

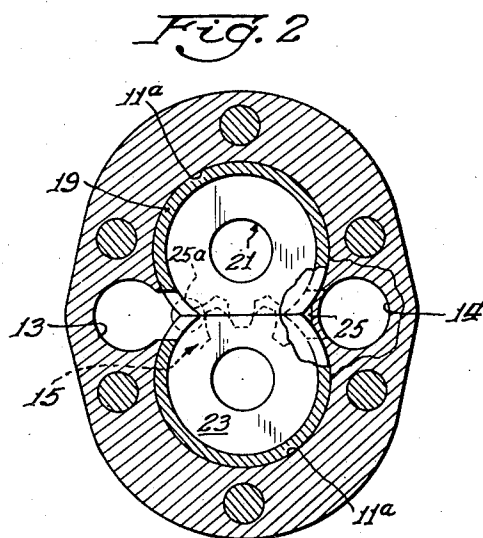
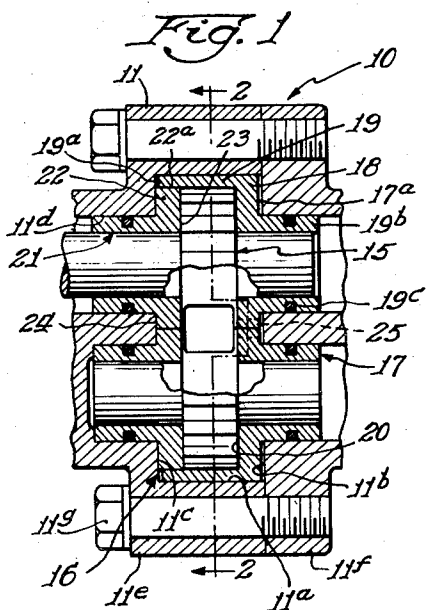
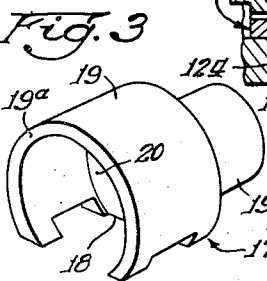
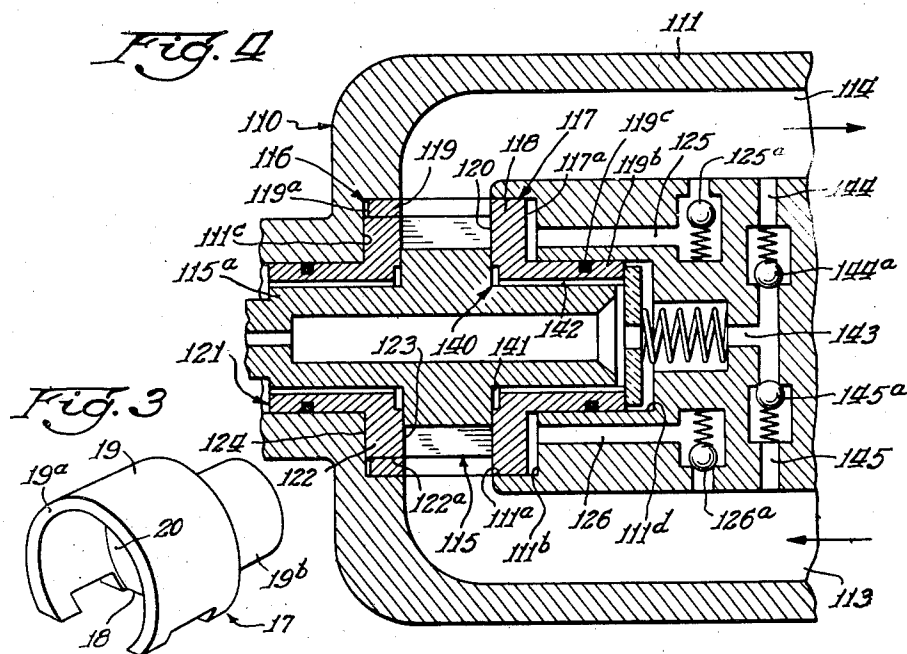
May 17, 1949.

