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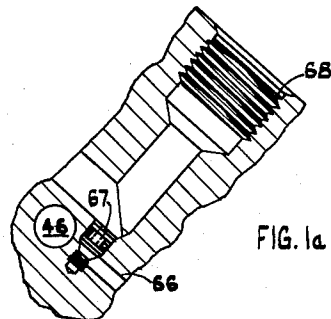
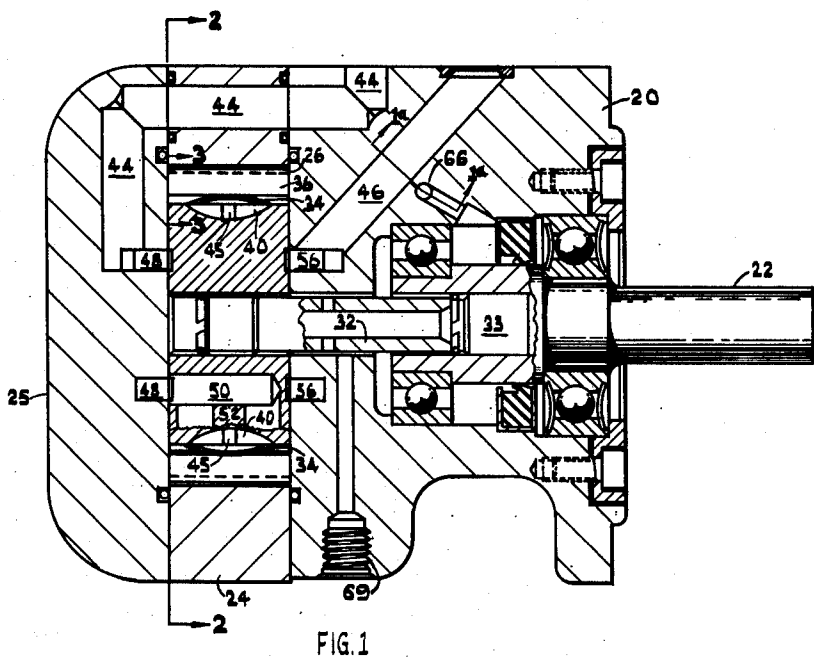
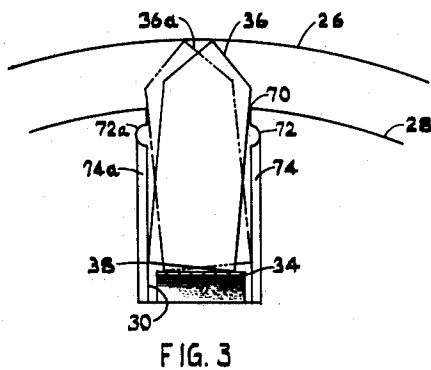
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3,076,415

REVERSIBLE VANE FLUID POWER DEVICE SUCH AS A PUMP OR MOTOR

Filed Jan. 8, 1960

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

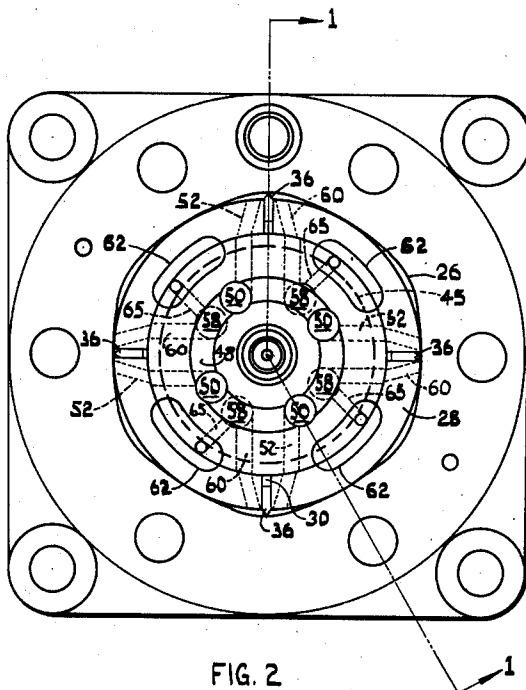


FIG. 2

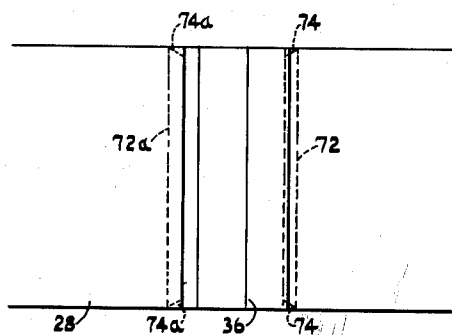


FIG. 4

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3,076,415 REVERSIBLE VANE FLUID POWER DEVICE SUCH AS A PUMP OR MOTOR

