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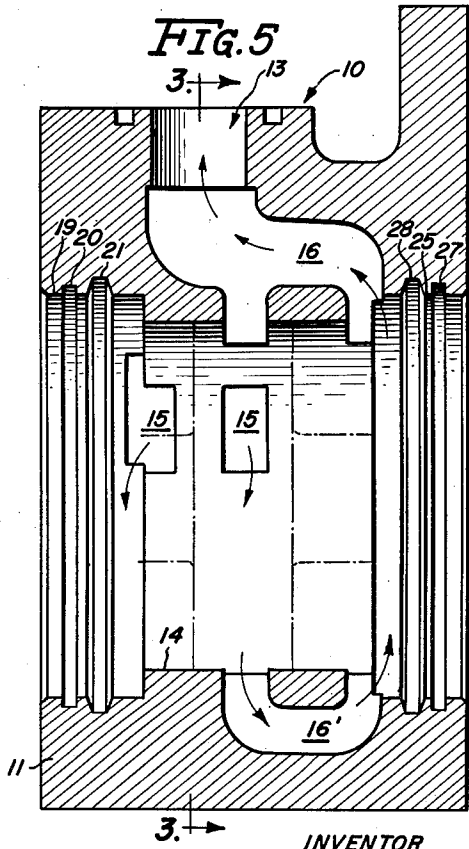
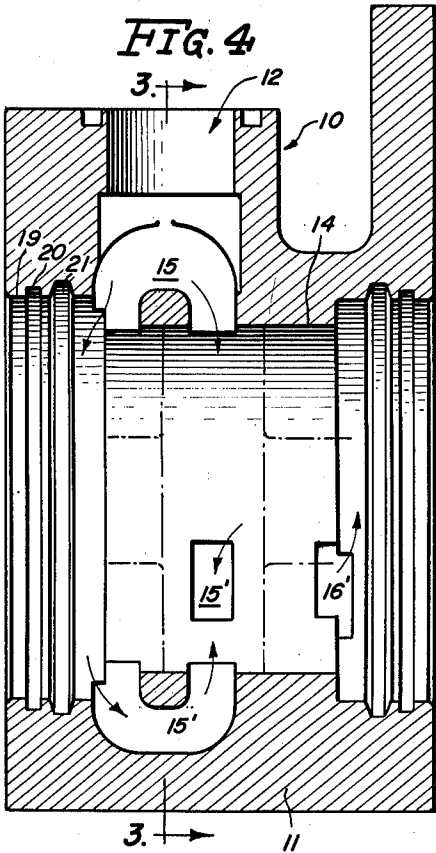
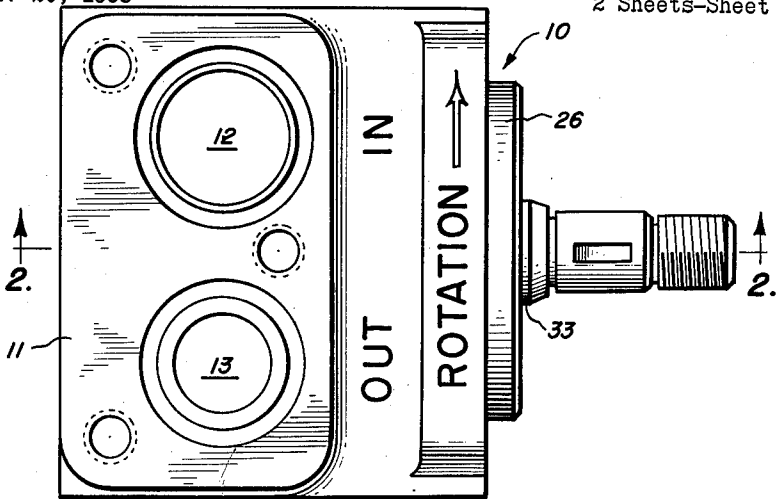
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VANE TYPE OIL PUMP LUBRICATION SYSTEM

