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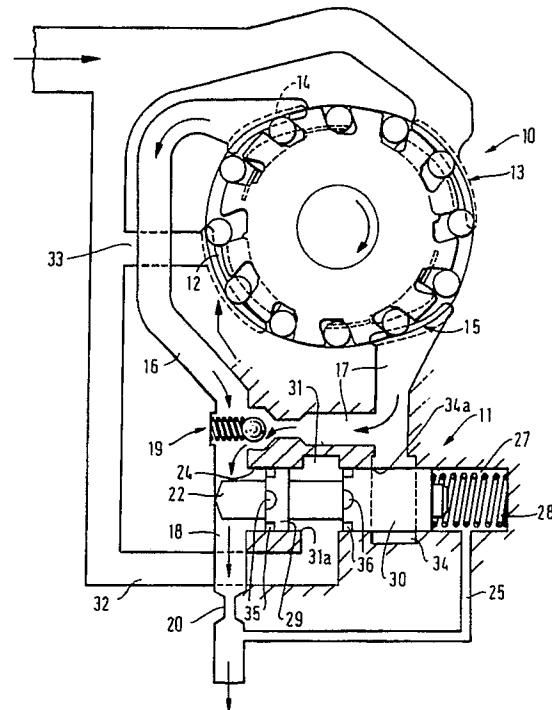
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(54) **Positive displacement pump systems.**

(57) A positive displacement pump has two separate outlet passages, 16, 17 leading to a main outlet passage 18 containing a constant flow orifice 20. Outlet passage 17 contains a non-return valve 19. A control valve member is mounted in a bore opening to passage 18 upstream to orifice 20. The bore has an annular overspill port 31 and a by-pass port 34 which opens to outlet passage 17 upstream of valve 19. The valve member has two lands 29, 30 having end faces co-operating respectively with annular edges 31a, 34a of ports 31, 34. Notches 35, 36 are respectively formed in said end faces. On increasing pressure upstream of orifice 20 moves the valve member to by-pass the delivery from passage 17 to the overspill. Further increase of pressure then causes closure of the valve 19 and causes the valve member to move suddenly to pass fluid from passage 18 to the overspill port 31.

FIG.1



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POSITIVE DISPLACEMENT PUMP SYSTEMS

This invention relates to positive displacement pump systems and is more particularly concerned with such systems in which deliveries from two positive displacement pump sources are available to be fed to a common supply passage.

According to this invention there is provided a positive displacement pump system having first and second delivery passages for pumped fluid, a main discharge passage connected to receive a flow from the first delivery passage and to receive through a non-return valve a flow from the second delivery passage, a control orifice disposed in the main discharge passage at a location to receive the combined said flows, and a control valve for apportioning the flow from the second delivery passage between the main discharge passage and overspill porting and controlling the by-passing of a proportion of the flow up to the full flow from the first delivery passage through the overspill porting, said control valve comprising a valve member slidably mounted in a bore in a valve body, one end of which bore is in communication with the main discharge passage at a location upstream of said control orifice, a spring which is disposed in a spring chamber in the valve body and which urges the valve member towards said one end of the bore, said spring chamber communicating with the main discharge passage at a location downstream of the control orifice, said valve member having a first metering land between said one end of the valve bore and the overspill porting, and a second metering land disposed between the spring chamber and the overspill porting, and the valve body having an annular by-pass port variably obstructed by the second land and connected to the second delivery passage at a location upstream of said non-return valve, the by-pass port and the axial end portion of the second land nearer the overspill porting being so shaped in relation to each other that on movement of the valve member against the spring loading, the communication between the by-pass port and the space in the valve bore at the axial side of the second land nearer said one end of the valve bore is initially at least, less than fully annular as the valve member moves against the spring loading.

According to a preferred feature of the invention, the overspill porting comprises an annular overspill port extending about the valve bore, and the edge of the overspill port nearer the first land and the end of the first land nearer said one end of the valve bore are so shaped in relation to each other that on movement of the valve member against the spring loading, the communication between the by-pass port and said one end of the

valve bore is, initially at least, less than fully annular as the valve member moves against the spring loading.

The progressive increase in the area of communication towards fully annular communication in these constructions may be achieved by providing peripheral notches in the said end face of the first and/or the second land or otherwise making the periphery of such end face non-circular. Alternatively notches may be cut in axial end edge of the port.

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 a positive displacement pump system according to the invention in a low-speed condition,

Figures 2 and 3 respectively show the control valve of the system of Figure 1 in medium speed and high speed conditions respectively,

Figure 4 illustrates a modified arrangement of the control valve, and

Figures 5 and 6 are respectively fragmentary sectional end views on the lines 5-5 and 6-6 of Figure 4.