J. A. LAUCK

2,470,355

PRESSURE LOADED GEAR PUMP

Filed Nov. 23, 1945



Inventor:
John G. Lauck.
By: Edward C. Pintzbaugh.
Atty.

UNITED STATES PATENT OFFICE

2,470,355

PRESSURE LOADED GEAR PUMP

John A. Lauck, Shaker Heights, Ohio, assignor,
by mesne assignments, to Borg-Warner Cor-
poration, Chicago, Ill., a corporation of Illinois

Application November 23, 1945, Serial No. 630,471

7 Claims. (Cl. 103—126)

1

The present invention relates to rotary fluid displacement devices of the type having fluid pressure actuated bearing and pumping seals, such devices being generally referred to as pressure loaded pumps.

I have found that in a pressure loaded gear pump of the type embodying axially extending tubular bearing insert portions for the gear journals and radially extending annular plate portions arranged for pressure loading, on at least one side of the gears, serious difficulty is encountered in effecting the required precise over-balance of the annular plate in the direction of the corresponding side face. This is due to the unavoidable radial thickness dimension of the wall of the tubular portion. In Roth and Lauck copending application Serial No. 439,030, now Patent No. 2,420,622, there is disclosed an example of the form of pressure loaded bushing or liner structure in extensive use prior to the invention of the present arrangement. This prior construction does not incorporate a completely enclosing wear-resistant liner assembly, but on the contrary the gear teeth have the same radial dimension as the annular plate portions, the radial periphery of the teeth cooperating with the main housing wall in pumping seal relation. This results in wearing away of the housing wall which is normally composed of a less wear-resistant material than is desired for cooperation with the radial periphery of the teeth. With this earlier construction when objectionable wear has taken place, the entire pump is considered expendable and is discarded. Furthermore, with this earlier construction it will be appreciated that the maximum area obtainable on the outer or back face of the radial bushing flange for the purpose of pressure loading the same is controlled by the radial thickness of the wall of the tubular liner portion surrounding the gear journal.

It is an object of the present invention to provide in a device of the present character, an improved arrangement of main body housing and an auxiliary liner assembly enclosing the fluid displacement member and having superior wear-resistant characteristics to those of the main body housing and being readily replaceable thus eliminating the usual wasteful practice of considering the pump as expendable and discarding the entire structure when the same has become worn.

It is a further object to provide in an arrangement of the above character, a replaceable wear-resistant liner assembly particularly arranged to

2

facilitate the effective pressure loading of the fluid displacement element, by increasing the area available for pressure loading.

Other objects, advantages and uses of my invention will become apparent from a reading of the following specification taken in connection with the appended drawing which forms a part thereof and wherein:

Figure 1 is an axial section view of a gear-type liquid pump incorporating a preferred embodiment of the present invention;

Figure 2 is a section view taken substantially on the line 2—2 of Figure 1;

Figure 3 is a perspective-like view of one of the bonnet-like bearing and pumping seal providing units forming the particular subject matter of the present invention; and

Figure 4 is an axial section view of a pump incorporating an alternative embodiment of the present invention.

Referring now in greater detail to the particular forms shown in the drawing by way of example only, there is illustrated in Figure 1 a preferred embodiment of my invention. A pump 10 having a main pump housing assembly 11 is composed preferably of a relatively light-weight material such as an aluminum alloy, which normally does not have the most desirable wear-resistant characteristics. Main housing 10 has an inlet 13, an outlet 14, and an intermediate chamber 11a for receiving a rotary fluid displacing unit 15. Received in substantially completely enclosing relation about the rotary displacement unit 15 is an auxiliary housing or wear-resistant liner assembly indicated generally at 16, the particular construction and arrangement of this liner assembly in combination forming the essential subject matter of the present invention.

The main housing chamber 11a is preferably in the form of a pair of parallel intersecting cylindrical compartments or chambers, with the liner assembly 16 complementarily formed and received in enclosing relation above the fluid displacement unit 15 which is preferably in the form of a pair of gears, the teeth of which intermesh in the area of intersection of the parallel cylindrical chambers.

