April 2020 (2020-04-16) * page 7, line 5 - page 21, line 16; figures *	1-4,6-11	INV. D21F1/40 D21F7/00 D21F9/00
X	WO 2018/097777 A1 (VALMET OY [SE]) 31 May 2018 (2018-05-31) * page 9, line 10 - page 17, line 4; figures *	1,4-10	
X	WO 91/17308 A1 (VALMET KARLSTAD AB [SE]) 14 November 1991 (1991-11-14) * page 7, line 20 - page 17, line 2; figures *	1,2,4,6, 7,9,11	
X,D	EP 2 350 385 B1 (VALMET TECHNOLOGIES INC [FI]) 30 September 2015 (2015-09-30) * paragraphs [0024] - [0025]; figure 2 *	1,2,6,8, 9,11	

TECHNICAL FIELDS SEARCHED (IPC)

D21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 June 2020	Maisonnier, Claire

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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30-06-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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