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(54) **Control ring for a hydrostatical device**

(57) Control ring (10; 210) for controlling the flow of a pressure medium in a displacement pump (200), said control ring (10; 210) is;
• centred about a rotational axis (ax)
• extending along said rotational axis (ax),
• having an inner and an outer diameter (d, D) and thereby an inner and outer radial surface (11, 12; 211, 212)
• a first and a second axial surface (13, 14; 213, 214), wherein said first axial surface (13; 213) having an interface section (20; 220) provided with at least a first and a second opening (21, 22; 221, 222), which first and second opening (21, 22; 221, 222) are separated by a first and a second intermediate section (15, 16; 215, 216), characterised in, that said first and second opening (21, 22; 221, 222) are mouthing to a corresponding mouthing area provided at either of the inner and outer radial surface (11, 12; 211, 212).

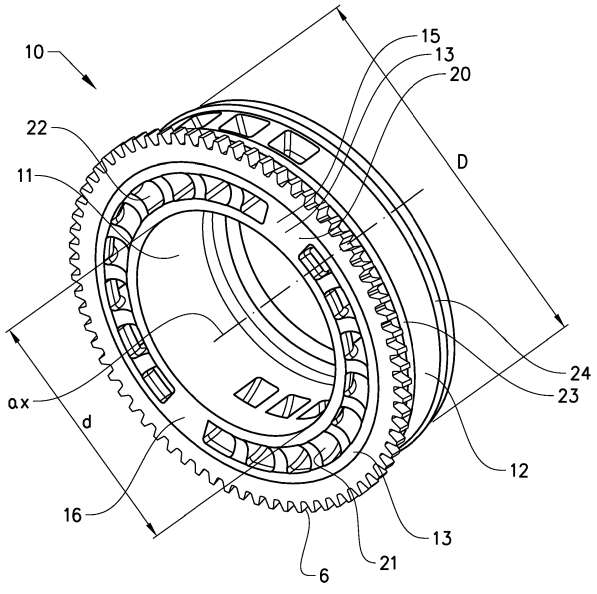

FIG. 2a

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Description

TECHNICAL FIELD

[0001] The present invention relates to displacements pumps and especially a control ring for a displacement pump.

BACKGROUND ART

[0002] In the document EP 2 497 950 a turnable port plate described. The port plate is provided with a first and a second opening, which is adapted to correspond to a first and a second pressure chamber of a displacement pump. By turning the port plate, the displacement of the displacement pump can be controlled.

[0003] A problem with the port plate according to the prior art is that the port plate becomes a large diameter due to its pressure balance areas outside the control openings. Another problem is to seal the port plate sufficiently to avoid leakage in the control interface.

[0004] There is thus a need for an improved device for controlling a displacement pump, wherein the above mentioned disadvantages are avoided.

SUMMARY

[0005] The object of the present invention is to provide an inventive control for displacement pumps, with which previously mentioned problems are avoided. This object is achieved by a control ring according as defined by claim 1.

[0006] The inventive control ring is provided for controlling the flow of a pressure medium in a displacement pump. The control ring is centred about a rotational axis about which it extends. The control ring is further provided with a first and a second axial surface, an inner and an outer diameter and thereby an inner and outer radial surface.

[0007] The first axial surface is provided with an interface section having at least a first and a second opening. The first and second openings are separated by a first and a second intermediate section, also called land. When the control ring is used within a displacement pump, one of the openings is a high pressure opening. The high pressure opening can be any of the two openings, and can also change depending on if the displacement pump is driven as a motor or as a pump.

[0008] According to the invention, the first and second opening is mouthing to a corresponding mouthing area provided at either of the inner and outer radial surface.

[0009] An advantaged of the radial placement of the mouthing of the openings is that it permits pressure equilibrium around the axial surfaces of the control ring. By providing seal rings between areas to which the respective opening is mounting and an area in the housing or about the axle it is mounted upon, ring formed spaces can be created about and/or inside the control ring. The pressure will be equal in the whole space sealed off by the seal rings, whereby pressure equilibrium is achieved. The pressure equilibrium prevents that the control ring becomes a skew position within the housing and thereby prevents leakage.

[0010] Further, due to that the first and the second openings are diverted about 90 degrees to a radial surface, an easy connection of input and output conduits are facilitated.

[0011] It is preferred that the control ring is provided with at least a first balance area at said second radial surface. The balance area is supposed to balance the pressure forces between the first and the second axial surfaces, whereby the balance area is arranged opposite the opening it balances. The balance area is interconnected with at one of said first and second opening via pressure conduits, wherein the opening the balance area is connected to is the high pressure opening. Due to the connection between the opening and the balance area, the axial surface of the opening and the balance area will be subjected to the same pressure.

[0012] In an alternative embodiment the control ring is provided with at least a first and a second balance area at its second axial surface. The first and the second balance area are connected to one of the first and second opening of the first axial surface area correspondently, wherein the pressure upon the balance areas corresponds to the pressure upon the surfaces in the openings. An axial surface area of the at least first and second balance area corresponds at least to an exposed axial area of said first and second opening, such that the axial force upon the first and second balance area corresponds to the axial force upon the exposed radial areas of the first and second opening.

