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(54) SLEEVE ROLL FOR A WIRE SECTION OF A FIBER WEB MACHINE

(57) The invention relates to a sleeve roll for a wire section of a fiber web machine. The sleeve roll (21) includes a stationary axle (28) and two circular roll heads (29) supported on the stationary axle (28) and arranged to rotate. The sleeve roll (21) further includes a belt loop (30) arranged around the stationary axle (28) and tensioned between the roll heads (29). There is also a curvilinear forming element (22) arranged between the stationary axle (28) and the belt loop (30). Said forming element (22) is in contact with the belt loop (30) in order to form rising pressure for water removal. Before the forming element (22) in the rotating direction of the belt loop (30) there is a lubricated sliding surface (31) for fabric support and lubrication of the forming element (22).

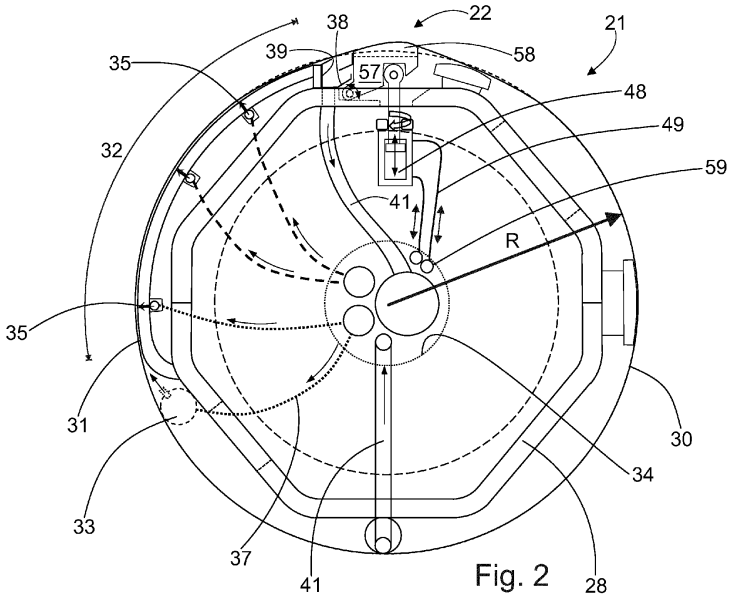

Fig. 2

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Description

[0001] The present invention relates to a sleeve roll for a wire section of a fiber web machine, which sleeve roll includes

- a stationary axle,
- two circular roll heads supported on the stationary axle and arranged to rotate,
- a belt loop arranged around the stationary axle and tensioned between the roll heads, and
  a curvilinear forming element arranged between the stationary axle,

wherein said forming element is in contact with the belt loop in order to form rising pressure for water removal.

[0002] EP-patent number 2350385 discloses a forming section of a fiber web machine. There is a sleeve roll having a belt loop arranged to rotate around a stationary axle. Inside the sleeve roll there is a curvilinear forming element forming a dewatering zone. The increased pressure pushes water out the fiber web formed by the fiber web machine such as paper, board, pulp or tissue machines.

[0003] The known forming element is a massive construction having a large contact area with the belt loop. Even with lubrication, the friction is remarkable. Especially, when starting the forming section, the belt loop may be adhered to the forming element. The axle includes a lubricant container and the lubricant is returned after use. The friction warms up the lubricant, so the amount of the lubricant must be significant. This increases the total weight of the sleeve roll, but still the heating problem remains. In addition, the known sleeve roll must align in certain position.

[0004] The object of the invention is to provide a sleeve roll for a wire section of a fiber web machine, which is more runnable and versatile than before. Also, the sleeve roll is more simply and less expensive to manufacture and use. The characteristic features of the sleeve roll according to the invention are stated in the accompanying claims. The sleeve roll has new and surprising constructions and functions which solve the problems. The sleeve roll is easy to implement into a fiber web machine with all kinds of formers and for all kinds of fiber webs to be formed. The first-time installation is simply, but the sleeve roll can be also retrofitted with very small modifications.

[0005] The invention is described below in detail by referring to the enclosed drawings, which illustrate some of the embodiments of the invention, in which

Figure 1 shows a schematic side view of a forming section equipped with a sleeve roll according to the invention,

Figure 2 shows a cross section in cross direction of the sleeve roll according to the invention.

