(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 242 963**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **87302043.2**

(51) Int. Cl.4: **F04C 2/10**

(22) Date of filing: **10.03.87**

(30) Priority: **14.03.86 GB 8606326**

(43) Date of publication of application:
28.10.87 Bulletin 87/44

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(71) Applicant: **HOBOURN-EATON LIMITED**
Priory Road Strood
Rochester, Kent ME2 2BD(GB)

(72) Inventor: **Bristow, Ian Trevor**
4 Hayes Close
Higham Kent(GB)
Inventor: **Thornelow, Alec**
67 Ingle Road
Chatham Kent(GB)

(74) Representative: **Brooke-Smith, Fred et al**
STEVENS, HEWLETT & PERKINS 5 Quality Court Chancery Lane
London WC2A 1HZ(GB)

(54) Rotary positive displacement pump.

(57) A gerotor or N(N+1) type pump comprises outer and inner lobed rotors 10, 11 defining pumping chambers 16 and has an inlet port 18 and two outlet ports 19, 20. Ports 19, 20 are separated from each other by a radially extending land 22. Between each pair of neighbouring lobes on the inner rotor 11 a radial slot 24 is formed which opens to the periphery of the rotor and extends inward a sufficient distance to overlap the two outlet ports 19, 20 radially when the said two lobes flank circumferentially opposite sides of the land 22. The circumferential extent of each slot 24 is sufficient to ensure that there is always a leakage path from the pumping chamber to which the slot opens to one or other of the two outlet ports as the slot passes the land 22.

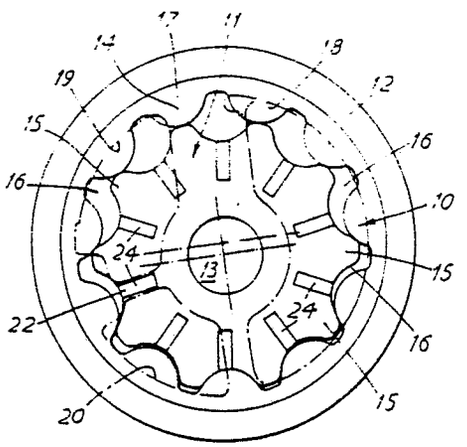

FIG. 1

EP 0 242 963 A2

IMPROVEMENTS RELATING TO POSITIVE DISPLACEMENT PUMPS

This invention relates to positive displacement rotary pumps and more particularly to pumps of the kinds known as gerotor or N(N+1) pumps and crescent pumps and which have a single ring of pumping chambers delivering pressure fluid to two separate outlet ports disposed one downstream of the other in the direction of rotation of the rotors.

According to this invention there is provided a positive displacement rotary pump comprising a housing, an outer rotor mounted in the housing for rotation and having internal teeth or lobes, an inner rotor disposed within and eccentrically with respect to the outer rotor and having external teeth or lobes which mesh with the internal teeth or lobes of the outer rotor and form therewith sealed pumping chambers operating to pump fluid from an inlet port in the housing to two outlet ports in the housing which outlet ports are arranged one downstream of the other in the direction of rotation of the rotors, the housing providing land means for sealing the two outlet ports from each other, each of said outlet ports having, in at least the regions thereof bordering opposite sides of the land means, a portion extending radially inward beyond the radially inner extremity of a pumping chamber passing the land means, and the inner rotor having between each adjoining pair of its external teeth or lobes slot means opening to one or both of the axial end surfaces of the inner rotor and to the pumping chamber between said pair teeth or lobes, the construction and arrangement being such that during the movement of the associated pumping chamber past the land means there is a permanent leakage path from the slot means to said portion of one or other of said two outlet ports.

In preferred constructions according to the invention said slot means has an effective circumferential extent greater than the effective circumferential extent of the land means such that during the movement of the associated pumping chamber past the land means the slot means serves to place the pumping chamber always in communication with said portion of one or other of said two outlet ports.

Where one of the end plates of the pump provides both of the outlet ports, the slot means may be formed in the end face of the inner rotor facing said one of the end plates.