[0013] The balance areas facilitate an easy control of the control ring, due to the pressure equilibrium that is achieved between the exposed radial areas and the balance area. A control ring having only one balance area interconnected with one of the first and the second opening, are preferably used just in one direction, in which the opening connected with the balance area is the high pressure opening. A control ring having two balance areas each interconnected with one of the first and second opening correspondently, will have pressure equilibrium when operated either of the rotational directions.

[0014] It is preferred that the area of the pressure areas is slightly larger than the corresponding axial area of the opening it is interconnected with. By having a slightly larger area of the pressure area, the first axial surface area will be pressed against a corresponding area of the pump (i.e. the rear plate or the rotor set or piston housing) it is arranged against, wherein the control ring can be sealed more efficiently.

[0015] The inventive control ring can be designed such that the first opening is mouthing to the inner radial surface and the second opening is mouthing to the outer radial surface. An easy connection of the first and second opening can thereby be facilitated. The connection con-

duits can easily be separated from each other and there are no risk for leakage between the input and the output connection. A configuration of the control ring such that the first opening is mouthing to the inner radial surface and the second opening is mouthing to the outer radial surface achieves an axial compact control ring, because both the openings can mouth at the same axial distances from the first axial surface.

[0016] In an alternative embodiment of the invention, the first and the second opening are mouthing to the inner radial surface, wherein the first and the second opening are mouthing to the inner radial surface at different axial distances from the first axial surface. By mouthing both the first and the second opening to the inner radial surface, a more radial compact displacement pump, with a small outer radius can be achieved.

[0017] In an alternative embodiment of the invention, the first and second opening are mouthing to said outer radial surface, wherein said first and second opening are mouthing to said outer radial surface at different axial distances from said first axial surface. By mouthing both the first and the second opening to the outer radial surface, a connection to the openings are more easily facilitated, due to that more space is provided, with an outer arrangement. Further, the diameter of the control ring can be made smaller in a configuration where both openings are mouthing in the radial direction. Still, further, seal rings between the mouthing areas/spaces and are known to be efficient, whereby very low leakages are achieved.

[0018] In order to have separate the first and the second opening from each other properly, it is suggested that seal rings are arranged such upon said outer radial surface, that the seal rings defines two separate axial areas in which said first and second opening mouth respectively. The seal rings are annular and coaxial with the control ring, whereby a seal ring can seal off one radial area from each other. By arranging three annual seal rings along the axial length of the control ring, two separate mouthing areas can be created. The first and the second opening can thereby mouth in one mouthing area each.

[0019] In order to facilitate a rigid construction of the control ring it is suggested that the first and/or the second opening comprises a plurality of channels. By providing the opening as a composition of several smaller openings with side walls in between, the same opening area can be achieved as one big opening and still achieve a higher strength in the construction.

[0020] It is preferred that the first and second openings are circular arc shaped, in order to adapted to a rotating displacement pump.

[0021] It is further suggested that balance valves are arranged in said first and second intermediate section, said balance valves connects said first and second intermediate section with a mouthing area of said first and/or second opening respectively, wherein said balance valves are adapted to open if a pressure at said first or second intermediate area raises above a predetermined threshold value.

[0022] The inventive control ring is adapted to be used in a displacement pump comprising a pumping unit arranged within a housing, with fix pressure sections and therewith connected supply chambers, wherein the control ring) is provided between said pressure sections and said supply chambers, wherein an interface section is arranged directed towards said pressure chamber such that said control ring can be turned in order to control the flow of pressure medium.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The present invention will now be described in detail with reference to the figures, wherein:

Figure 1	shows a displacement pump with a control ring according to the invention;
Figure 2a, b	shows a first embodiment of a control ring according to the invention; and
Figure 3a, b	shows a second embodiment of a control ring according to the invention.

DETAILED DESCRIPTION

[0024] In the following only one embodiment of the invention is shown and described, simply by way of illustration of one mode of carrying out the invention. All the illustrations are schematic.

[0025] Figure 1 discloses a displacement pump 200, in which the inventive control ring 210 is provided. The displacement pump 101 is disclosed as a gerotor pump. The inventive control ring 10, 210 is however compatible with any displacement pump having stationary pressure chambers. The displacement pump 200 comprises a front and a back housing 101, 102 a front and a rear plate 103, 104, in between which a rotor set 105 is arranged, a eccentric shaft 106 upon which the rotor set 105 is mounted a control ring 210. The rotor set 105 is provided in between the front and the rear plate 103, 104, wherein the rear plate 104 is provided with supply conduits in order to connect pressure chambers of the rotor set with an inlet and an outlet 108, 109 in the rear housing.

