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GEAR TYPE PUMP WITH PRESSURE LOADED BUSHING AND WEAR INSERT ELEMENT

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Fig. 1

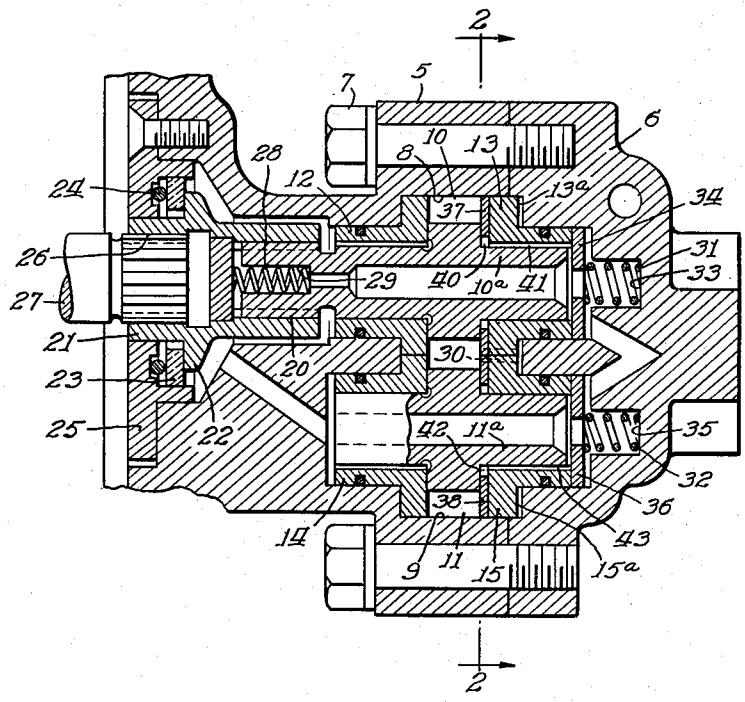
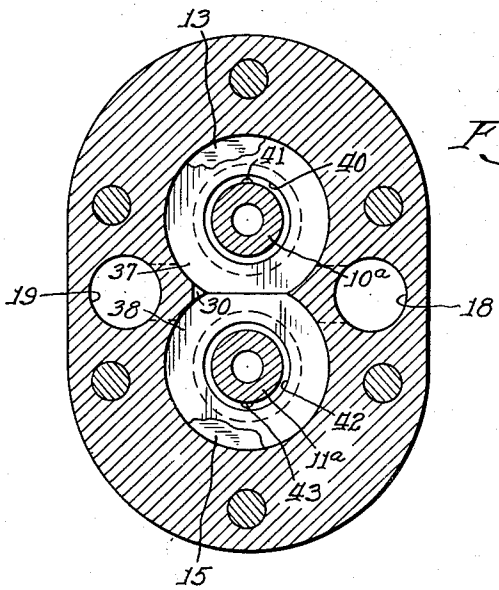


Fig. 2



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GEAR TYPE PUMP WITH PRESSURE LOADED BUSHING AND WEAR INSERT ELEMENT

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4 Claims. (Cl. 103—126)

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This invention relates to a pressure loaded pump and more particularly to a bushing construction for a pressure loaded type, intermeshing gear pump.

In a pressure loaded type gear pump one set of bushings are made axially movable in response to discharge pressure, a part of the discharge pressure being applied to the rear or motive surfaces of the axially adjustable bushings to urge the forward surfaces of these bushings into sealing engagement with the adjacent side faces of their associated gears. As disclosed in U. S. Patent No. 2,420,622 to Roth et al., by carefully selecting the relative areas of the forward surfaces of the bushings and of the rear motive surfaces of the bushings, it is possible to control within very close limits the actual sealing engagement pressure. This requires a somewhat higher effective pressure in the direction of establishing the seal than in the direction tending to open the seal.

As disclosed in the aforementioned patent, in order to control the effective areas subjected to discharge pressure at the forward surfaces of the axially movable bushings, one practice is to form a groove or recess, which is vented to a zone of low pressure, either in the forward or gear side face engaging surface of the bushing or in the adjacent surface of the pumping gear, the groove in either case being located radially inwardly of the pumping gear teeth. Because the dimensions of this groove are critical, since the degree of overbalance is directly controlled by the area of the groove, the machining operation involved in forming the groove is one which must be carried out with the greatest precision. This, of course, contributes materially to the cost of the bushings.