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2 Sheets-Sheet 1

FIG. 1



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FIG. 3

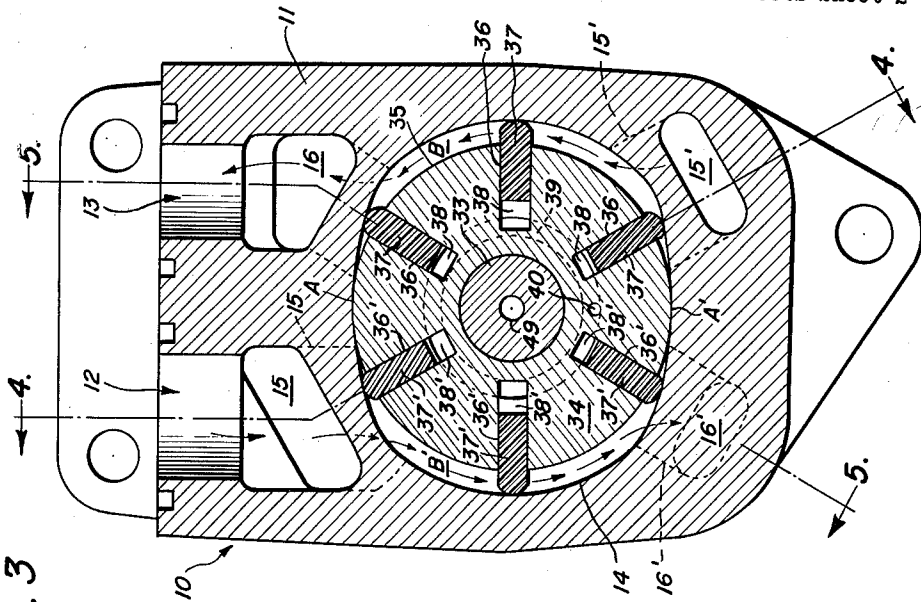
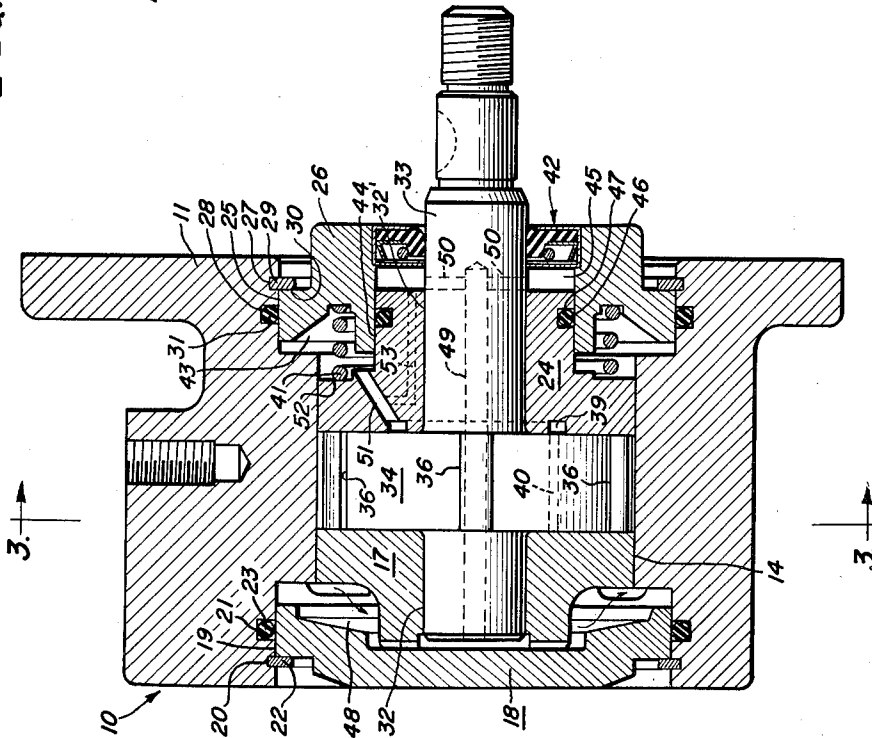


FIG. 2



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VANE TYPE OIL PUMP LUBRICATION SYSTEM
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1 Claim. (Cl. 103-136)

This invention relates to a system for lubricating the working parts of a vane type oil pump. More in particular this invention relates to a means for lubricating the bearings of a vane type oil pump from low pressure oil source and lubricating the rotor at high pressure and, alternately, lubricating the bearings and rotor at elevated pressure. Further, this invention relates to combining of high pressure lubrication of the rotor vane type pumps with means for fluid pressure actuation of the vanes.