Figure 3 shows a schematic view of the sleeve roll according to the invention without the belt loop,

Figure 4 shows a partial cross section in machine direction of the sleeve roll according to the invention,

[0006] In the shown embodiment, the forming section includes a first wire loop 10 and a second wire loop 11 (Fig. 1). The first wire loop 10 circles over a forming roll 12 while the second wire loop 11 circles over a breast roll 13. The travel direction of the first wire loop 10 is designated with an arrow 14 and the travel direction of the second wire loop 11 is designated with an arrow 15. The first wire loop 10 and the second wire loop 11 form a converging gap 16 such that both wires loops 10 and 11 converge on the area of the forming roll 12. The forming section also includes a headbox 17 for feeding pulp suspension to the gap 16 between the wire loops 10 and 11. After the forming roll 12, there are three suction boxes 18, 19, 20 for water removal. Next there is the sleeve roll 21 according to the invention. Both wire loops 10 and 11 travel over the sleeve roll 21 equipped with a curvilinear forming element 22 for water removal. The sleeve roll 21 is followed by a twin-wire section on which water is removed from the fiber web 23 travelling between the wire loops 10 and 11 with a suction box pair 24 being below the first wire loop 10. At the end of this twin-wire section, the travel direction of the second wire loop 11 is diverted with a second guide roll 25 and led to the return cycle. At the point of the second guide roll 25, the second wire loop 11 is separated from the first wire loop 10, in connection with which the fiber web 23 is attached with another suction box 26 to the first wire loop 10 and conveyed on the upper surface of the first wire loop 10 over a third guide roll 27 and then picked up to the following press section.

[0007] Fig. 2 shows a cross section in cross direction of the sleeve roll 21 according to the invention. The sleeve roll is for a wire section of a fiber web machine, as described above. The sleeve roll 21 includes a stationary axle 28 and two circular roll heads 29 having axle stubs 53 supported on the stationary axle 28 and arranged to rotate (Fig. 4). Each roll head is circular having a fixed radius. In addition, the sleeve roll 21 includes a belt loop 30 arranged around the stationary axle 28 and tensioned between the roll heads 29. The circular roll heads 29 form the belt loop 30 in cylindrical shape especially when tensioned and rotating. Then the belt loop 30 can rotate around the stationary axle 28. In addition, there is a curvilinear forming element 22 arranged between the stationary axle 28 and the belt loop 30. Said forming element 22 is in contact with the belt loop 30 in order to form rising pressure for water removal. In the invention the forming element urges the belt loop 30 locally outwards from its round form to follow the smaller radius forming element. The curved shape of forming element changes continuously or stepwise shorter in radius.

[0008] According to the invention, before the forming

element 22 in the rotating direction of the belt loop 30 there is a lubricated sliding surface 31 for belt and fabric support and lubrication of the forming element 22. Then both wire loops 10 and 11 have good support. With support on sliding surface for the fabric tension wrap, the wire loops can drive the belt loop. Simultaneously, the friction between the sliding surface and the belt loop remains low. And more, the forming element is lubricated at the same time when the lubricant travels with the belt loop. Here the sliding surface 31 is a metal or metal-plate structure supported on the axle 28 (Fig. 2). In principle, the sliding surface can be part of the stationary axle.

[0009] Advantageously, the sliding surface 31 has a curvature R corresponding to the radius of the roll head 29. Then the belt loop together with the wire loops run smoothly with low friction, but good support. After the sliding surface, the forming element urges the belt loop outwardly causing fabrics and the web to follow the smaller radius of the forming element which induces raising pressure which effectively removes water out of the fiber web. In Fig. 2 the belt loop 30 is shown in its un-urged cylindrical shape with dashed line and over the urged forming element with continuous line. When rotating, the belt loop has continuous deformation, which is handled by a newly developed belt material and structure.

[0010] The sliding surface 31 defines a zone 32 of 30 - 120 degrees. In Fig. 2 the zone 32 is about 80 degrees. Even this large zone is possible by a new kind of lubrication which keeps friction low. Here, before the sliding surface 31 there is a shower pipe 33 for lubrication. In the invention, the lubricant is fed via the center bore 24 of the stationary axle stub and then led out also via center bore 24. The center bore is explained in more detail in connection with Fig. 4.

[0011] Fig. 3 shows the basic components of the sleeve roll 21, but only part of the outline of the belt loop 30 itself. According to the invention, the sliding surface 31 is equipped one or more fluid pocket 35. The size of the pockets can vary from a counter sunk of single hole to long channel with several feed holes extending to axial direction of the sleeve roll. Fluid pockets are arranged in rows of several pockets and the rows of the lubricant pockets can be controlled and used individually. For example, in start-up and/or running modes different number of rows takes part to lubricating. Lubricant is fed to these fluid pockets. Then, especially during the start-up, lubricant spreads from the fluid pockets between the sliding surface and the belt loop, so that there is continuous oil film over all surface area. Then, the belt loop is unadhered and the belt loop can start rotating with low friction like a hydrostatic lubrication. In Fig. 3, there are three rows of fluid pockets 35 in different points of the sliding surface 31. Each fluid pocket is narrow and extends axially. In other words, the fluid pockets are long in axial direction and short in machine direction. At least there is one row of fluid pockets or there is a single long axial fluid pocket. So, lubricant is fed on entirely width of the sliding surface. In Fig. 2, there is one fluid pocket 35 formed on the sliding surface 31. Under the sliding surface 31, there is a manifold 36 extending axially on the area of the fluid pocket. Then lubricant is spread evenly throughout of the sliding surface. In Fig. 3, there is three manifolds 36, one for each fluid pocket 35. Lubricant may be fed to these manifolds at their inlet via single conduit 37 (Fig. 4) .