An object of the present invention is to provide a new and improved bushing construction for a pressure loaded type pump which will reduce materially the cost of the bushings.

A further object of the present invention is to provide a bushing construction having increased durability for a pressure loaded type pump.

A still further object of the present invention is to provide a bushing construction wherein the area of the relief recess may be readily varied to make the pump easily adaptable to different operating conditions.

In accordance with one embodiment of this invention as applied to a pressure loaded type, intermeshing gear pump such as that disclosed in the aforementioned patent, each of the axially movable, pressure loadable bushings is formed so that the forward surface is substantially flat and an annular plate or insert is provided which is positioned between this forward surface and

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the adjacent side surface of the associated pumping gear, the inner diameter of the annular plate being slightly greater than the outer diameter of the associated pumping gear journal. In this manner, there is provided an annular chamber or relief recess which corresponds to the groove ordinarily provided in the forward surface of each of the pressure loadable bushings. This chamber is vented to a zone of low pressure in the same manner as the groove usually provided.

Other objects and advantages of the present invention will be apparent from the following detailed description taken in conjunction with the drawings wherein:

Fig. 1 is an axial, sectional view of a pressure loadable, intermeshing gear type pump having one set of axially movable bushings constructed in accordance with this invention; and

Fig. 2 is a transverse, sectional view taken substantially along the line 2—2 of Fig. 1 and showing to advantage the relative dimensions of the annular inserts and the associated bushings.

Referring now to Fig. 1, a sectional pump housing is there illustrated comprising a main body portion 5 and a right closure or cover member 6. These two sections are securely bolted together as by threaded stud bolts 7 carried by the body portion 5 and threaded into the closure member 6. The two housing sections cooperate to define a pair of parallel, intersecting bores or pump gear chambers 8 and 9, receiving in complementary relationship intermeshing pumping gears 10 and 11 which are rotatably journalled therein. The chambers 8 and 9 are suitably formed to receive and support on either side of the pumping gears 10 and 11 bearing or bushing means 12, 13 and 14, 15, respectively. These bushing assemblies are radially flanged at their ends adjacent the gear side surfaces while their tubular body portions or barrels extend in opposite directions away from the pump gears, the body portions providing journal support for the pump gear shafts 10*a* and 11*a*. Low pressure liquid is introduced into the pump housing at inlet 18 and high pressure liquid is delivered from the outlet 19, the inlet and outlet passages communicating, respectively, with the inlet and discharge sides of the intermeshing pumping gears.

In the embodiment illustrated, the upper pumping gear 10 is the driving gear and, accordingly, the left end portion of gear journal 10*a* is extended to the left to provide an externally splined coupling termination 20. The coupling termination 20 is received in the recessed right end of an internally splined coupling and packing member 21, having a radially extending flange 22 engaging a ring 23, the opposite side

of which ring presses against a flexible ring seal 24 retained against a similarly recessed portion of an annular retainer plate 25 mounted on and secured to the left side of housing section 5. Coupling 21 terminates at its outer end in an internally splined connector recess 26 adapted to be engaged in driving relation with an auxiliary power shaft, such as shaft 27, of an aircraft engine or other driving mechanism..

Compression spring 28 received in axially extending chamber 29 formed in the coupling termination 20 at the left end of gear shaft 10*a* tends to urge the coupling member 21 to the left, thus eliminating initial end play and effecting an initial sealed engagement of flange 22, ring 23 and flexible seal 24. In the operation of this pump, the intermediate liquid pressure communicated to the seal, as explained in detail in the above-referred-to Patent No. 2,420,622 is effective to cause the operation of the seal assembly.