[0026] In the embodiment shown, the inventive control ring 210 is provided in between the rear plate 104 and the rear housing 102, such that it controls the flow of pressure medium between the inlet and the outlet 108, 109 and the pressure chambers of the rotor set 105. The control ring 210 could however be arranged directly against a pumping unit, independently if it is a gerotor, bend axis pump or another displacement pump with stationary pressure chambers. An actuator pin 107 is provided, which acts upon a gearing of the control ring 210 in order to rotate the control ring 210 into different control positions. The control ring 110 is centred about a rotational axis ax, which also is the centre axis of the displacement pump 101. In figure 1 is the displacement pump 200 provided with a control ring 210 disclosed in

figure 3a and b. The displacement pump 200 could however also be provided with a control ring 10 disclosed in figure 2a and b. The only difference to the displacement pump 200 will be the configuration of the rear housing 102, and how the inlet and the outlet 108, 109 are connected to the control ring 10.

[0027] The general function of the displacement pump 101 is known and will not be described further. The control ring 10, 210 replaces a traditional port plate, wherein the displacement of the displacement pump 200 can be controlled by rotating the control ring 10, 210 relative the rear plate 104 and thereby the pressure chambers of the rotor set 105.

[0028] Figure 2a, b shows a control ring 10 according to the invention. The control ring having an inner radius d and an outer radius D, a first and a second axial surface 13, 14, and an inner and outer radial surface 11, 12. The control ring 10 is centred about its rotational axis ax.

[0029] The first axial surface 13 is provided with an interface section 20 with a first and a second opening 21, 22. The first and the second opening 21, 22 are separated with a first and a second intermediate sections 15, 16. The interface section 20 is adapted to connect to the pressure chambers of rotor set 105 via the rear plate 104. As can be seen in the figure, the first and the second opening 21, 22 are shaped as circular arcs and follow the circumference of the control ring 10. It shall be noted that the control ring 210 could also be arranged directly against the rotor unit 105; this however is mostly suitable for a device with lower pressures. The first and the second opening 21, 22 are separated by a first and a second intermediate section 15, 16. The first and the second opening 21, 22 are constructed by several smaller openings which all have a common upper space, such that the pressure in the whole opening 21, 22 are the same.

[0030] In the embodiment disclosed in figure 2a, b, the first opening 21 is mouthing to the inner radial surface 11 and the second opening 22 is mouthing to the outer radial surface 12.

[0031] Due to the radial mouthing of the first and the second opening 21, 22 to a radial surface 11, 12, the pressure medium inlet and outlet 108, 109 can be easily connected. One of the inlet and outlet 108, 109 is connected to the space within the inner radius of the control ring 10; the other is connected to the outer radial surface 12.

[0032] In order to create a space at the outer radial surface 12, the surface to which the second opening 22 are mouthing to is delimited by two seal rings 23, 24. The seal rings 23, 24 are arranged such upon the control ring 10, that when the control ring 10 is arranged within the rear housing 102, the seal rings 23, 24 seals against the control ring 10 and the inner of the rear housing 102, such that a ring formed space is formed there between. The second opening 22 thereby mouth in the space in between the seal rings 23, 24. The one of the inlet and outlet 108, 109 that are connected to the second opening 22 thereby also mouth to the space in between the seal rings, but from the side of the rear housing 102.

[0033] Due to the bend in the first and the second opening 21, 22 such that they mouth to an inner and outer radial surface 11, 12 respectively the control ring can be build compact. As can be seen in figure 2a, b, both the first and the second opening 21, 22 are mouthing to their respective radial surface 21, 22 at essentially the same axial distance from the interface surface 20. The axial length of the control ring 10 can thereby be held short.

[0034] In figure 1b, it can be seen that the control ring 10 is provided with a first and a second balance area 28, 29. The balance areas 28, 29 are interconnected with the first and the second opening 21, 22 through a first and a second pressure conduit 26, 27. The first and the second balance area 28, 29 is provided with an axial surface which correspond to the axial surface of the respective first and second opening 21, 22. Due to the interconnection of the balance areas 28, 29 with the corresponding openings 21, 22 the axial pressure acting upon the first and the second balance area 24, 25 corresponds to the pressure acting upon the axial surfaces of the first and the second opening 21, 22. By having the same size on the balance areas 28, 29 as the axial areas of the corresponding opening 21, 22, the axial forces upon the two axial sided will equal each other out.

[0035] It is however preferred that the respective area of balance areas 28, 29 are slightly larger, e.g. 4%, than the axial areas of the corresponding opening 21, 22. The control ring 10 will thereby be pressed against the rear plate 104, whereby a tighter seal between the control ring 10 and the rear plate 104 is achieved.

[0036] The control ring 10 if further provided with a gearing 6, at which an actuator pin 107 (figure 1) can act in order to rotate the control ring 10 relative the rear plate 104, whereby the displacement of the displacement pump 200 can be controlled.

[0037] In figure 3a and b an alternative embodiment of the inventive control ring 210 is disclosed.