[0012] The shower pipe 33 is located before the sliding surface 31 and lubricant is fed especially during normal running forming a hydrodynamic lubrication. The shower pipe extends axially over the width of the sliding surface. So, the lubrication during running can be done just before sliding surface with shower pipe or in the begin of the sliding surface with one or more of the first pocket arrangements. Running lubrication can be done also with combination of fluid pockets and lubrication pipes bringing more lubrication and cooling. According to the invention, there is a fluid collector 38 before the sliding surface 31 or the forming element 22. The location of the fluid collector depends how the sleeve roll is installed. In Fig. 2 and Fig. 3, the fluid collector 38 is before the forming element 22. Then the excess lubricant is collected before the forming element 22. The fluid collector should be covered by lubricant to achieve powerful removal of lubricant. Excess air entering the outlet pipe weakens the efficiency of the removal.

[0013] In the shown embodiment, the fluid collector 38 has at least one edge 39 arranged adjacent to sliding surface and forming element and is located between said elements. In other words, the fluid collector is integrated next to sliding surface and part of the fluid collector can be attached to the forming element. This makes the structure efficient in every driving mode. The fluid collector 38 is a rigidly attached to the axle beam 52 or it moves at least partly together with the forming element 22 or it is divided to said two separate parts. It may also be at least partly tiltable. Then, the fluid collector conforms to the movement of the forming element. This avoid splashing of the lubricant when the fluid collector is always in right position to the forming element. In other machine layouts and alignments of the sleeve roll, there may be an extra fluid shower 40 before the forming element 22. Then lubrication will be ensured between the forming element and the belt loop.

[0014] As shown in Fig. 4, the fluid collector 38 has a return connection 41 to a center bore 24 arranged to the axle 28 for removing lubricant from the sleeve roll 21. Then the lubricant is led out of the sleeve roll to be filtered and cooled. In this way, the amount of lubricant inside the sleeve roll is minimized which reduces the weight of the sleeve roll. Also, lubricant is cooled when again feed with the shower pipe and fluid pockets which both ensure longer lifetime for the belt made from reinforced polymer structure vulnerable to excess heat and wear. Another return connection 41 is on the other side of the sleeve roll. Here could be a pump for removal lubricant before the shutdown.

[0015] The belt loop is tensioned by moving at least of one of the roll head axially. Here, the roll head 29 is

equipped with a tension device 42 having hydraulic conducts 43 inside the axle 28 and a center bore 24 arranged to the axle 28. The structure is simple, and the tension of the belt loop can be adjusted precisely and apart from other adjustments of the sleeve roll. Here, the tension device 42 is a double-action cylinder connected to the roll head 29. The roll head is in two part. The first part is an inner ring 44, which is nonrotating, but can slide axially. The second part is an outer ring 45 which is rotary by the bearing 46. Thus, the belt loop can be adjustable tensioned even during the rotation. For example, at the start-up when lubricant is cold, the tension may be low. Then, after production is started and the forming element urged out, the tension may be tuned to optimize runability of the sleeve roll and the whole forming section.

[0016] Still another new feature is in the roll head. According to the invention, the roll head 29 has a bearing 46 with a separate lubrication. In other words, the lubrication of the bearing is separated from the lubrication of the sliding element and the forming element. So, different lubricant can be used, and hazardous contaminants do not end from lubricant to another. For example, metal particles from the bearing does not end between the forming element and the belt loop. This lengthens the lifetime of the sleeve roll. Here, lubricant is fed via pipe 47 which is installed in the center bore 34 (Fig. 4).

[0017] Actually, the size and shape of the forming element are new per se. Also, according to the invention, the forming element 22 is arranged tiltable and/or movable in relation to the axle 28. In the shown embodiment, the forming element is pivoted at its front end and it is urged against the belt loop 30 by hydraulic devices 48. Again, the hydraulic pressure is led via the center bore as described above. There are significant forces which requires several parallel hydraulic devices 48 (Fig. 4) . In the center bore 34 there are first rigid pipes 59 and then steel braided hoses 49 leading pressurized oil in and out from double-acting hydraulic devices 48. The hoses flex if some movements or deformations occurs. Steel braided hoses are advantageous also for other lubricant feed and removal arrangements inside the sleeve roll.