Referring first to Figure 1 the system comprises a positive displacement pump 10 and in this instance of the well-known roller type and has two inlet ports 12, 13 and two outlet ports 14, 15 from which the pumped fluid flows into first and second delivery passages 16, 17 respectively. The downstream end of delivery passage 16 is in direct communication with the upstream end of a main discharge passage 18. The downstream end of the second delivery passage 17 communicates with the discharge passage 18 through a non-return valve 19. A discharge orifice 20 is provided in the discharge passage 18.

The control valve 11 comprises a spool valve member 22 slidably mounted in a bore 24 in a body part 26. One end of the bore 24 opens to the main discharge passage 18 upstream of the orifice 20. The other end of the bore forms a chamber 27 housing a spring 28 which urges the valve member into abutment with a wall of the main discharge passage 18. The chamber 27 communicates through a duct 25 with the passage 18 at a location downstream of the orifice 20 so that the pressure drop across the orifice opposes the force of the spring 28.

The valve member has first and second lands 29, 30 of which, in the position shown in Figure 1, the former is disposed between the main discharge passage and an annular overspill port 31 in the bore 24. Port 31 communicates through a passage

32 with a passage 33 leading to the inlet port 12. Land 30 is axially spaced from land 29 and, in the position shown in Figure 1, obstructs an annular by-pass port 34 which is in communication with the second delivery passage 17 at a location upstream of the non-return valve 19. The lands 29,30 have in the periphery of their end portions nearer the main discharge passage a number of notches 35, 36 respectively opening to the end face.

Figure 1 shows the valve in its position in low-speed operation of the pump. The pressure in the main discharge passage is low, and the lands 29 and 30 respectively prevent communication between the discharge passage 18 and the by-pass port 34 respectively and the overspill port 31, so that the whole flow from the second outlet port 15 flows through the non-return valve 19 and joins the flow from the first outlet port 14 in the main discharge passage leading to the point of utilisation. As the pump speed increases, assuming for the moment that the pressure at the downstream side of orifice 20 remains constant, the increase in pressure at the upstream side of the orifice urges the valve member to move against the spring force as shown in Figure 2. As the notches 36 in the end portion of the second land pass the circular edge 34a of the port 34, a flow of fluid through the port to the overspill port 31 occurs which is less than if there were fully annular communication between the port and the bore, so that the flow to the overspill is not greatly affected by ie is less sensitive to, small movements of the valve member on initial opening. An increasing proportion of the flow from the second delivery port 15 is by-passed through the overspill port 34, as the pump speed increases. As the valve member moves rightward the area of communication increases to the position where the plane of the end face passes the edge 34a of the port 34 and communication is then fully annular.

Up to this point the non-return valve 19 has remained open but at their maximum opening the notches 36 are capable of passing to the overspill port 31 the entire flow from the second delivery passage 17 and when the end face of land 35 moves past the edge 34a, the resulting fall in pressure in the second delivery passage tends to produce a reverse flow through the non-return valve, which causes the valve 19 to close. The next increase in the pump speed causes a sudden and substantial rightward movement of the valve member, which moves notches 35 to a point relative to the edge 31a of overspill port 31 at which the fresh excess of fluid can pass to the overspill port through the notches 35, see Figure 3. This rightward movement of the valve member causes a sharp fall in the pressure in the second delivery passage 17 and a consequent reduction in the

power requirement of the pump. Further increases in pump speed move the valve member further rightward permitting increased flow of fluid from the first delivery passage to pass through notches 35 to the overspill port 34.

Thus, with progressively increasing pump speed, all of the fluid delivered to the second delivery passage is passed at low pressure through the overspill port, and an increasing proportion of the fluid delivered to the first delivery passage is also passed through the overspill port

In an alternative arrangement illustrated in Figures 4 to 6, the two lands 29, 30 of the valve member have fully planar end faces and notches 37, 38 are instead formed in the axial end faces 31b, 34b of the ports 31, 34 which co-operate with the lands in controlling the opening of the ports. The notches 37, 38 operate in conjunction with the ends of the lands 29, 30 in exactly the same way as the notches 35, 36 operate in conjunction with the edges 31a of the ports in the arrangement of Figure 1.

The orifice 20 operates to maintain a constant flow to the point of utilisation, and if at any stage of operation, the pressure downstream of the orifice 20 falls, the resulting drop in pressure in chamber 27 causes the valve member to move to increase the amount of fluid passed to the overspill port. Conversely if the pressure downstream of orifice 20 rises, the resulting rise in pressure in chamber 27 causes the valve member to move to reduce the amount of fluid passed to the overspill port.