[0038] The embodiment of the control ring 210 in figure 3a, b is in many aspects correspondent to the control ring 10 disclosed in figure 2a, b. The control ring 210 is centred about its rotational axis ax and extending along said axis ax. The control ring 210 having a inner and an outer diameter d, D and thereby an inner and outer radial surface 211, 212 and is provided with a first and a second axial surface 213, 214. The first and the second axial surface 213, 314 is provided with an interface section 220, with a first and a second opening 21, 22. The first and the second opening 221, 222 are separated by a first and a second intermediate section 215, 216.

[0039] The control ring 210 is further provided with a first and a second balance area 228, 229, with pressure conduits 226, 227, having the same functionality as the balance areas 28, 29 and pressure conduits 26, 27 disclosed in figure 1.

[0040] The difference between the control ring 210 in figure 3a, b and the control ring 10 in figure 2a, b is where the first opening 221 is mouthing. Both the first and the

second opening 221, 222 of the control ring 210 is mouthing to the outer axial surface 212, however at a different axial distance from the first axial surface 213. The different axial distance of the mouthing is important in order to create two separate mouthing areas. A first, a second and a third seal ring 223, 224, 225 is thereby also provided at the outer radial surface 212, in order to create to mouthing spaces between the control ring 212 and the rear housing 102. The inner radial surface 211 is thereby not provided with any openings.

[0041] The rear housing 102 is thereby adapted to receive the control ring 210, wherein both the pressure medium inlet and outlet 108, 109 connected to a respective mouthing space between the control ring 210 and the rear housing 102.

[0042] As will be realised, the invention is capable of modification in various obvious respects, all without departing from the scope of the appended claims. Accordingly, the drawings and the description thereto are to be regarded as illustrative in nature, and not restrictive.

Claims

1. Control ring (10; 210) for controlling the flow of a pressure medium in a displacement pump (200), said control ring (10; 210) is;

   - centred about a rotational axis (ax)
   - extending along said rotational axis (ax),
   - having an inner and an outer diameter (d, D) and thereby an inner and outer radial surface (11, 12; 211, 212)
   - a first and a second axial surface (13, 14; 213, 214), wherein

   said first axial surface (13; 213) having an interface section (20; 220) provided with at least a first and a second opening (21, 22; 221, 222), which first and second opening (21, 22; 221, 222) are separated by a first and a second intermediate section (15, 16; 215, 216), **characterised in, that** said first and second opening (21, 22; 221, 222) are mouthing to a corresponding mouthing area provided at either of the inner and outer radial surface (11, 12; 211, 212).

2. Control ring (10; 210) according to claim 1, wherein said control ring (10; 210) is provided with at least a first balance area (28, 29; 228, 229) at said second radial surface (14; 214), wherein said first (28, 29; 228, 229) are interconnected with one of said first and second opening (21, 22; 221, 222) via pressure conduits (26, 7; 226, 227).

3. Control ring (10; 210) according to claim 2, wherein said control ring (10; 210) is provided with a first and a second balance area (28, 29; 228, 229) and a surface area of said at least first and second balance are (28, 29; 228, 229) at least corresponds to an exposed radial area of said first and second opening (21, 22; 221, 222), such that the pressure upon the first and second balance area (28, 29; 228, 229) essentially corresponds to the pressure upon the exposed radial areas of the first and second opening (21, 22; 221, 222).

4. Control ring (10) according to any of the preceding claims, wherein said first opening (21) is mouthing to said inner axial surface (11) and said second opening (22) is mouthing to said outer axial surface (12).

5. Control ring (10) according to any one of the claims 1-3, wherein said first and second opening (21, 22) are mouthing to said inner axial surface (11).

6. Control ring (210) according to any one of the claims 1-3, wherein said first and second opening (221, 222) are mouthing to said outer radial surface (212), wherein said first and second opening (221, 222) are mouthing to said outer radial surface (11) at different axial distances from said first axial surface (13).

7. Control ring (210) according to claim 6, wherein seal rings (223, 224, 225) are arranged such upon said outer radial surface (212), that said seal rings (223, 224 225) defines two separate axial areas in which said first and second opening (221, 222) mouth respectively.

8. Control ring (10, 210) according to any of the preceding claims, wherein said first opening (21; 221) comprises a plurality of channels and/or said second opening (22; 222) comprises a plurality of channels.

9. Control ring (10, 210) according to any of the preceding claims, wherein said first and second openings (21, 22) are circular arc shaped.

10. Control ring (10, 210) according to any of the preceding claims, wherein balance valves are arranged in said first and second intermediate section (15, 16; 215, 216), said balance valves connects said first and second intermediate section (15, 16; 215, 216) with a mouthing area of said first and/or second opening (21, 22) respectively, wherein said balance valves are adapted to open if a pressure at said first or second intermediate area (15, 16; 215, 216) raises above a predetermined threshold value.

11. Displacement pump (200) comprising a pumping unit (105) arranged within a housing (101, 102) and having fix pressure sections and therewith connected inlet and outlet ports (108, 109), wherein a control ring (10, 210) is provided between said pressure sections and said inlet and outlet ports (108, 109), wherein an interface section (10, 220) is arranged

directed towards said pressure chamber such that said control ring (10, 210) can be turned in order to control the flow of pressure medium, **characterised in that** said control ring (10, 210) is a control ring (10, 210) according to any one of the claims 1-10.