Where both of the end plates have recesses constituting outlet ports the slot means associated with each pumping chamber may comprise slots formed in both end faces of the inner rotor or may comprise slots extending through the full axial length of the inner rotor. Where in such a construction the circumferential edges defining the effective circumferential limits of the land means are provided by the two end plates respectively, the circumferential limits of the slot means may similarly be defined by slots opening to opposite end faces respectively of the inner rotor.

The invention will now be described in more detail with reference by way of example to the accompanying diagrammatic drawings in which:

Figure 1 shows in elevation part of a pump according to the invention, with one end plate removed,

Figure 2 shows schematically in elevation the ported end plate of the pump of Figure 1, and

Figure 3 shows a modified arrangement.

Referring to Figures 1 and 2 of the drawings, the pump is of the gerotor or N(N+1) type comprising an outer rotor 10 and an inner rotor 11 mounted for rotation in a housing 12 which includes also two end plates flanking opposite ends of the rotors. The inner rotor is disposed eccentrically with respect to the outer rotor and is secured to the drive shaft 13 of the pump. The outer rotor is formed internally with lobes 14 and the inner rotor is formed with complementary lobes 15 which mesh with the lobes 14 and form seals at the points of contact to define pumping chambers 16 carrying working fluid of the pump from an inlet port 18 in the axial end plate 17 to each of two outlet ports 19, 20 also formed in the end plate. The positions of ports 17, 18 and 19 are shown superimposed in chain lines in Figure 1. The number of lobes on the outer rotor exceeds that on the inner rotor by 1.

The two outlet ports are arranged one downstream of the other in the direction of rotation of the rotors and are isolated from each other in the end plate by a radially extending land 22 which is in sliding sealing engagement with the adjoining face of the inner rotor 11. During the time in which the lobes 14, 15 are passing the two outlet ports 19, 20 the pumping chambers defined by those lobes are continuously contracting in volume so that part of the fluid contained in each pumping chamber is expelled into the first outlet port 19 and the remainder is expelled into the second outlet port 20.

However, the contraction in volume also occurs during the time in which the pumping chamber is passing the land 22 and is occurring at substantially its maximum rate at this point, and since the land has a circumferential extent, over the radial dimension of the chamber, substantially equal to that of the pumping chamber, fluid being compressed in the pumping chamber during passage of the chamber past the land can escape only

through the leading or trailing end portions of the pumping chamber to the outlet ports 19 or 20 respectively. The two end portions of the pumping chamber are of very small area so that the ejection of fluid through these small area end portions causes noisy operation and a sharp rise in the fluid pressure in the pumping chamber. It is desirable to minimise this rise in pressure, for example in order to enable the outer diameter of the outer rotor to be kept to a minimum so that the weight of the rotor is minimised and so that the friction between the outer rotor and the housing is reduced.

For this purpose the face of the inner rotor 11 adjoining the end plate is formed with a series of slots 24 extending radially inward from the bottom of the channels between the lobes 15. The slots 24 have a circumferential width which is greater than the minimum width of the part of the land 22 axially aligned with the slots so that fluid from the pumping chamber can flow inward along the slot and thence into the outlet port 19 or 20. Since the slots in the illustrated arrangement are parallel-sided, a small rotational movement of the rotors causes a substantial change in the area of communication between the pumping chambers and the outlet ports, so that a rise in the pressure in the pumping chamber is very quickly relieved by a rapidly increasing area of communication between the slot and the downstream outlet port 20, as communication between the slot and upstream outletport 19 diminishes.

In some cases where there is an adequate axial clearance for the purpose between the housing and the inner rotor, the slots 24 may have a circumferential width equal to or even slightly less than the corresponding dimension of the land so that the clearance provides a leakage path for fluid from the slot during the instant of passage of the pumping chamber past the land.

The slots may conveniently be formed using a milling cutter so as when viewed in axial section to have the shape of a sector of a circle. However, the slots may if desired extend across the full axial width of the inner rotor. In cases where the other end plate has recesses opposite the two outlet ports and a land between these recesses, the slots 24 may extend across the full axial width of the inner rotor 11, or the rotor 11 may have slots 24 in both of its end faces. In cases where the two lands respectively provide the two cut-off points of communication between the two outlet ports, the circumferential edges of the slots at opposite axial ends of the inner rotor may be correspondingly disposed to provide the required extent of communication between the pumping chambers and the outlet ports and recesses.