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1 Claim. (Cl. 103—136)

This invention pertains to a reversible vane fluid power device such as a pump or motor and particularly to a device which utilizes fluid pressure for urging the vanes against their confining surface even during rotation reversal.

It is an object of this invention to provide a reversible vane pump or motor which utilizes fluid pressure to hold the vanes against their confining surface even during reversal in rotation of the pump or motor.

It is another object of this invention to provide in such a pump or motor, slots in which the vanes are reciprocally mounted, with the slots being wider than the vanes to permit the vanes to tilt about an axis parallel to the axis of rotation and to provide grooved means in the slot walls so that a relatively large passage is available for fluid to flow during pump or motor reversal so that the pressure is maintained against one vane end to urge the other vane end against the confining surface.

It is a further object of this invention to provide in such a device slot walls having a transverse groove near that extremity adjacent to the confining surface and having each transverse groove communicating with a radial groove at each end so that fluid in the transverse groove can flow readily through the radial groove to the one end of the vane to urge it against its confining surface.

These and other objects will become more apparent when a detailed description of a preferred embodiment of this invention is made in connection with the drawings in which:

FIGURE 1 is a section taken along 1—1 of FIGURE 2; FIGURE 1a is a section taken along 1a—1a of FIGURE 1;

FIGURE 2 is a section taken along 2—2 of FIGURE 1;

FIGURE 3 is an enlarged section taken along 3—3 of FIGURE 1; and

FIGURE 4 is a plan view of FIGURE 3.

In the drawings, and especially in FIGURES 1 and 2, is a frame 20 having rotatably mounted therein a rotor shaft 22 and having bolted thereto a housing 24 and an end piece 25. Formed along the inside of housing 24 is a cammed surface 26 in which a rotor 28 having four radial slots 30 is rotatably mounted, surface 26 and rotor 28 are in close registration at six points about their circumference to form six areas of restricted fluid passage. Forming a driving connection between shaft 22 and rotor 28 is spindle 32 having at each end a crowned spline portion 33 which engages mating spline portions in the shaft 22 and the rotor 28. The crowning of the splines provides a universal type joint so that misalignments of shaft 22 will not affect the alignment of rotor 28.

Mounted in each slot 30 is a spring 34 and a vane 36 with each slot being slightly wider than the vane to permit a slight pivoting of the vane about an axis parallel to the axis of rotor 28. In this embodiment, each vane is .0625" wide and each slot is .0635" wide with the vane height being .375". With the vane pivoted or tilted in one direction, as shown in FIGURE 3, it is seen that an inner vane corner 38 bears against one slot wall and the opposite vane side bears against an outer corner 70 of the other slot wall. This is the position the vane would assume when the pressure is from the left vane side as viewed in FIGURE 3. When pressure is from the opposite vane side, the vane would tilt in the oppo-

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site direction and assume the position of vane 36A shown in dotted lines.

Formed in one wall of each slot near the outer slot extremity, is a transverse groove 72 which extends the axial length of the slot and which communicates at each end with a radial passage 74 formed by chamfering the slot wall corners. Since the vane is tilted away from the high fluid pressure, this fluid can flow freely from 72a through 74a to the inner end of the vane urging it outwardly against its confining cam surface 26 since the inner end of the vane which is subject to the high pressure is twice as large as the outer end subject to the high pressure. Fluid cannot pass to the low pressure side since the radial passages 74 do not extend to corner 70 of the slot wall. It can be seen that on rotor reversal each vane 36 will tilt about an axis parallel to the rotor axis until it assumes the position of the vane 36a shown in dotted lines. In this position a groove 72 in the opposite slot wall receives the high fluid pressure and conducts it through its associated radial passages 74 before the vane loses contact with confining surface 26. With this construction, spring 34 may be very light or even unnecessary.