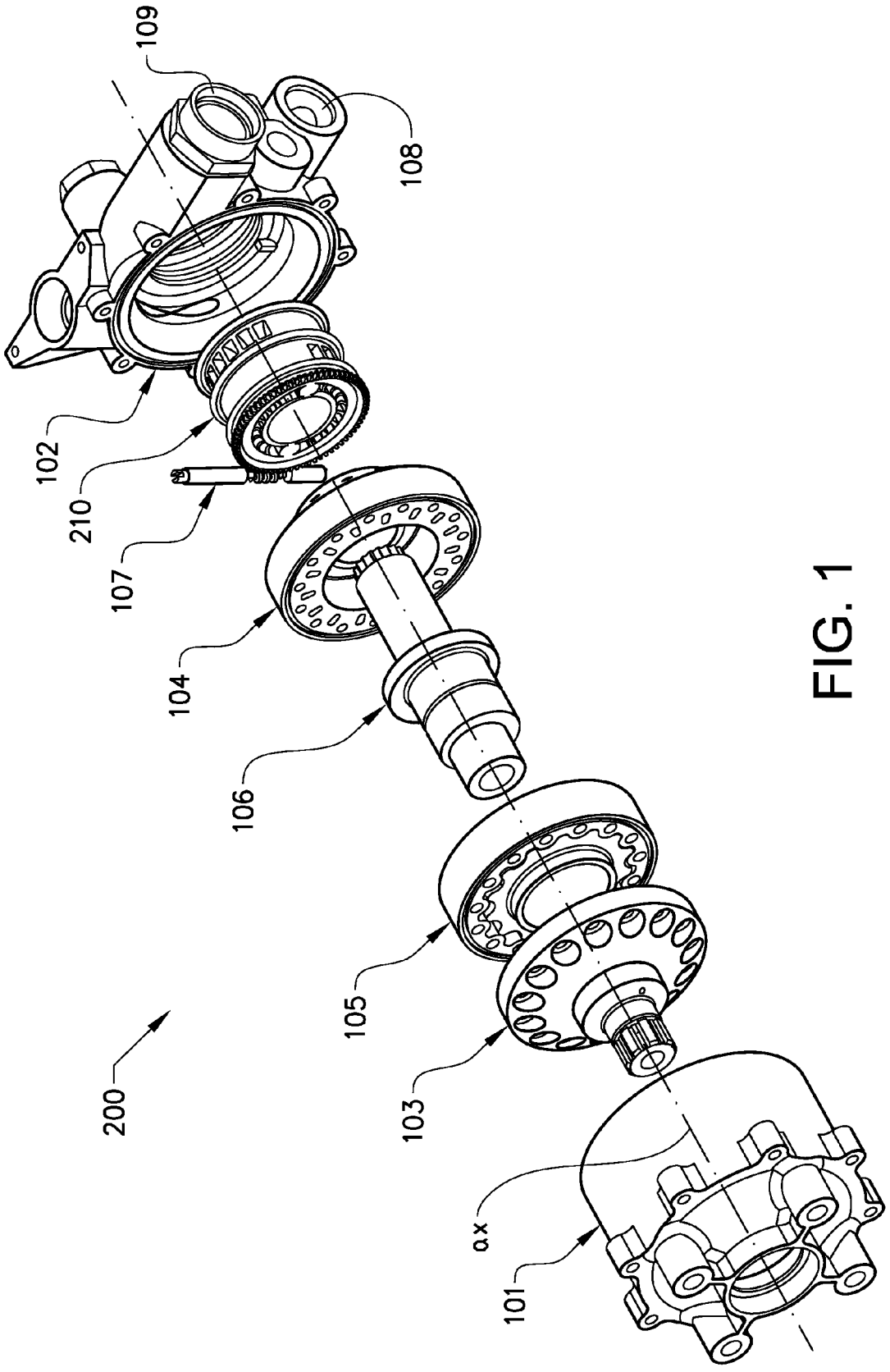

FIG. 1

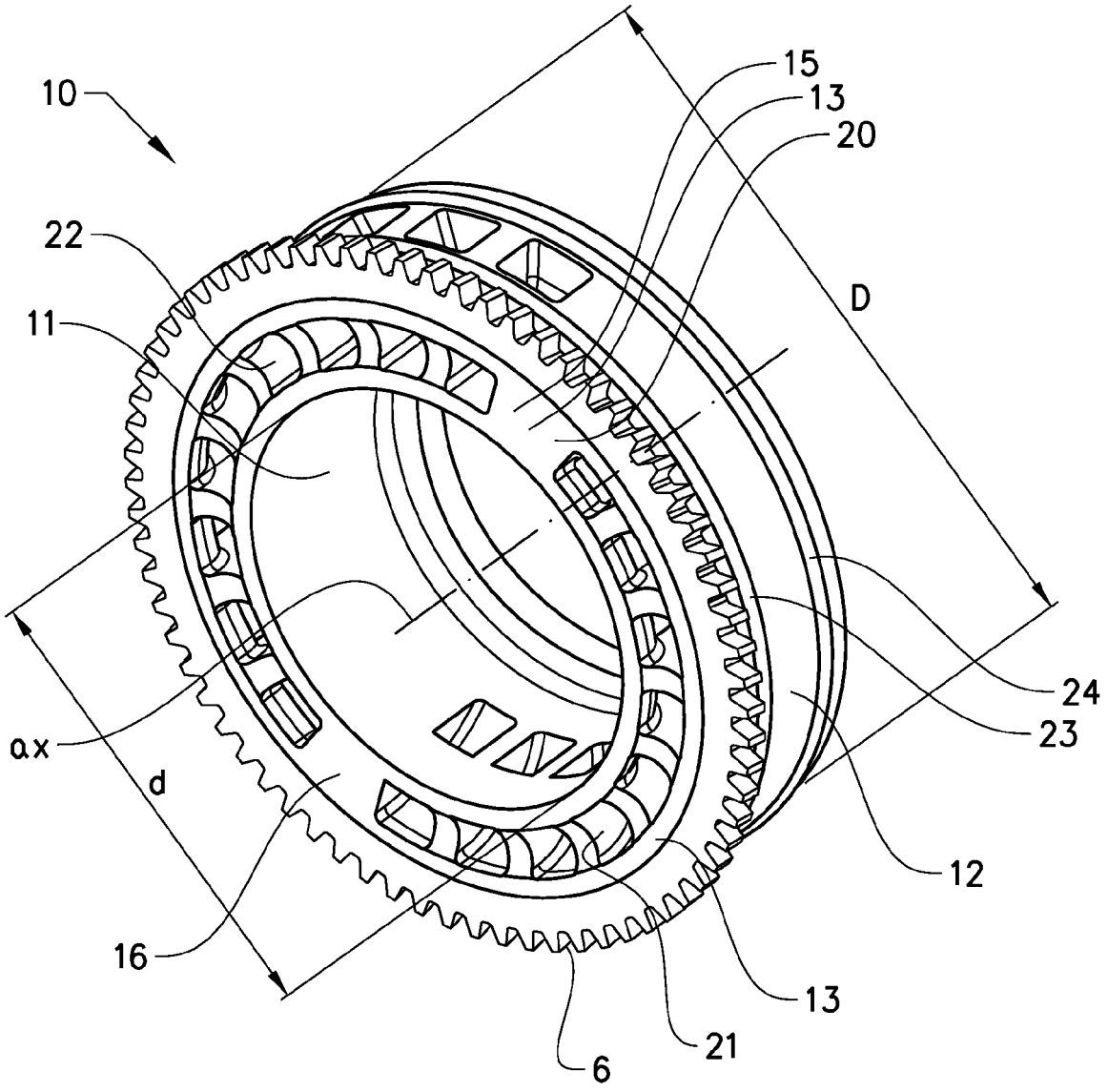

FIG. 2a

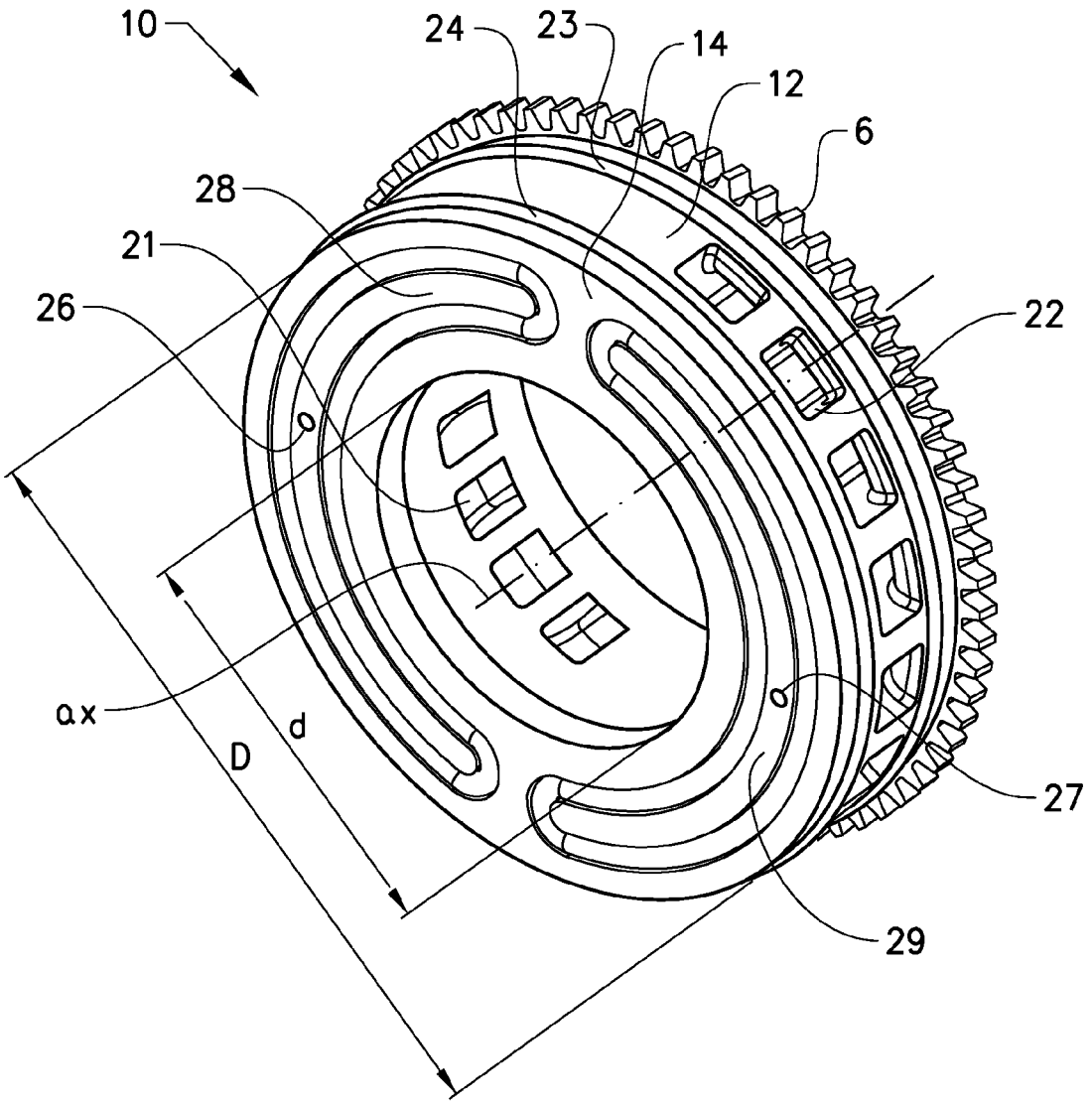

FIG. 2b

