

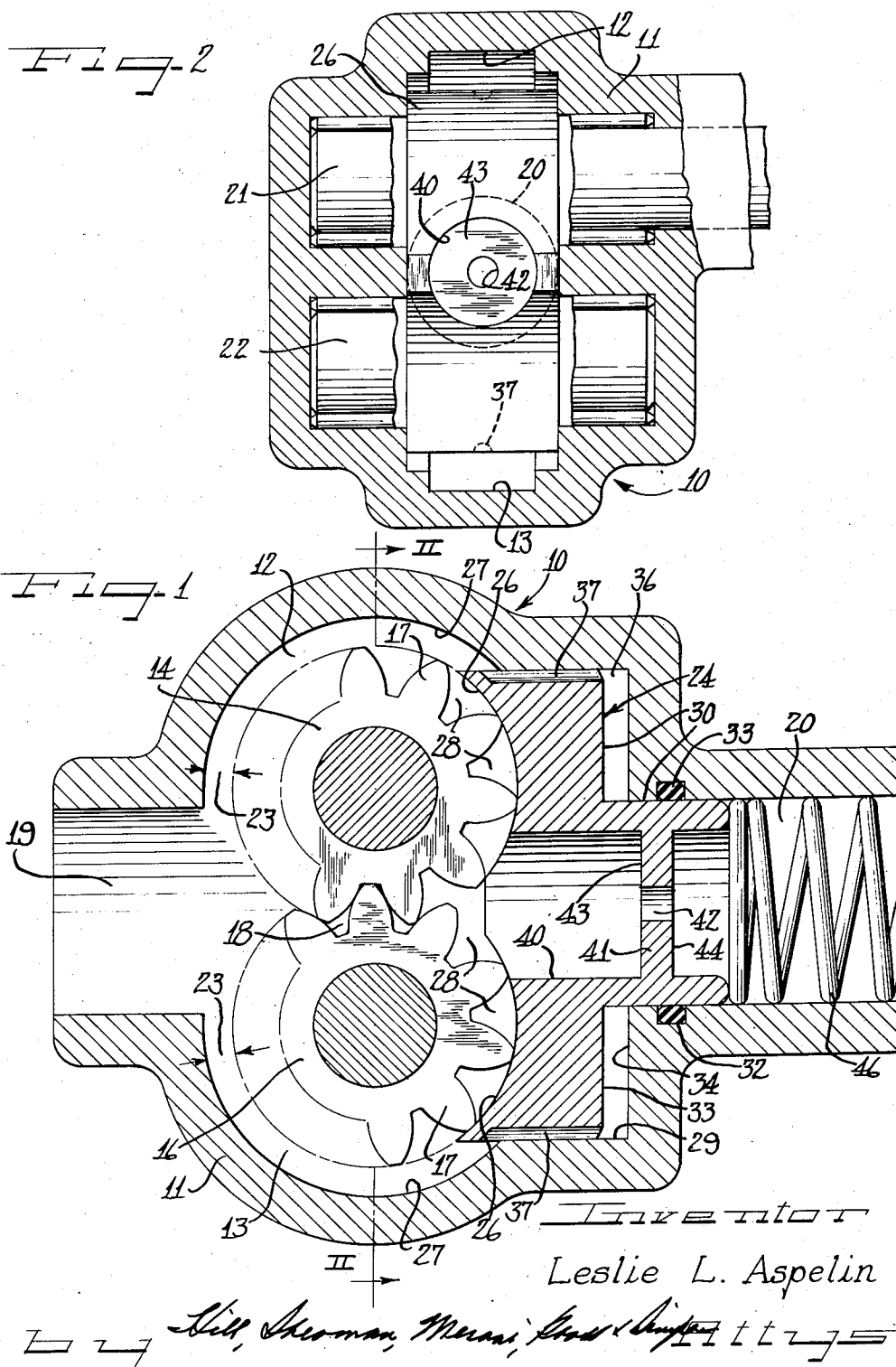
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PUMP WITH PRESSURE LOADED SHOE

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This invention relates generally to a pump having a moveable sealing shoe which is normally pressure balanced against the periphery of the rotary fluid displacement means and more particularly relates to a means for selectively unloading the sealing shoe as a function of the pump outlet flow, thereby to selectively control the capacity of the pump.

According to the general principles of the present invention, a pump is provided in which a casing means having an inlet and an outlet has formed therein a pumping chamber comprising a pair of intersecting bores. Rotary fluid displacement means are located in the pumping chamber to move fluid from the inlet to the outlet and preferably comprise a pair of intermeshing gears.