Claims

1. A positive displacement pump system having first and second delivery passages for pumped fluid, a main discharge passage connected to receive a flow from the first delivery passage and to receive through a non- return valve a flow from the second delivery passage, a control orifice disposed in the main discharge passage at a location to receive the combined said flows, and a control valve for apportioning the flow from the second delivery passage between the main discharge passage and overspill porting and controlling the by-passing of a proportion of the flow up to the full flow from the first delivery passage through the overspill porting, said control valve comprising a valve member slidably mounted in a bore in a valve body, one end of which bore is in communication with the main discharge passage at a location upstream of said control orifice, a spring which is disposed in a spring chamber in the valve body and which urges the valve member towards said one end of the bore, said spring chamber communicating with the main discharge passage at

a location downstream of the control orifice, said valve member having a first metering land between said one end of the valve bore and the overspill porting, and a second metering land disposed between the spring chamber and the overspill porting, and the valve body having an annular by-pass port variably obstructed by the second land and connected to the second delivery passage at a location upstream of said non-return valve, the by-pass port and the axial end portion of the second land nearer the overspill porting being so shaped in relation to each other that on movement of the valve member against the spring loading, the communication between the by-pass port and the space in the valve bore at the axial side of the second land nearer said one end of the valve bore is initially at least, less than fully annular as the valve member moves against the spring loading.

2. A pump system as claimed in claim 1, wherein the overspill porting comprises an annular overspill port extending about the valve bore, and the edge of the overspill port nearer the first land and the end of the first land nearer said one end of the valve bore are so shaped in relation to each other that on movement of the valve member against the spring loading, the communication between the by-pass port and said one end of the valve bore is, initially at least, less than fully annular as the valve member moves against the spring loading.

3. A pump system as claimed in claim 2, wherein the peripheries of the said end faces of the first and second lands are non-circular.

4. A pump system as claimed in claim 3, wherein peripheral notches are formed in the said end face of the first and/or second land.

5. A pump system as claimed in claim 2, wherein the notches are formed in the axial end of the overspill part and the by-pass part which cooperate with the respective lands.