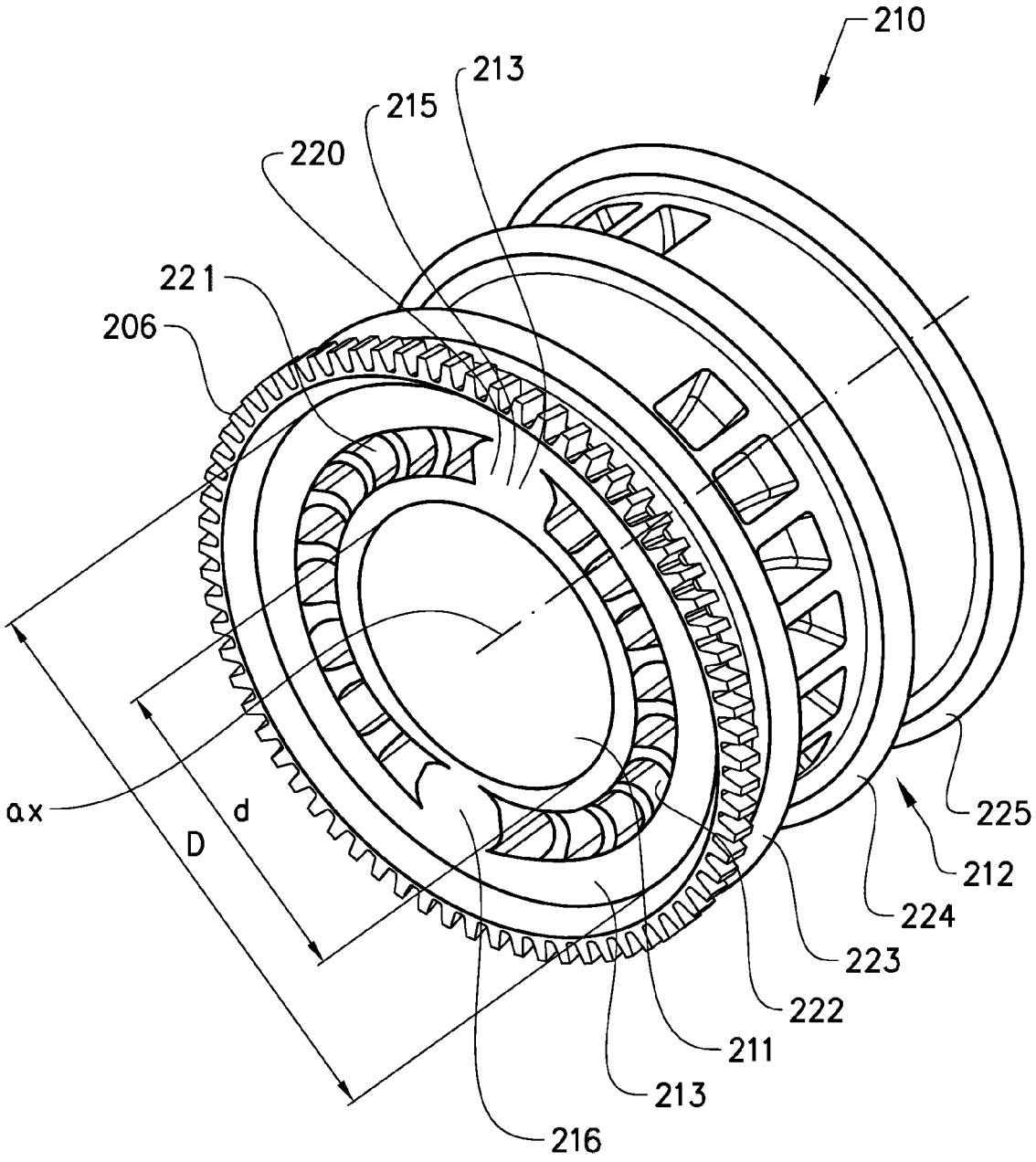

FIG. 3a

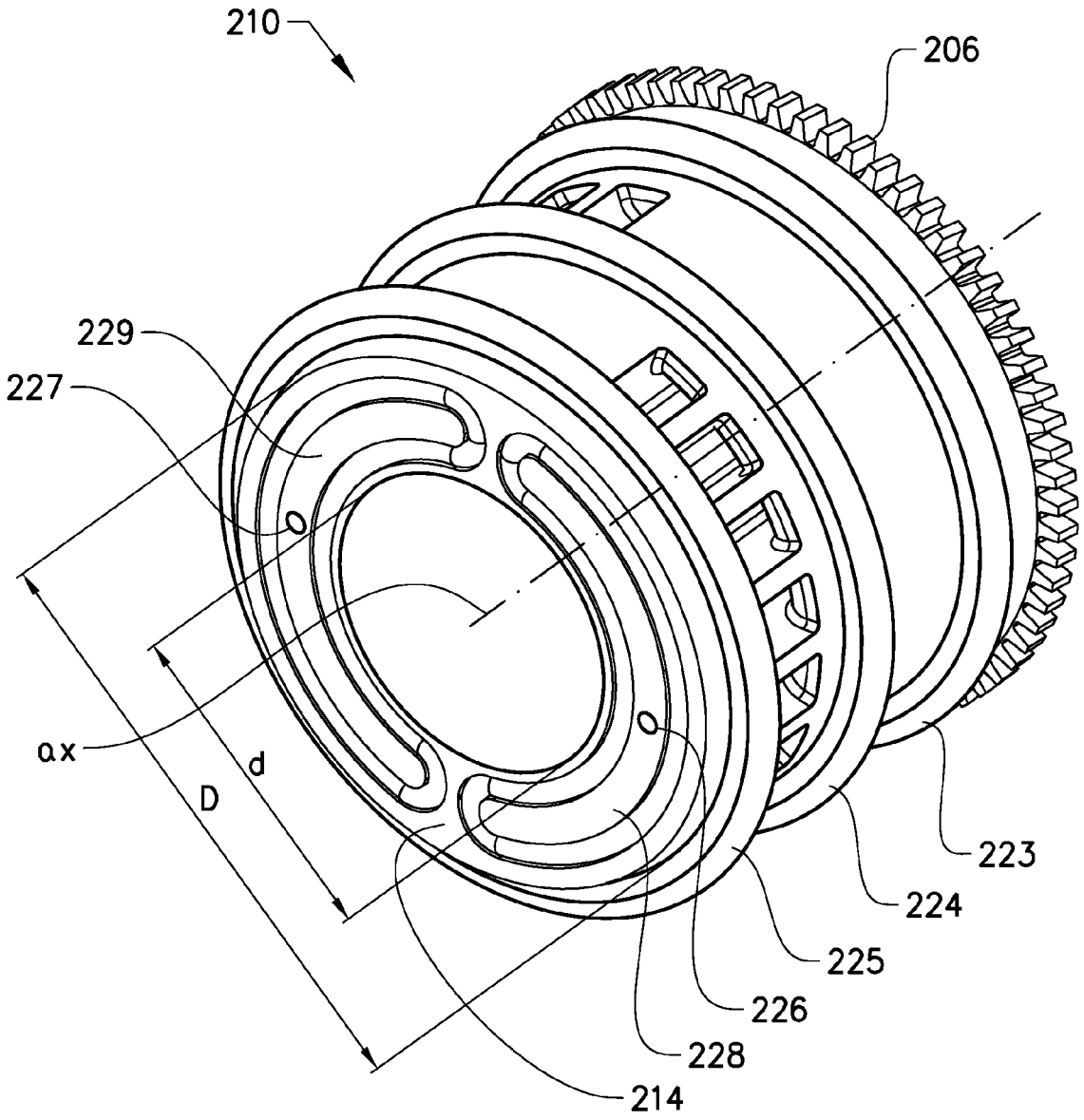

FIG. 3b

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EUROPEAN SEARCH REPORT

Application Number
EP 14 15 0742

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TECHNICAL FIELDS SEARCHED (IPC)
F01C
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 March 2014	Durante, Andrea

CATEGORY OF CITED DOCUMENTS

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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