On the discharge side of the pump there is provided a cavity receiving a moveable sealing shoe having a first surface which is shaped to conform to the peripheral contour of the gears, this first surface engaging the periphery of the gears in tooth sealing contact therewith.

The sealing shoe is provided with a second surface which conforms generally to the shape of an adjoining casing wall, thereby confining the sealing shoe for movement towards and away from the gears. Sealing means are located between the casing and the sealing shoe for purposes of effecting a liquid seal between. At least a portion of the second surface constitutes a motive surface subject to pump generated pressure so that the sealing shoe will normally be pressure balanced against the periphery of the rotary fluid displacement means. A control spring is also located between the pump casing and the sealing shoe to provide a continuous biasing force urging the sealing shoe into peripheral tooth sealing contact with the gears.

In order to make the sealing shoe movably responsive to flow conditions, there is provided an orifice establishing a restricted flow passage in the pump outlet. The pressure drop across the orifice will reflect a control variable responsive to the pump outlet flow. Thus as the flow is increased through the orifice in the sealing shoe, the pressure drop through the orifice works against the spring pressure of the biasing means and the hydraulic loading pressure operative on the sealing shoe to move the sealing shoe away from the gears thereby allowing the pumping medium to escape from the high pressure portion of the pump back into the low pressure portion of the pump across the tips of the gear teeth adjacent to the sealing shoe. When the pump is running faster but the flow requirements from the pump are not proportionately increased, the shoe will move away from the pumping gears, thereby decreasing friction and allowing the excess pumping medium to be spilled back towards the low pressure portions of the pump.

It is an object of the present invention, therefore, to provide a gear pump having improved peripheral tooth sealing means.

Another object of the present invention is to provide a gear pump having peripheral tooth sealing means controlled in response to variations in pump outlet flow.

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A further object of the present invention is to provide a means for unloading a peripheral sealing shoe in a pump in response to variations in pump outlet flow.

A further object of the present invention is to provide a pressure loaded gear pump having a peripheral tooth sealing shoe and a casing structure conformably shaped.

Another object of the present invention is to provide an improved constant delivery variable capacity pump which comprises a reduced number of simplified elements and which is economical to manufacture and efficient in operation.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheet of drawings in which a preferred structural embodiment of a pump incorporating the principles of the present invention is shown by way of illustrative example.

On the drawings:

Figure 1 is a cross-sectional fragmentary view of a pump incorporating the principles of the present invention.

Figure 2 is a cross-sectional view taken substantially on line 2—2 of Figure 1 with parts removed for the sake of clarity and showing the pump of the present invention in reduced size.

As shown on the drawings:

The pump of the present invention is indicated generally by the reference numeral 10 and comprises a casing 11 having formed therein a pair of bores 12 and 13 together forming a pumping chamber for a rotary fluid displacement means which, in this specific form of the invention, includes a pair of rotary gears 14 and 16, respectively, each being provided with a plurality of circumferentially spaced gear teeth 17 engaging with one another at an area of intermesh indicated generally at 18.

The casing 11 is formed to provide an inlet 19 and an outlet 20, the inlet 19 lying on one side of the intermesh 18 and the outlet 20 lying on the opposite side of the intermesh 18 so that the rotary fluid displacement means comprising the intermeshing gears 14 and 16 will operate to move the fluid pumping medium acted upon by the pump 10 from the inlet 19 towards the outlet 20.

As is shown in the drawings, the gear 14 is provided with a shaft 21 extending from opposite sides of the hub portion of the gear 14 and the gear 16 is provided with a shaft 22 extending on opposite sides of a hub portion of the gear 16. The gear 14 is shown as comprising the driver gear and, accordingly, the shaft 21 is provided with a suitable extension projecting outwardly of the casing 11 for coupling to a suitable source of power, not shown.

As is clearly indicated in Figure 1, the outer diameter of the gears 14 and 16 measured at the tips of the gear teeth 17 is of lesser dimension than the inside diameter of the intersecting bores 12 and 13 so that there is a definite arcuate clearance space indicated between the arrows at 23 between each of the gears 14 and 16 and the casing 11.

In accordance with the principles of the present invention, however, there is provided a movable sealing means to engage against the periphery of the gears 14 and 16 at the tips of the teeth 17 in order to provide peripheral tooth sealing for the rotary fluid displacement means adjacent the outlet port 20. In this particular embodiment, the movable sealing means takes the form of a shoe member or shoe sealing member 24.