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FIG.1

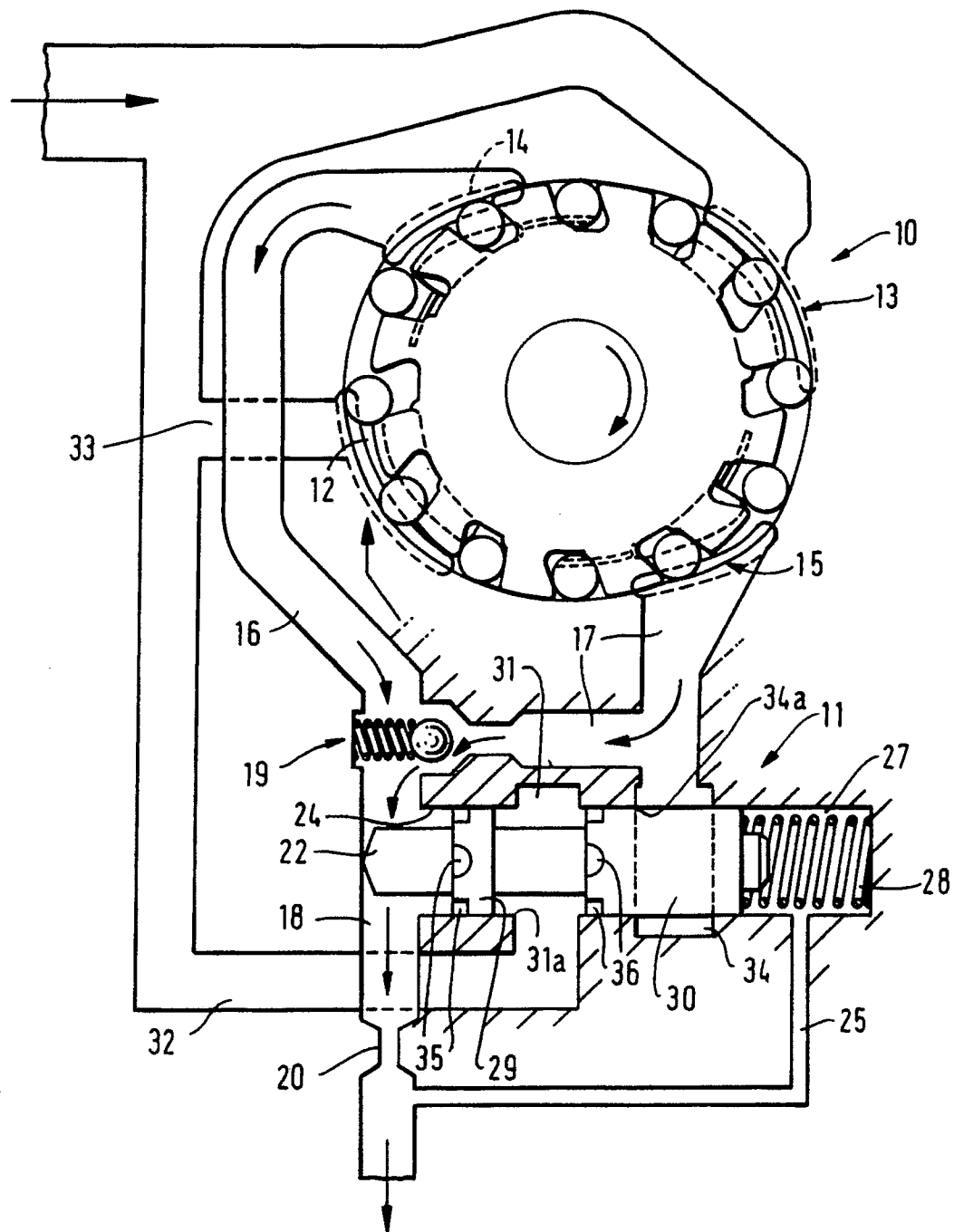


FIG. 2

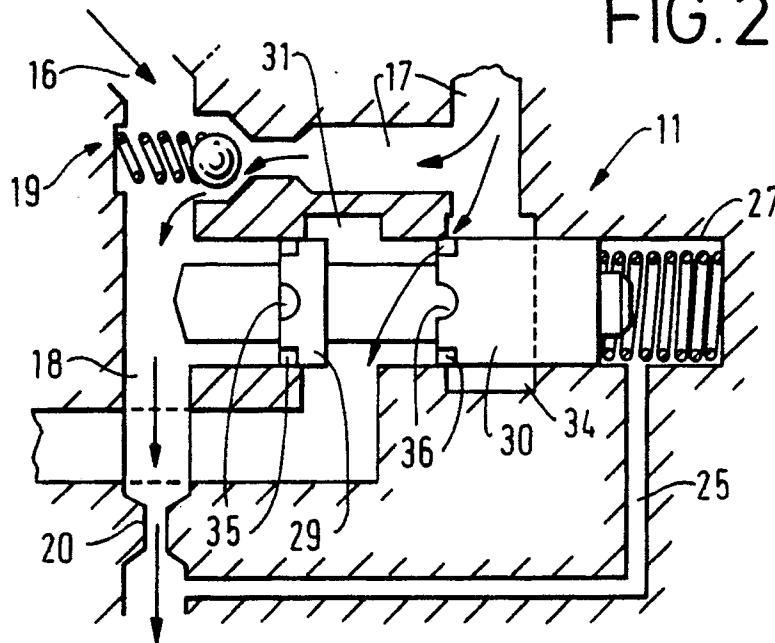


FIG. 3

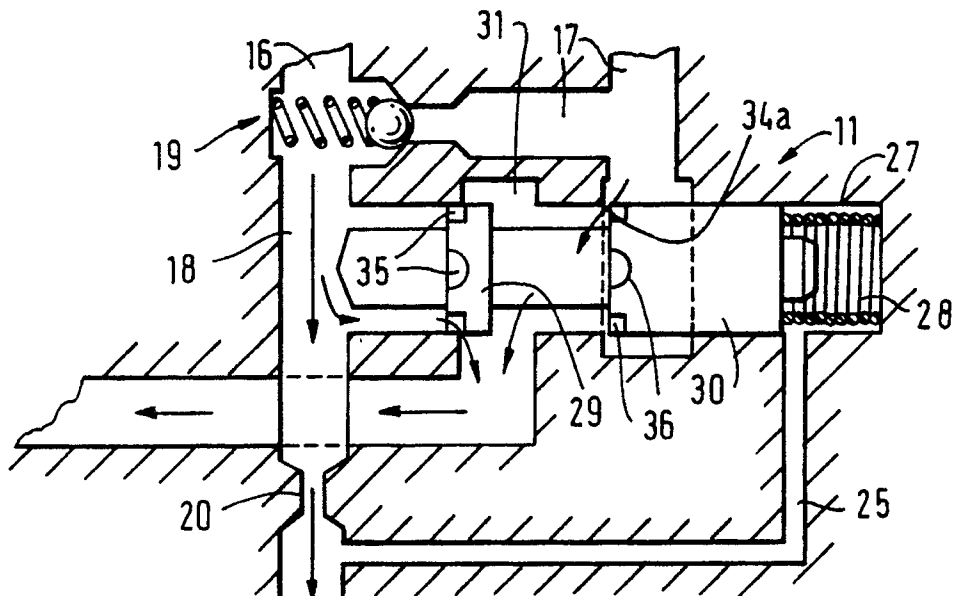


FIG.4

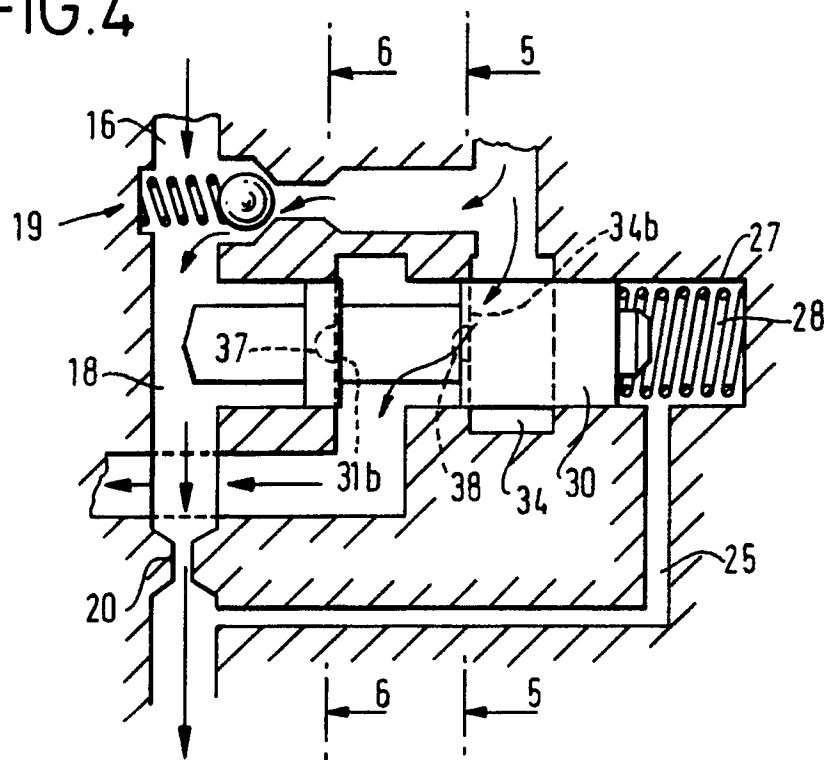


FIG. 5

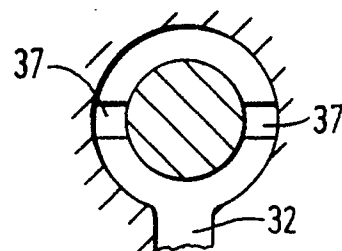
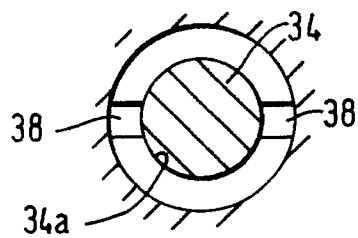


FIG.6



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EUROPEAN SEARCH REPORT

Application Number

EP 90 31 2361

DOCUMENTS CONSIDERED TO BE RELEVANT					
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)		
A	EP-A-0 005 190 (REXROTH) * page 2, line 11 - page 7, line 35; figures 1-3 * - - -	1	F 04 B 49/00 F 04 B 1/06		
A	US-A-2 074 618 (ROEDER) * page 2, line 16 - page 3, line 7; figures 4-9 * - - -	1,2			
A	EP-A-0 047 885 (KRAUSS-MAFFEI) * page 2, line 30 - page 3, line 17; figures 1, 2 * - - -	1			
A	US-A-2 192 512 (TWISS) * page 1, line 53 - page 2, line 52; figures 2-6 * - - -	1-4			
A	FR-A-2 136 479 (LUCAS) * page 2, lines 10 - 28; figure 6 * - - -	1,2			
A	GB-A-6 816 25 (HOBSON) * page 2, line 95 - page 4, line 41; figure 2 * - - - - -	1,2			
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.5) F 04 B F 01 B		
Place of search The Hague		Date of completion of search 29 January 91	Examiner BERTRAND G.		
<table border="0"><tr><td>CATEGORY OF CITED DOCUMENTS X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention</td><td>E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons &: member of the same patent family, corresponding document</td></tr></table>				CATEGORY OF CITED DOCUMENTS X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention	E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons &: member of the same patent family, corresponding document
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