For purposes of increased accuracy the circumferential end portions of the two outlet ports, and of the recesses where provided, which cooperate with the slots may be shaped by drilling holes 26 as illustrated in Figure 2.

The slots may be of any desired shape to produce the required control of rise of pressure in the pumping chambers. Thus, for example the radially inner portions of the slots may be circumferentially wider than the outer portions so that the slots are somewhat T-shaped where the land has a large minimum circumferential extent.

Incidental advantages of the provision of the slots are firstly that the volume of fluid in the slots increases the volume of the fluid compressed during passage of the pumping chamber past the land and thus tends to cushion the rise in pressure in the chamber, and secondly that since the inlet port has a radial extent which brings it with communication with the slots, the slots are able to assist in filling the pumping chambers as they pass the inlet port.

Claims

1. A positive displacement rotary pump comprising a housing (12), an outer rotor (10) mounted in the housing for rotation and having internal teeth or lobes, an inner rotor (11) disposed within and eccentrically with respect to the outer rotor and having external teeth or lobes which mesh with the internal teeth or lobes of the outer rotor and form therewith sealed pumping chambers (16) operating to pump fluid from an inlet port (18) in the housing to two outlet ports (19,20) in the housing which outlet ports are arranged one downstream of the other in the direction of rotation of the rotors, the housing providing land means (22) for sealing the two outlet ports from each other, characterised in that each of said outlet ports (19,20) has, in at least the regions thereof bordering opposite sides of the land means, a portion extending radially inward beyond the radially inner extremity of a pumping chamber (16) passing the land means, and the inner rotor (11) having between each adjoining pair of its external teeth or lobes slot means (24) opening to one or both of the axial end surfaces of the inner rotor and to the pumping chamber (16) between said pair of teeth or lobes, the construction and arrangement being such that during the movement of the associated pumping chamber (16) past the land means (22) there is a permanent leakage path from the slot means to said portion of one or other of said two outlet ports.

2. A pump as claimed in claim 1, characterised in that said slot means (24) has an effective circumferential extent greater than the effective cir-

cumferential extent of the land means (22) such that during the movement of the associated pumping chamber past the land means the slot means serves to place the pumping chamber always in communication with said portion of one or other of said two outlet ports.

3. A pump as claimed in claim 1 or claim 2, characterised in that one of the end plates of the pump provides both of the outlet ports (19,20), and the slot means is formed in the end face of the inner rotor facing said one of the end plates.

4. A pump as claimed in claim 1 or claim 2, characterised in that both of the end plates have recesses constituting outlet ports and the slot means (24) associated with each pumping chamber (16) comprises slots formed in both end faces of the inner rotor.

5. A pump as claimed in claim 1 or claim 2, characterised in that both of the end plates have recesses constituting outlet ports and the slot means (24) associated with each pumping chamber (16) comprises a slot extending through the full axial width of the rotor.

6. A pump as claimed in claim 4 or claim 5, characterised in that the circumferential edges of the land means are provided by the two end plates respectively, and the slot means opens to opposite end faces respectively of the main rotor in a manner such that the circumferential limits of the slot means are correspondingly defined.