[0018] After the pipe 47, next is a conduit 37 for feeding lubricant to the fluid pockets 35. The third is a rigid pipe 59 is for hydraulic device 48 moving the forming element 22. The fourth is the hydraulic conducts 43 for tension device 42. Then there is a joint 50 for feeding pressured air inside the sleeve roll 21 in order to aid removal of lubricant. When the fluid collector is filled with lubricant, lubricant can be pumped out of the sleeve roll. Advantageously, the interior of the sleeve roll 21 is on overpressure. Pressure aids the lubricant removal and keeps the sleeve roll circular. For closing the sleeve roll there is a seal 51 at the end of the axle 28.

[0019] The stationary axle comprises an axle beam 52 with two axle stubs 53. Here the axle beam 52 is polygonal in cross section. Thus, the axle beam is rigid and can be positioned in any angle. At least partly, advantageously wholly, there are at least six rounded convex corners and the sides of the axle beam can have different length to fit equipment inside the sleeve roll better.

[0020] The sleeve roll has a good possibility of changing the forming process by position of the forming element. Here, the end of the axle 28 has also a rocker bearing 54 and there is rotating means 55 between the axle 28 and a bearing bracket 56 belonging to the rocker bearing 54. Thus, the alignment of the sleeve roll can be fine adjusted. Then the wearing of the belt loop and wire loops are minimized, and the water removal is maximized. This turning during start-up is illustrated in Fig. 1.

[0021] The forming element is convex, and it protrudes out of the circular belt loop. By urging the forming element tensions the belt loop in both machine direction and cross machine direction while no other roll is involved. The protrusion of the forming element is on its maximum advantageously smaller than 120 mm, advantageously 50 - 90 mm. The sliding surface can be arranged also inwards from the belt radius to form an indent support for the belt loop which reduces the amount of protrusion outwards of the forming element. Said arrangement reduces the local elongation of the belt and can help to increase the belt lifetime. Preferably the indent of the sliding surface is less than 40 mm. Retraction of the forming element inside the circumference of the belt loop reduces friction in the start-up of the forming section. Convexity of the forming element gets bigger in running direction which means that the radius is getting shorter. The change of the radius can be either continuous or stepwise with 3 - 12 steps, advantageously 5-9 steps of radius. These changes or steps help to adjust the pressure curve affecting the fiber web. In the cross-machine direction, the edge areas in both end of the forming element have radius that is equal or bigger than the smallest radius in machine direction. Axial distance between the straight part of the forming element and roll head belt locking is 150 - 800 mm. Advantageously the forming element is in two part. The first part is a base part 57 which is pivoted to the axle 28. The second part is contact part 58 which is replaceable fixed to the base part BR. Thus, simply by changing the contact part, to features of the sleeve roll can be tuned. The forming element may include one or more fluid pockets (not shown).

[0022] There is fabric tension wrap over the sleeve roll before forming element which is handled according to the invention with the lubricated sliding surface prior to the forming element. With the fluid pockets and/or fluid showers in connection the sliding surface also the forming element is lubricated. The sliding surface and the forming element create together a friction surface on the area of the fabric tension wrap. The wrap against the sleeve roll is advantageously 30 - 120 degrees. The sliding surface has about the same radius than the roll head which keeps the belt loop tensioned and on its circular path. The sliding surface makes the axle more rigid against bending when properly joined. Also, the sliding surface is lubricated against friction and there are lubri-

cation showers prior to sliding surface and and/or through said surface. The pipe of the lubrication shower before sliding surface forms a kind of lubrication pocket by closing the oils route against the belt rotation. The fabric tension against the belt loop on the sliding surface during wrap over it arranges the driving power to the sleeve roll.

[0023] The axle beam is made of hollow polygonal and/or round beam structure giving support to forming element and other devices and have room inside the belt loop for said equipment. Said axle beam is preferably made of polygonal, say 6 - 12 rounded corners, beam structure with axle stubs attached to it. The polygonal form comes from bended metal plates which are welded together from at least two pieces. Stationary polygonal axle beam is rigid to large angle of tension forces from both belt loop together with the forming element protrusion and fabric wrap. Surprisingly, both high I-shaped and simple square beams meant to press nips were poor for sleeve roll solutions with varying angle of forces. Metal plate thickness is advantageously 30 - 60 mm. Polygon structure is advantageously symmetric in different planes for loading requirements and for room to fit equipment. For example, the beam can be a bit higher in top tension direction of the forming element and narrower for accommodate the sliding surface. Said axle can have opening and hatches for service of the devices inside the axle beam.

[0024] The roll heads are supported with sliding means from the stationary axle stub. There are means for moving the roll head axially advantageously hydraulic cylinder means attached to the roll head and placed inside the axle beam. There are also indexing means in connection with the rocker bearing outer side of the roll head. Then it is possible to tune the alignment of the sleeve roll. At least one of the roll heads has opening through the axle stub for lubrication oil inlets and outlets. Said opening is sealed so that air pressure inside the belt can be increased.