Vane type pumps are efficient mechanisms for pumping fluids, particularly oil, at high pressures. For a given capacity these pumps are relatively small and of low priced construction. Because of the high pressure characteristics of these pumps their construction requires close tolerances and where they are operated at high speed adequate means for urging the vanes outwardly is necessary otherwise the efficiency is reduced through fluid slippage. Thus the axial thrust or force of the bearing surfaces against the rotor are necessarily of higher order which is difficult to lubricate adequately particularly the inner areas close to the drive shaft. Also, because of close tolerances the supporting bearings must be adequately lubricated or excessive wearing results which tends to lower the efficiency of the pump.

Insofar as is known, heretofore conventional means have been used to lubricate the supporting bearings and slippage of oil has been relied upon to lubricate the rotor surfaces. Particularly in high speed operation these conventional methods of lubrication were inadequate because wearing was excessive resulting in the lowering of the pump's efficiency prematurely.

It is therefore a prime object of this invention to provide adequate lubrication of a vane type pump utilizing the pumped oil as a lubricant.

It is a further object of this invention to provide adequate lubrication of a vane type pump operating at high speed wherein the lubricant is under elevated pressure.

A still further object of this invention is to provide continuous lubrication to the supporting bearings of a vane type pump operating at low speed from a low pressure oil source and lubrication of the rotor surfaces at high pressure oil source.

Another object of this invention is the combining of a lubricating means at high oil pressure to the rotor surfaces with additional means for urging the vanes outwardly under the influence of oil under high pressure delivered by the pump.

These and other desirable and important objects inherent in and encompassed by the invention will be more readily understood from the ensuing description, the appended claim and the annexed drawings wherein:

FIGURE 1 is a plan view of a vane type pump showing a portion of the external construction including fluid inlet and fluid outlet means.

FIGURE 2 is a sectional view taken on line 2-2 of FIGURE 1 illustrating the internal construction of a vane type pump and details of the lubricating system of this invention.

FIGURE 3 is a sectional view taken along the line 3-3 of FIGURES 2, 4 and 5 showing additional details of the construction of a vane type pump.

FIGURE 4 is a sectional view taken along the line 4-4 of FIGURE 3 with rotor and shaft removed illus-

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trating the flow of oil path from the inlet means to the vanes of a vane type pump.

FIGURE 5 is a sectional view taken along the line 5-5 of FIGURE 3 with rotor and shaft removed showing the flow of oil path from the vanes of the pump to the outlet means.

For high speed operation a balanced type vane pump is preferable because each vane is always positioned equidistant from the axis of rotation as is the corresponding vane positioned in diametrical opposed relation. For this reason the balanced type pump shown in the drawings was selected as the preferred environment of this invention.

With continued reference to the drawings, the numeral 10 indicates a balanced vane type of pump. The pump 10 comprises a housing 11 having fluid inlet means 12 connected to a conventional source of oil such as a reservoir (not shown) and a fluid outlet means 13 connected to a conventional receiver of oil under pressure such as, for example, an hydraulic motor (not shown). Referring to FIGURES 2 to 5, the housing 11 is provided with a longitudinally positioned bore 14. As will be seen from FIGURE 3 the cross-sectional shape of the bore 14 is generally of an ovate or elliptical contour for a purpose which will become evident later. The inlet means 12 in the housing 11 includes an inlet port 15 communicatively connected to the bore 14 as best shown in FIGURES 3 and 4. In diametric opposed relation with reference to the centrally disposed longitudinal axis of the bore 14 the inlet port 15 again communicates with the bore 14 at 15' as best shown in FIGURES 3 and 4. Thus the fluid inlet means 12 feeds oil to the bore 14 through the combined inlet port designated 15 and 15'.

The outlet means 13 in the housing 11 includes an outlet port 16 communicatively connected to the bore 14 as shown in FIGURES 3 and 5. In diametric opposed relation with reference to the centrally disposed longitudinal axis of the bore 14 the outlet port 16 again communicates with the bore 14 at 16'. Thus the fluid outlet means 13 conducts oil from the bore 14 through the combined outlet port designated 16 and 16'.

Fitted into the left end portion of the bore 14 in close tolerance contour relation, as seen in FIGURE 2, is a stationary bearing element 17 which is positioned in abutting relation against a closure member or cap 18. The cap 18 is seated in a circular recess 19 in the housing 11 in sealed relation. The housing 11 is provided with a pair of circumferential grooves 20 and 21. A conventional snap ring 22 (FIGURE 2) is inserted in the groove 20 which acts as a stop means for preventing outward movement of the cap 18 in an axial direction. The groove 21 is provided with a conventional packing means such as an O ring 23 to prevent leakage of oil thereby.