It will be noted that the flanged bushing assemblies 13 and 15 disposed, respectviely, on the right sides of gears 10 and 11 are fitted into the bores 8 and 9 with sufficient end clearance to permit slight, axial movement of the bushings with respect to the bores. In the operation of this pump, discharge pressure generated by the intermeshing gears is communicated from the outlet or discharge side thereof to the annular pressure loading chambers defined by the rear flanged surfaces 13*a* and 15*a* of the bushing assemblies 13 and 15, the adjacent walls of the housing section 6 and the barrel portions of the bushing assemblies through an axially extending passage 30 formed between the peripheries of the flanged portions of the bushings 13 and 15 on the discharge side of the pump at the point of convergence of the bushing assemblies. The passage 30 extends from the discharge side of the gears to the right, as viewed in Fig. 1, to the intercommunicating portions of the pressure loading chambers at their point of juncture. In the operation of the pump discharge pressure is effective to move the bushing assemblies into sealing relation with the associated gear side faces.

Initial loading pressure is provided by helically coiled springs 31 and 32, respectively, the spring 31 being associated with the upper bushing 13, and the spring 32 being associated with the lower bushing 15. More particularly, spring 31 has its right portion disposed in a cylindrical recess 33 formed in the cover member 6, and its left end bears against an annular disc 34 disposed in the right end of bore 8 and engaging at its left side of the right end of bushing 13. A similar arrangement is provided for the spring 32, which is disposed in a recess 35 and bears against annular plate 36.

Since the pump so far described is generally similar to that shown in U. S. Patent No. 2,420,622, further detailed description of the general features thereof is believed unnecessary.

In accordance with the present invention, each of the pressure loadable bushing assemblies 13 and 15 includes an annular plate or insert 37 and 38, respectively, these plates each having an outer diameter substantially identical with the outer diameter of the flanged portion of the associated bushing but having an inner diameter slightly greater than the inner diameter of the hollow portion of the bushings in which the journals 10*a* and 11*a* extend. In this manner there is provided by the annular plate 37 an annular

chamber or relief recess 40 which is communicated to a zone of low pressure through axially extending groove 41 formed in bushing 13 and similarly an annular chamber or relief recess 42 is provided at the inner edge of plate 38 which is communicated to a zone of low pressure through axially extending groove 43 in bushing 15. These chambers correspond in function and location, being located radially inwardly of the gear teeth of the associated pumping gears, to the grooves ordinarily provided in the gear side face engaging surfaces of the bushings of the pressure loaded pump, as disclosed in the aforementioned patent. Since the outer diameter of the body portion of the bushing assembly is fitted with a journal fit in the pumping chambers, making the outer diameter of the insert plates the same as that of the flanged portions of the bushing assemblies ensures concentric location of the insert plates despite axial movement.

The plates 37 and 38 may be formed of any suitable wear-resistant material and may be made of a metal, such as the metal of which the bushing itself is made, usually bronze, or may be made of other material having a suitably low coefficient of friction such as synthetic rubber, nylon or various other similar materials. The axial thickness of the insert must, of course, be sufficient to provide dimensional stability and this will vary somewhat with the material employed, the over-all length of the flange bushing body portion being at the same time made greater or less as the axial thickness of the plate is made less or greater to provide the required end clearance.

In the operation of the pump, the inserts will be moved axially into sealing engagement with the gear side faces in response to application of discharge pressure to the motive surfaces 13*a* and 15*a*. After a period of use resulting in substantial wear of the insert plates, the pump may be disassembled and the inserts replaced, thus materially increasing the useful life of the pump at relatively low cost. The plates are, of course, free to move axially with respect to the pumping gears and are thus able to take up end clearance without distortion or deflection.

The size of the relief recess or chamber which controls the effective sealing pressure may be varied within considerable limits merely by changing the inner diameter of the two insert plates; this greatly increases the adaptability of a pump to different operating conditions. Also, the use of the plates facilitates eccentric location of the relief recesses as disclosed, for example, in application Serial No. 168,587 of John A. Lauck, filed June 16, 1950.

Where herein the various parts of this invention have been referred to as being located in a right or a left position, or an upper or a lower position, it will be understood that this is done solely for the purpose of facilitating description and that such references relate only to the relative positions of the parts as shown in the accompanying drawings.

While but one embodiment of this invention has been shown and described, it will be understood that many changes and modifications may be made therein without departing from the spirit or scope of the invention. Also, while an important feature of the invention is the facility with which the relief groove may be formed, the insert plates may be formed to fit closely the outer diameter of the gear journal.