[0025] There are turning means for the sleeve roll for fine tuning the angle of protrusion of the forming element. Said means has torque support from solid machine structure and the other end is attached to the rotation symmetric axle stub. Rotating means like screws, rigging screws or worm gears can be used as turning means because those can keep their position while no control force is applied. Sleeve roll diameter is advantageously 700 - 1600 mm.

[0026] Lubricant is fluid, preferably oil. Also compressed air or mixture of air and oil or even water can be used, especially with the fluid pockets of the sliding surface.

Claims

1. Sleeve roll for a wire section of a fiber web machine, which sleeve roll (21) includes

- a stationary axle (28),
- two circular roll heads (29) supported on the stationary axle (28) and arranged to rotate,
- a belt loop (30) arranged around the stationary axle (28) and tensioned between the roll heads (29), and

a curvilinear forming element (22) arranged between the stationary axle (28) and the belt loop (30),

wherein said forming element (22) is in contact with the belt loop (30) in order to form rising pressure for water removal, **characterized in that** before the forming element (22) in the rotating direction of the belt loop (30) there is a lubricated sliding surface (31) for fabric support and lubrication of the forming element (22).

2. Sleeve roll according to claim 1, **characterized in that** the sliding surface (31) has a curvature R corresponding to the radius of the roll head (29).

3. Sleeve roll according to claim 1 or 2, **characterized in that** the sliding surface (31) defines a zone (32) of 30 - 120 degrees.

4. Sleeve roll according to any of claims 1 - 3, **characterized in that** before the sliding surface (31) there is a shower pipe (33) for lubrication.

5. Sleeve roll according to any of claims 1 - 4, **characterized in that** the sliding surface (31) is equipped one or more fluid pocket (35).

6. Sleeve roll according to any of claims 1 - 5, **characterized in that** there is an extra fluid shower (40) before the forming element (22).

7. Sleeve roll according to any of claims 1 - 6, **characterized in that** there is a fluid collector (38) before the sliding surface (31) or the forming element (22).

8. Sleeve roll according to claim 7, **characterized in that** the fluid collector (38) has at least one edge (39) arranged as a part of the sliding surface (31).

9. Sleeve roll according to claim 7 or 8, **characterized in that** the fluid collector (38) has a return connection (41) to a center bore (24) arranged to the stationary axle (28) for removing lubricant from the sleeve roll (21).

10. Sleeve roll according to any of claims 1 - 9, **characterized in that** the roll head (29) is equipped with a tension device (42) having hydraulic conducts (43) inside the stationary axle (28) and a center bore (24) arranged to the stationary axle (28).

11. Sleeve roll according to any of claims 1 - 10, **characterized in that** the roll head (29) has a bearing (46) with a separate lubrication.

12. Sleeve roll according to any of claims 1 - 11, **characterized in that** the forming element (22) is arranged tiltable and/or movable in relation to the stationary axle (28) for urging the belt loop (30) locally outwards from its round form.

13. Sleeve roll according to any of claims 1 - 12, **characterized in that** the interior of the sleeve roll (21) is on overpressure.

14. Sleeve roll according to any of claims 1 - 13, **characterized in that** the stationary axle (28) is polygonal in cross section.

15. Sleeve roll according to any of claims 1 - 15, **characterized in that** the end of the stationary axle (28) has a rocker bearing (54), and there is rotating means (55) between the stationary axle (28) and a bearing bracket (56) belonging to the rocker bearing (54).