Fitted into the right end portion of the bore 14 in close tolerance but slidable contour relation, as seen in FIGURE 2, is a movable bearing member 24. The right end portion of the housing 11 is provided with a circular recess 25 in which is fitted in close tolerance relation an annular shaped bearing support element 26. The housing 11 is also provided in the right end portion thereof a pair of circumferential grooves 27 and 28. A conventional snap ring 29 is inserted in the groove 27 in abutting relation with the shoulder portion 30 of the bearing support element 26 to prevent outward movement thereof. The groove 28 is provided with conventional packing means such as an O ring 31 to prevent leakage of oil thereby.

The stationary bearing element 17 and the movable bearing member 24 are each provided with a bearing bore 32 and 32' as shown in FIGURE 2 disposed in coaxial relation with respect to the central longitudinal axis of the bore 14. Supported in the bearing bores 32

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and 32' is the pump's driving shaft 33 which extends through the element 26 externally. The shaft 33 is connected to a suitable source of power (not shown) is rotative drive relation.

Disposed in the bore 14 between the stationary bearing element 17 and the movable bearing member 24 is the pump's rotor 34. As seen in FIGURE 3 the cross-sectional contour of the rotor 34 is circular and of such diameter that it engages the bore 14 of the housing 11 in sliding relation at the points designated at A and A'. The rotor 34 is rigidly mounted on the shaft 33.

From FIGURE 3 it can be seen that the outer peripheral surface 35 of the rotor 34 defines open areas designated as B and B'. Of course it should readily be understood that, from FIGURE 2, the areas B and B' have depth in a longitudinal direction defined by the minimal distance between the bearings 17 and 24 or substantially the longitudinal thickness of the rotor 34 and thus represent well defined volumes.

The pump's rotor 34 is provided with a plurality of longitudinally extending radially disposed slots 36 and 36' positioned equidistant from each other as illustrated in FIGURES 2 and 3. Each slot 36 or 36' is provided with a vane 37—37' slidable in the slot 36—36' in a radial direction. The vanes 37—37' each define an inner chamber 38—38' communicatively connected together by an adjacent annular groove 39 (FIGURES 2 and 3) disposed on the inner face of the movable bearing member 24. It will be seen from this that oil within the annular groove 39 lubricates the surface of the inner face of the movable bearing member 24 and the adjacent face of the rotor 34. In order to lubricate the opposite side of the rotor 34 and the inner face of the stationary bearing element 17, at least one oil passage, one being shown at 40, is provided in the rotor 34 longitudinally disposed and in communication with the annular groove 39 as best shown in dotted lines of FIGURE 2. Obviously a plurality of such passages 40 may be provided as may be expedient to maintain the rotor 34 in dynamic balance.

The movable bearing member 24 is urged in a longitudinal direction toward the rotor 34 by a compression spring 41 bearing upon the member 24 and seated or anchored in an annularly shaped recess 43 against the supporting element 26 as best shown in FIGURE 2. Thus the rotor 34 is maintained in close tolerance but slidable relation between the stationary bearing element 17 and the movable bearing member 24. A conventional packing means generally indicated at 42 is provided to prevent leakage of oil between the bearing support element 26 and the shaft 33 as shown in FIGURE 2.

It can be appreciated that the movable bearing member 24 is slidable in a longitudinal direction with reference to the bearing support member 26 at the support element bore 44. In order to prevent oil under pressure from leaking from the annular recess 43 to the right bearing chamber 45 through the support element bore 44 a conventional packing means such as an O ring 46 is provided in a circumferentially disposed groove 47 in the movable bearing member 24 as best shown in FIGURE 2.

For communicating lubricant oil from the annularly shaped left bearing chamber 48 (FIGURE 2) to the annularly shaped right bearing chamber 45 there is provided a small bore 49 disposed longitudinally along the axis of the shaft 33 extending from the left end of shaft 33 to approximately the vertical plane formed by the packing means 42. A transverse bore 50 in the shaft 33 intersecting the small bore 49 and opening into the right bearing chamber 45 is provided as shown in FIGURE 2.

In order to provide lubricant at high pressure to the annular groove 39 (FIGURE 2) the movable bearing member 24 is provided with an angular bore 51 communicating the groove 39 with the recess 43.