What is claimed is:

1. A liquid pump comprising a housing having a pump chamber and an inlet leading to and an outlet leading from said pump chamber, means including a rotatable member received in said pump chamber for forcing liquid from said inlet out of said housing through said outlet, an end plate assembly in said pump chamber having a back face normally spaced from the adjacent end wall of said pump chamber and having portions cooperable with said housing to provide a pressure chamber, said end plate assembly also having a front face subject to the pressure in said pump chamber and cooperable with the adjacent side face of said rotatable member to provide a pumping seal therewith, said end plate assembly including an annular disc-like member which can be moved axially independently of said back face providing at one side thereof said front face and having an inner dimension such that a relief recess is formed to limit the sealing area between said side face and said front face; means establishing communication between said relief recess and said inlet and means establishing communication between said pressure chamber at the back face of said plate and said outlet, the relation of the area of said back face to said sealing area being such that the force acting upon said back face of said end plate always exceeds slightly the force acting upon said front face of said end plate whereby to maintain said pumping seal without excessive friction, wear or lost volumetric efficiency.

2. A liquid pump comprising a housing having a pump chamber and an inlet leading to and an outlet leading from said pump chamber, means including a rotatable member received in said pump chamber for forcing liquid from said inlet out of said housing through said outlet, an end plate assembly in said pump chamber having a back face normally spaced from the adjacent end wall of said pump chamber and having portions cooperable with said housing to provide a pressure chamber, said end plate assembly also having a front face subject to the pressure in said pump chamber and cooperable with the adjacent side face of said rotatable member to provide a pumping seal therewith, said end plate assembly including an annular disc-like member providing at one side thereof said front face and having an inner dimension such that a relief recess is formed to limit the sealing area between said side face and said front face; said end plate assembly including said disc-like member being axially movable in said pump chamber, said disc-like member being replaceable independently of the remainder of said end plate assembly, means establishing commnication between said relief recess and said inlet and means establishing communication between said pressure chamber at the back face of said plate and said outlet, the relation of the area of said back face to said sealing area being such that the force acting upon said back face of said end plate always exceeds slightly the force acting upon said front face of said end plate whereby to maintain said pumping seal without excessive friction, wear or lost volumetric efficiency.

3. In a fluid pump of the type comprising a housing having a pump chamber formed therein and an inlet leading to and an outlet leading from said pump chamber, pumping means including a pumping gear in said chamber effective to force fluid from said inlet out of said housing through said outlet, a supporting shaft connected to said gear and having a portion extending axially from at least one side thereof, an axially movable pressure loadable bushing associated with said gear and having an axially extending aperture formed therein to receive said portion of said gear supporting shaft in journal relation, said bushing having a generally annular forward surface and an oppositely disposed motive surface, said motive surface being effective upon application thereto of discharge pressure generated by said pump and to move said bushing toward said gear side face, a substantially flat annular wear insert member interposed between said forward surface of said bushing and said side face of said pumping gear, said member having an outer diameter substantially equivalent to the outer diameter of the forward surface of said bushing and having an inner diameter slightly greater than the diameter of said axially extending aperture, whereby to provide at said inner diameter a generally annular relief recess, means placing said relief recess in communication with a zone of lower than discharge pressure, and means placing said motive surface in communication with discharge pressure generated by said pump.

4. In a fluid pump of the type comprising a housing having a pump chamber formed therein and an inlet leading to and an outlet leading from said pump chamber, pumping means including a pumping gear in said chamber effective to force fluid from said inlet out of said housing through said outlet, a supporting shaft connected to said gear and having a portion extending axially from at least one side thereof, an axially movable pressure loadable bushing associated with said gear and having an axially extending aperture formed therein to receive said portion of said gear supporting shaft in journal relation, said bushing having a generally annular forward surface and an oppositely disposed motive surface, said motive surface being effective upon application thereto of discharge pressure generated by said pump and to move said bushing toward said gear side face, a substantially flat annular wear insert member interposed between the said forward surface of said bushing and said side face of said pumping gear, said wear insert member comprising a material different from the remainder of said bushing and said gear, said wear insert member having an outer diameter substantially equivalent to the outer diameter of the forward surface of said bushing and having an inner diameter slightly greater than the diameter of said axially extending aperture, whereby to provide at said inner diameter a generally annular relief recess, means placing said relief recess in communication with a zone of lower than discharge pressure, and means placing said motive surface in communication with discharge pressure generated by said pump.

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