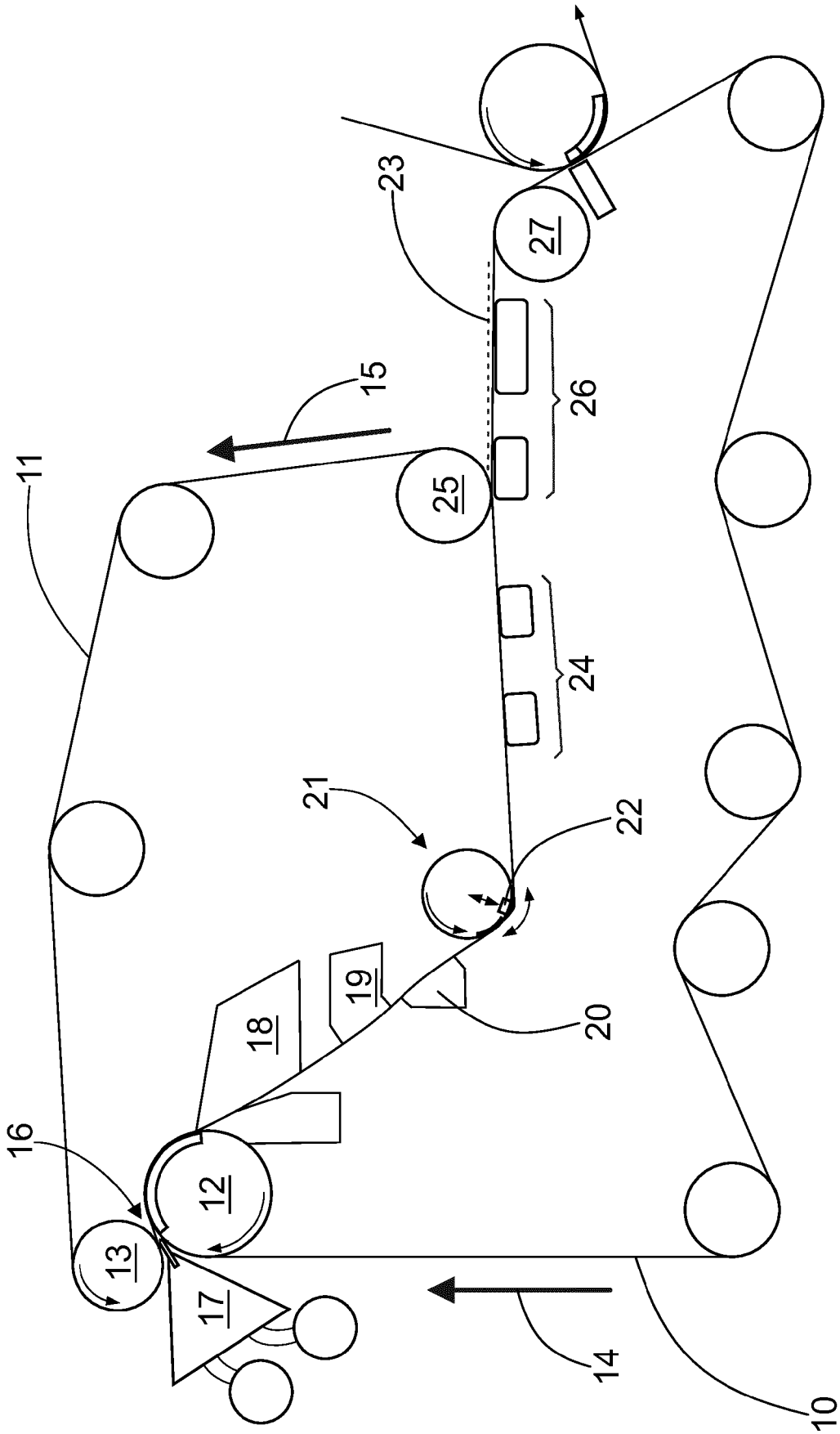

Fig. 1

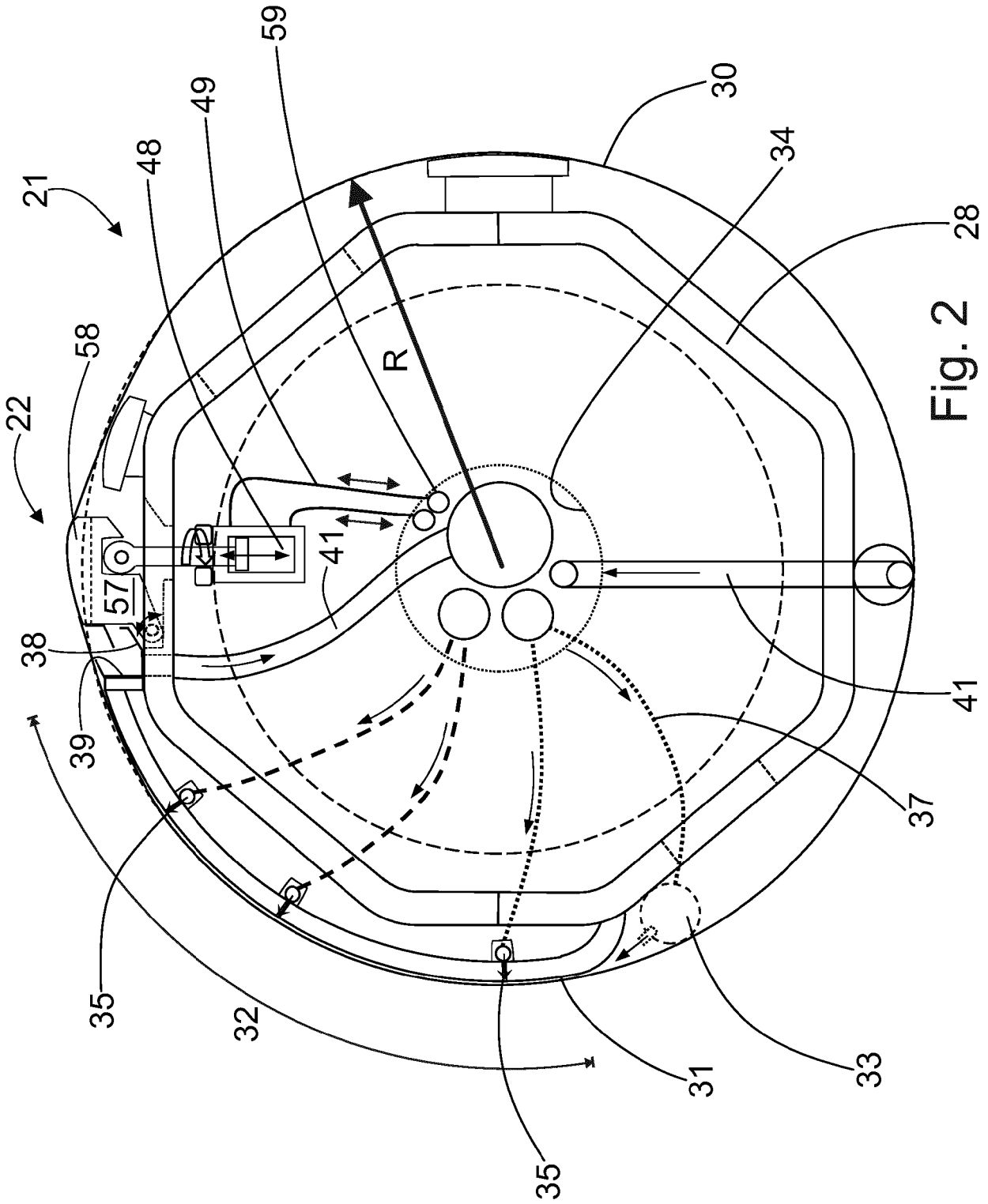

Fig. 2

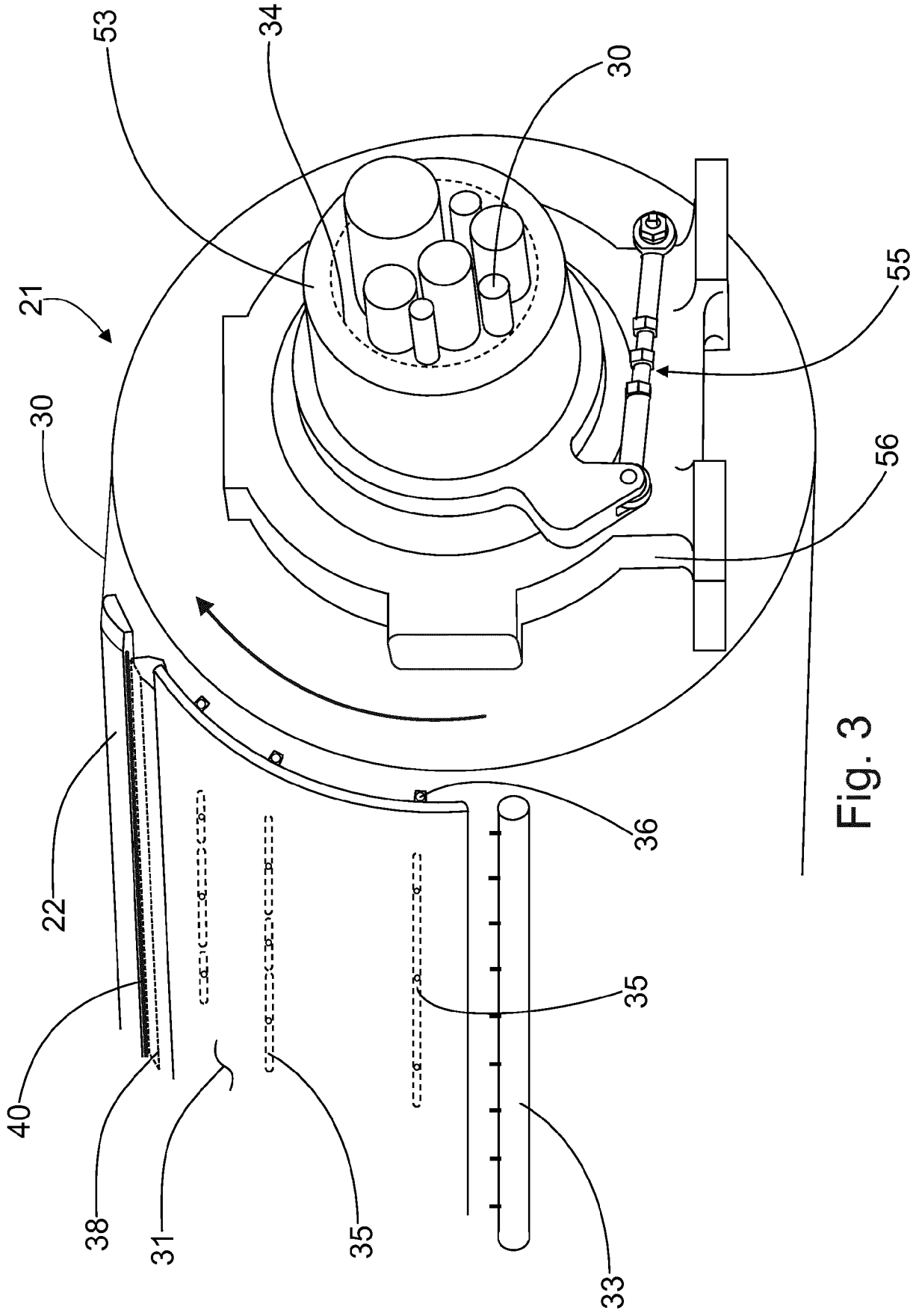

Fig. 3

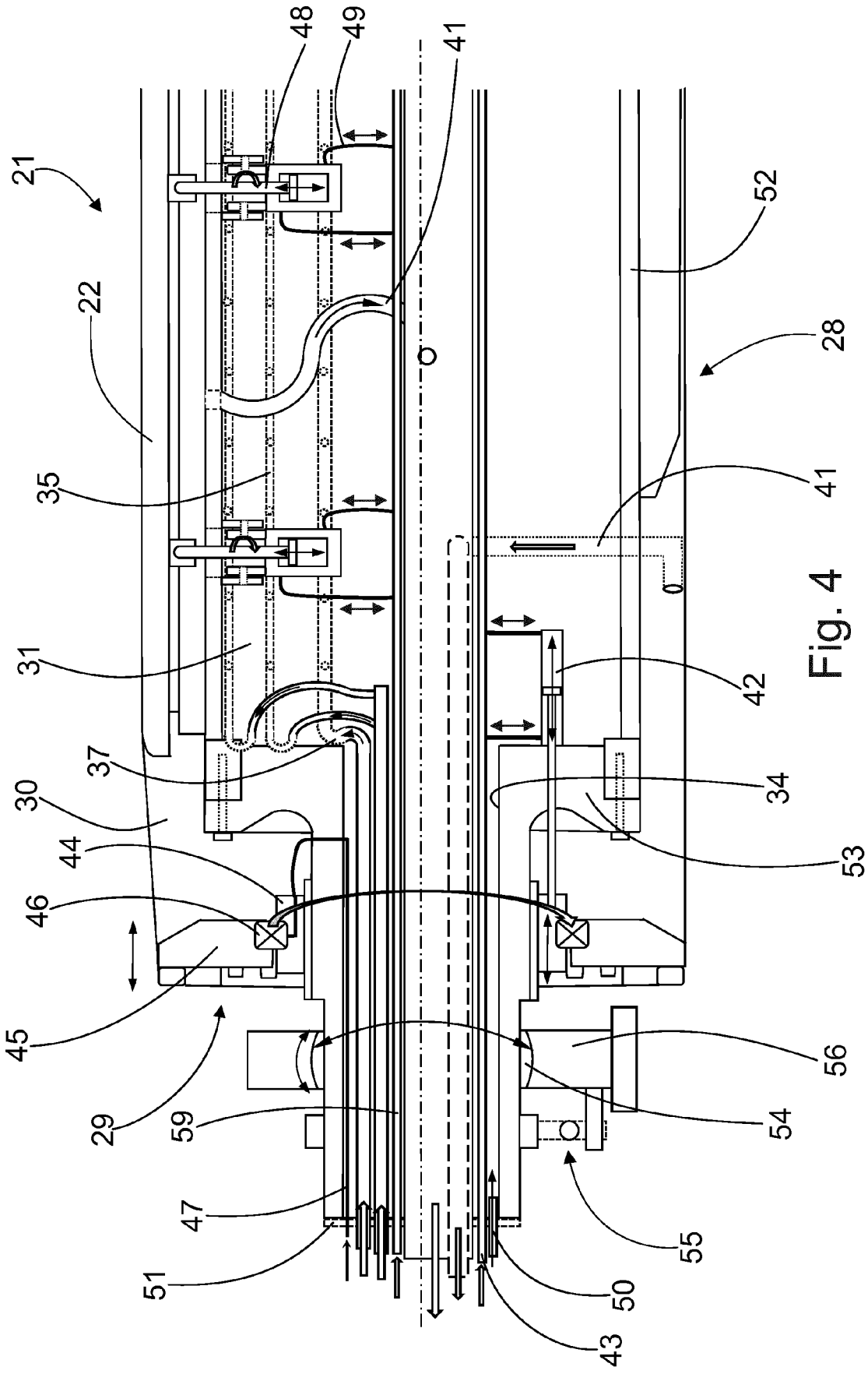
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Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 20 17 5646

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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	25 June 2020	Maisonnier, Claire

CATEGORY OF CITED DOCUMENTS

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