The shoe member 24 is provided with a surface 26 which, in effect, constitutes a continuation of the wall surface 27 provided by the casing 11 around the intersecting bores 12 and 13, thereby conforming generally to the peripheral contour of the intermeshing gears 14

and 16 and providing a peripheral tooth sealing surface to engage against the tips of the gear teeth 17, thereby to confine fluids under pressure in the spaces 28 between the gear teeth 17.

The casing 11 is recessed as at 29 to receive the shoe member 24, the recess 29 being located between the intersecting bores 12 and 13 and the outlet port 20. In order to confine the shoe member 24 within the casing 11, the shoe member 24 is provided with a second surface 30 which constitutes the entire back surface thereof and which conforms in shape to the adjoining wall surface of the casing 11 at the recess 29 and in the outlet 20. The casing 11 is grooved as at 32 and a sealing member 33 located in the groove 32 effects a liquid seal between the casing 11 and the shoe member 24. In this embodiment of the invention, the sealing member 33 takes the form of an O-ring type rubber sealing member.

The second surface 30 of the shoe member 24 includes a back wall portion 33 which is spaced from an adjoining casing wall 34 to provide a pressure chamber 36 in the recess 29. This chamber 36 is communicated to the low pressure portions of the pump 10 by means of notched groove passageways 37 formed in the upper and lower portions of the shoe member 24. The notched grooves 37 terminate short of the surface 26, however, when the pressure shoe 24 is moved into tooth sealing engagement with the gears 14 and 16, it will be noted that the ends of the notched grooves 37 communicate with the clearance area 23 between the wall surface 27 of the casing 11 and the tips of the teeth 17 on the gears 14 and 16. In this manner, the lower portion 33 of the second surface 30 provided on the sealing shoe 24 will be subject only to the pressures existing in the low pressure portions of the pump 10.

It will be noted that a passageway 40 extends through the sealing shoe member 24 so as to communicate the discharge side of the intermesh 18 with the outlet port 20. To provide a flow restriction means or a flow resistance means in the passage 40, the moveable sealing shoe member 24 is provided with an inwardly extending wall 41 having formed therein an orifice 42. The wall 41 provides a surface 43 and a surface 44 on opposite sides thereof, both of which will be subject to pump generated pressures exhibited in the passage 40. Because of the provision of the orifice 42, however, there will also be exhibited a pressure drop across the wall 41 which will be a function of the pump outlet flow.

To provide a control bias against the movable sealing shoe member 24, there is provided a continuous biasing means taking the form of a coil spring 46 bottomed at one end against the second surface 30 of the movable sealing shoe member 24 and confined within the casing 11 of the pump 10 so that a continuous biasing force will urge the movable sealing shoe member 24 toward tooth sealing engagement with the teeth 17 of the gears 14 and 16.

It will appear that there has been provided in accordance with the principles of the present invention a means for unloading the moveable sealing shoe member 24 which is normally pressure balanced against the periphery of the teeth 17 of the gears 14 and 16. The shoe member 24 at some normal lower speed and flow is so pressure balanced that it will always be held in contact with the periphery of the gears 14 and 16, but not in excessive amount. Then, as the flow from the pump outlet 20 is increased and, consequently, when the flow through the orifice 42 is increased, the pressure drop across the orifice 42 operates against the continuous biasing force of the coil spring 46 and the hydraulic loading pressure operating on the surface 43 and the first surface 26 to move the shoe member 24 away from the gears 14 and 16 to allow fluid pumping medium to escape from the high pressure portion of the pump 10 back into the low pressure portions of the pump 10 across the tips of the gear teeth

17 adjacent to the shoe member 24. Thus, when the pump is running faster but the flow requirements are not commensurately increased, the shoe member 24 will move away from the pumping gears 14 and 16, thereby decreasing friction and allowing the excess fluid pumping medium to be passed back to the low pressure portions of the pump.

It should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. A gear pump comprising a casing having a pumping chamber with an inlet and an outlet, rotary gears in said chamber, peripheral tooth sealing means in said outlet having a first surface conforming in shape to the outer peripheral contour of said gears for engaging and sealing against the periphery of said rotary gears on the discharge side of the pump, and having a second surface conforming in shape to an adjoining wall portion of said casing to confine said sealing means for movement towards and away from said gears, means for moving said sealing means towards said gears said first and second surfaces of said sealing means being intersected by a restricted passage providing a flow resistance means in said outlet to regulate the movement of said sealing means away from the gears as a function of pump outlet flow.