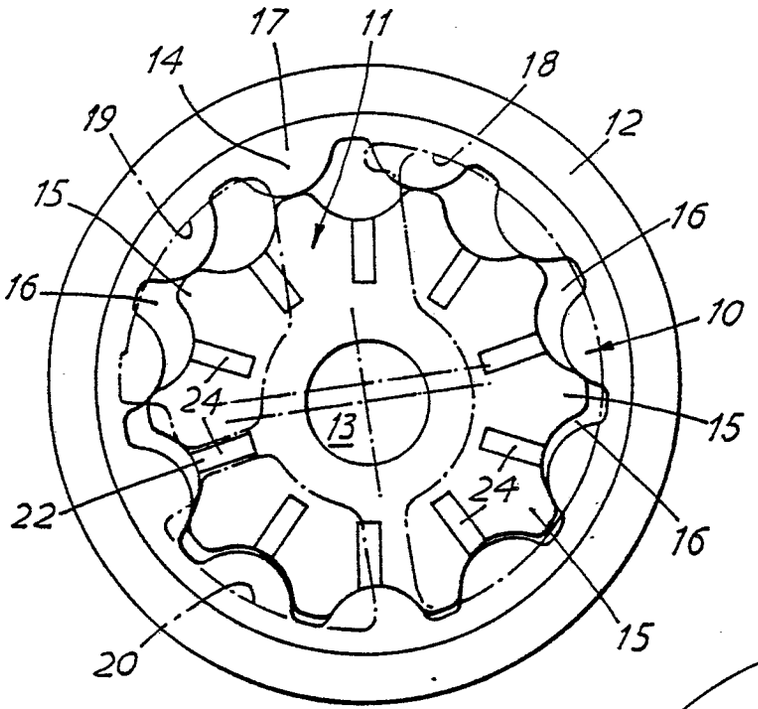

FIG.1

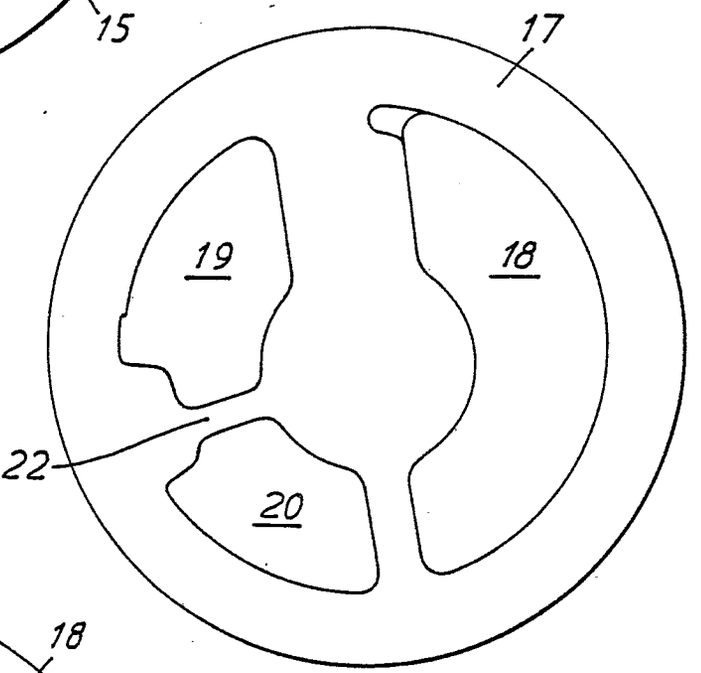

FIG.2

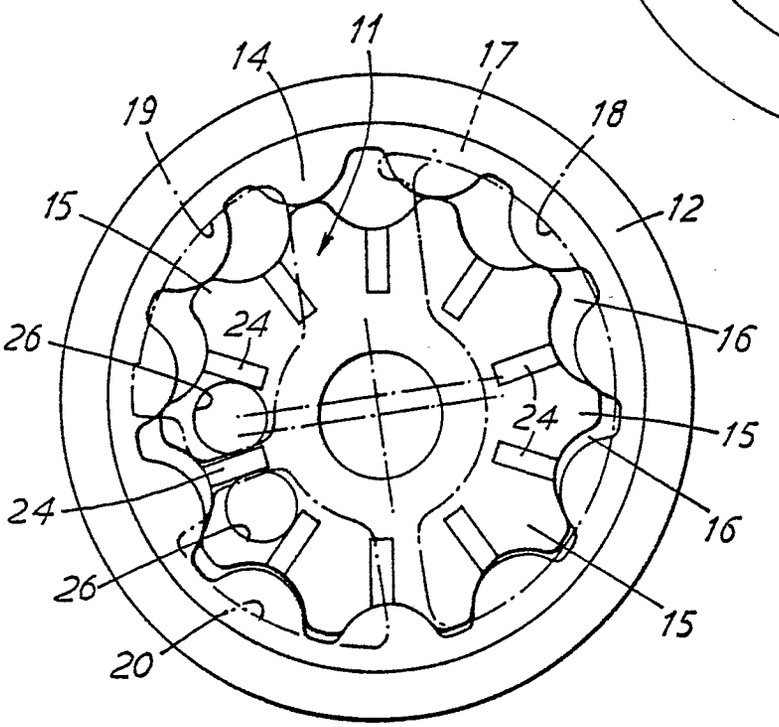

FIG.3