In operation the source of oil is admitted to the pump 10 through the fluid inlet means 12 to the inlet port

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15 where the fluid is divided. Part of the fluid enters the area B' through the port 15 and the balance passes through the annular shaped left bearing chamber 48 to the inlet port 15' from which it passes into the area B (FIGURES 2 and 3). As the rotor 34 rotates the vanes 37' abutting the bore 14 picks up the oil and pushes it under pressure to the outlet port 16'. From the outlet port 16' the oil under pressure passes through the annular shaped recess 43 to the outlet port 16 and thence to the outlet means 13 for transmission to the receiver (not shown) for the oil delivered under pressure. The oil in the area B on the other side of the pump 10 is picked up by the vanes 37 abutting the bore 14 and pushed to the outlet port 16 where it is merged with the oil from the area B' and discharged through the outlet means 13.

Lubrication of the bearing bore 32 of the stationary bearing element 17 and shaft 33 is provided from the inlet oil passing through the left bearing chamber 48. Inlet oil also passes through the small bore 49 and the transverse bore 50 in the shaft 33 to provide lubrication of the bearing bore 32' of the movable bearing member 24 through the right bearing chamber 45 as best shown in FIGURE 2. From this it can be seen that the shaft 33 with respect to the stationary bearing element 17 and the movable bearing member 24 is lubricated from inlet oil at low pressure.

Oil under pressure in the annular recess 43 urges the movable bearing member 24 toward the rotor 34 by hydraulically acting on the annular surface 52 thus assisting the urging of the spring 41. Also, oil under pressure passes from the annular recess 43 into the angular disposed bore 51 into the annular groove 39. From the annular groove 39 the oil under pressure passes into the inner chambers 38 and 38' and the oil passage 40 which lubricates the sliding surfaces of the rotor 34 with respect to the inner faces of the stationary bearing element 17 and movable bearing member 24.

Oil under pressure in the inner chambers 38—38' hydraulically acts upon the respective vanes 37—37' to urge them outwardly for abutting against the bore 14. Thus as the oil pressure is increased the radial force applied to the vanes 37—37' is correspondingly increased which serves to minimize or prevent slippage of oil from the high pressure side of the vanes to the low pressure side. From this it can be seen that the outward force applied to the vanes is not dependent upon centrifugal force but is proportional to the pressure of the oil being pumped which tends to improve the efficiency of the pump 10. It may also be appreciated from the above that all moving surfaces are adequately lubricated at all times.

FIGURE 2 also illustrates a slightly modified optional form of the invention whereby the flow of lubricating oil through the small bore 49 is in reverse direction. This is effected by providing an oil conducting passage or channel 53 shown in dotted lines in the movable bearing member 24 which permits oil under pressure from the outlet side of the pump to flow into the right bearing chamber 45 thence through the bore 49 for discharge into the left bearing chamber 48. Thus the movable bearing member 24 is lubricated entirely by oil under elevated pressure.

Having thus described preferred embodiments of the invention, it can now be seen that the objects of the invention have been fully achieved and it must be understood that changes and modifications may be made which do not depart from the spirit of the invention nor from the scope thereof as defined in the appended claim.

What is claimed is:

A vane oil pump comprising a housing, said housing having a pumping zone therein, intake and discharge ports formed in said housing and communicating with said pumping zone, a stationary bearing member and a movable bearing member supported in said housing, said

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bearing members being positioned in axially spaced relation, each of said bearing members having an inner face and an outer face, a first chamber disposed in said housing adjacent the outer face of said stationary bearing member and communicating with said inlet ports, a second chamber disposed in said housing adjacent to one portion of said outer face of said movable bearing member, a shaft rotatably supported by said bearing members, a rotor disposed between the inner faces of said bearing members in abutting relation therewith and secured to said shaft for rotation in said pumping zone, an annular recess in said housing adjacent to another portion of the outer face of said movable bearing member, said recess being in communication with said discharge ports for urging under fluid pressure said movable bearing member axially toward said rotor, said rotor having a plurality of radially disposed slots therein, a radially movable vane disposed in each of said slots in abutting relation with said housing; means for lubricating said pump comprising a first oil passage means disposed in said shaft communicatively connecting said first chamber with said second chamber, a second oil passage means disposed in said movable bearing member and said rotor

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independent of said vanes communicating with said recess for lubricating the sides and vanes of said rotor and the inner faces of said bearing members at elevated pressure, and a restricted flow oil conducting channel disposed in said movable bearing member communicating said second passage means with said second chamber for lubricating said stationary bearing member and said movable bearing member.

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