Each slot 30 has formed at the inner extremity a convexity 40 which are connected by an annular groove 45. The total quantity of fluid beneath the vanes is substantially constant since when alternate vanes are being moved inwardly as they travel along confining cam surface 26, the fluid at their inner ends is pumped through groove 45 to the inner ends of the other vanes which are moving outwardly.

Formed in frame 20, housing 24, and end piece 25, is a first passage 44, and formed in frame 20 is a second passage 46. An annular groove 48 is formed in end piece 25 and communicates with passage 44 and also registers with ports 50 in rotor 28. Each port 50 is connected by a duct 52 to corresponding sides of each vane 36. Formed in frame 20 is an annular groove 56 which communicates with passage 46 and registers with a plurality of ports 58 formed in rotor 28 which connect with ducts 60. Ducts 60 communicate with the one side of the vanes 36 and ducts 52 communicate with the opposite vane side. It can readily be seen that by supplying pressure to passage 44, rotor 28 will be caused to move in a clockwise direction and supplying pressure to passage 46 will cause rotor 28 to move in a counterclockwise direction. Also, of course, the apparatus of this invention can operate as a pump by applying a rotating motion to shaft 22 with pressure being developed in passage 44 or 46, depending on the direction of rotation of shaft 22.

Formed on one rotor side are a plurality of balancing ports 62 which are connected to the ports 58 on the opposite rotor side and formed on the opposite rotor side are a plurality of balancing ports 64 which are connected to the ports 50 on the first rotor side by passage 65. This equalizes the pressure on opposite sides of the rotor regardless of which passage 44, 46 receives pressure to reduce friction and excessive wear between moving parts.

Provided in frame 20 is a passage 66 containing a plug 67 which, when removed, allows leakage to pass from passage 66 to outlet 68. When plug 67 is in place, leakage must be removed through port 69.

Operation

In the operation of this embodiment as a motor, when fluid pressure is applied to passage 44, it is communicated to corresponding sides of vanes 36 tilting them in the position shown in FIGURE 3 to cause clockwise rotation of the rotor 28. The fluid under pressure passes through groove 72a and radial passages 74a to the inner side of vane 36 to urge it outwardly against the confin-

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ing cam surface 26. Since vane 36 bears against corner 70 where there is no radial passage, fluid is prevented from passing to the low pressure side of the vane.

Application of fluid pressure to passage 46 causes rotor reversal, and vane 36 tilts in an opposite position 36a with the pressure being maintained at the inner side of the vane through the groove 72 and in radial passages 74 in the opposite slot wall. In this manner, regardless of which passage 44, 46 conducts fluid under pressure to the vane 36, there will always be pressure at the vane inner side to urge it against the confining surface 26.

Although this invention has been disclosed and illustrated with reference to particular applications, the principles involved are susceptible of numerous other applications which will be apparent to persons skilled in the art. The invention is, therefore, to be limited only as indicated by the scope of the appended claim.

Having thus described my invention, I claim:

In a reversible vane motor or pump, a housing, a rotor mounted within and rotatable in a circumferential direction relative to said housing, said rotor being in close registration with said housing in at least one area to form a substantially sealing area for restricting fluid passage, the surfaces of said rotor and housing being spaced apart on either side of said substantially sealed area, a slot having opposed walls spaced apart in said circumferential direction, said slot having an open end and a wall connecting end formed in one of said rotor and housing, a vane mounted for reciprocal motion in said slot and having one end extendable through said open slot end and adapted to bear against a confining surface of the other of said rotor and housing, said slot

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being sufficiently wider in said circumferential direction than said vane to allow said vane to tilt in a direction having a circumferential component and so that one side of said vane bears against and forms a line contact with one wall of said open slot end, substantially radial first passage means being formed in the surfaces of said slot walls and extending from a point spaced from and closely adjacent said open slot end to a point closely adjacent to the other slot end so that high pressure fluid can pass by the high pressure side of said vane in all operating positions of said vane but is prevented by said line contact from passing by the low pressure side of said vane so that it is trapped back of the other end of said vane to urge said one end of said vane against the confining surface for either direction of rotation, said passage means having a connection groove portion extending substantially parallel to said open end formed in a surface of said slot walls located near said open end and connected to said radial passage means to collect fluid.

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