2. A gear pump comprising a casing having a pumping chamber with an inlet and an outlet, rotary gears in said chamber, peripheral tooth sealing means in said outlet having a first surface conforming in shape to the outer peripheral contour of said gears for engaging and sealing against the periphery of said rotary gears, and having a second surface conforming in shape to an adjoining wall portion of said casing to confine said sealing means for movement towards and away from said gears, said first and second surfaces of said sealing means being intersected by a restricted passage providing a flow resistance means in said outlet to regulate the movement of said sealing means away from the gears as a function of pump outlet flow, and biasing means between the pump casing and the sealing means for exerting a control bias against said sealing means towards the gears.

3. A gear pump comprising a casing having a pumping chamber with an inlet and an outlet, rotary gears in said chamber, peripheral tooth sealing means having a first surface conforming in shape to the outer peripheral contour of said gears for engaging and sealing against the periphery of said rotary gears on the discharge side of the pump, and having a second surface conforming in shape to an adjoining wall portion of said casing to confine said sealing means for movement towards and away from said gears, said second surface and said wall portion of said casing having sealing means effecting a liquid seal therebetween, said first and second surfaces of said sealing means being intersected by a restricted passage providing a flow resistance means in said outlet to regulate the movement of said sealing means away from the gears as a function of pump outlet flow, and biasing means between the pump casing and the sealing means for exerting a control bias against said sealing means towards the gears, said second surface of said sealing means having portions subject to less than pump discharge pressure to balance the pressure forces acting on said sealing means.

4. A gear pump comprising a casing having a pair of intersecting bores providing a pumping chamber, rotary gear fluid displacement means in said chamber having an intermesh at the area of intersection of said bores, means providing an inlet port on one side of said intermesh, means providing a discharge port on the opposite side of said intermesh, and flow responsive moveable sealing means on the discharge side of said rotary gear means engaging the periphery of said rotary gear means for

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effecting variable peripheral tooth sealing adjacent the discharge port, means loading said sealing means towards the gears, said moveable sealing means providing an orifice in said discharge port through which pumped fluids flow to produce a pressure drop across said orifice as a function of flow out of said discharge port to move the sealing means away from the gears at increased flow rates.

5. In a gear pump, rotary fluid displacement gears, means providing wall surfaces circumscribing a pumping chamber for said gears and having an inlet and an outlet, at least a portion of said wall surface providing means adjacent said outlet being moveable inwardly into peripheral tooth sealing contact with said gears to provide a high pressure area in communication with the pump outlet, a spring continuously biasing said moveable portion of said wall surface providing means towards tooth sealing contact, and pump outlet flow responsive means controlling the movement of said wall surface providing means away from tooth sealing contact.

6. In a gear pump, rotary fluid displacement gears, a casing providing wall surfaces circumscribing a pumping chamber for said gears and having an inlet and an outlet, said wall surfaces and said gears being spaced to provide arcuate recesses at the tips of the gears, said casing having an enlarged recess formed therein at the outlet side of the pump, a shoe member received in said recessed portion of said casing and having a first surface shaped to cooperate with said wall surfaces in circumscribing the pumping chamber for said gears, said shoe member being moveable inwardly into peripheral tooth sealing contact with said gears to provide a high pressure area in said pumping chamber in communication with the pump outlet, a spring between said casing and said shoe member biasing said shoe member towards tooth sealing contact with said gears, and pump outlet flow responsive means controlling the movement of said shoe member away from the gears for effecting constant delivery and variable capacity from said pump outlet.

7. A gear pump comprising a casing providing a pumping cavity having an inlet and an outlet and meshing

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gears rotatable in said cavity, said cavity having a discharge pressure zone remote from said inlet, a sealing member in said zone having a sealing surface engaging the peripheries of the gear teeth approaching said zone and having an oppositely disposed motive surface subject to the pressure in said discharge zone to pressure-load said sealing member against the peripheries of the gear teeth, and an orifice formed in said sealing member and interconnecting said discharge zone with said outlet, the pressure drop through said orifice tending to counteract said pressure load at increased flow rates to move said sealing member away from said gears, thereby to automatically reduce the flow.

8. A gear pump comprising a casing having a pumping cavity with an inlet and an outlet, and meshing gears rotatable in said cavity, said cavity having a discharge pressure zone remote from said inlet, a sealing member in said zone having a sealing surface engaging the peripheries of the gear teeth approaching said zone and having an oppositely disposed motive surface subject to the pressure in said discharge zone to pressure-load said sealing member against the peripheries of the gear teeth, means forming a discharge passage through said sealing member extending from said zone to said outlet, and having a restriction formed therein to produce a pressure drop as the function of the flow rate through said discharge passage, thereby to move the sealing member in opposition to the pressure loading at increased flow rates to move said sealing member away from said gears, thereby to automatically reduce the flow.

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