Each of the cylindrical chambers 11a have parallel radially extending end walls 11b and 11c and co-axially extending reduced bores 11d, the gears proper being received in the chambers 11a.

Each of the liner assemblies 16 comprises a first bonnet-like bearing and pumping seal providing unit referred to generally at 17 and a second closure liner unit indicated generally at 21,

the two units making up the complete liner assembly being composed of a wear-resistant material such as bronze and functioning to completely enclose the fluid displacing gears in bearing and fluid pumping seal relation.

The unit 17 includes a radially extending annular plate-like portion 18, a co-axially extending tubular liner 19 cooperating with the teeth of the corresponding gear in fluid pumping seal relation and terminating at 19a in spaced relation to the adjacent radial end wall 11c providing for axial adjustment of the bonnet-like unit. A first radially extending bearing and pumping seal providing face 20 is formed on the inner side of radial flange 18 and an outer radially extending face 17a is normally spaced from the adjacent radially extending chamber wall 11b to provide therewith a pressure fluid motive chamber for urging the bonnet-like unit axially to thus maintain said first inner face 20 in bearing and pumping seal relation to the adjacent gear side face. In addition unit 17, in the more specific aspect of the present invention, includes a second tubular liner insert portion 19b embracing the corresponding gear journal and received within reduced bore 11d of the main housing 11. Donut-type seal 19c is preferably included between tubular insert 19b and the reduced cross-section bore 11d. Alternatively the tolerance may be so closely maintained as to provide the necessary seal, particularly where the tubular portion 19b is given a sufficient length. The enlarged tubular insert portion 19 is normally of sufficient length and the tolerance between this tubular portion and the surrounding housing is sufficiently closely maintained to provide the requisite fluid seal, this being particularly true in view of the fact that tubular insert 19 necessarily has an appreciable length considerably overlapping the embraced gear teeth.

The second closure insert unit 21 includes essentially a second radially extending annular plate 22 having a second radially extending inner face 23 defining a bearing and pumping seal surface with the corresponding side face of the gear and having a second outer radially extending face 24 complementary to and engaging the corresponding radial end wall 11c of the enclosing cylindrical chamber.

The radial outer periphery 22a of radial flange 22 is formed complementary to and is received within the outer terminal of enlarged tubular insert 19 preferably in fluid sealed relation providing for axial adjustment of tubular bearing insert 19.

A passage 25 communicates at the inner terminal thereof with the gear teeth preferably at or adjacent the high pressure zone and communicates at the outer terminal thereof with the motive chamber defined in part by the outer radial face 17a of radial flange 20. It will be appreciated that passage 25 may be located so as to place the motive chamber in communication with the gear teeth at any arcuate position thereabout where a positive pressure is generated. Plug 25a functions to prevent circulation of fluid therewith between port 13, and the back of the bushings and the port 14. It will be readily appreciated that the pressure generated by the gear teeth ranges all the way from a slightly negative pressure in communication with inlet 13 to the maximum outlet pressure in communication with the outlet 14. Thus radial inner face 20 of radial flange 18 as well as the inner periphery of bear-

ing insert tubular portion 19 are subjected to pressures ranging all the way from a slightly negative pressure at the arcuate position corresponding to inlet 13 to the maximum pressure at the arcuate position corresponding to outlet 14. On the other hand the pressure existing in the motive chamber in pressure actuating contact with radial outer faces 17a is uniform throughout the arcuate extent of this motive surface. Therefore there will exist a slightly dominating overbalance in the direction of the gear side face cooperating with radial inner face 20 of flange 18.

It is important to note that by virtue of the provision of tubular bearing insert 19 the total radial dimension of flange 18 is made greater than the radial dimension of the enclosed gear and hence radial outer face 17a functioning as the motivating area is given an increased over-all area corresponding to the radial thickness of tubular insert 19.

Main outside body housing 11 is preferably formed in two parts including main portion 11e and closure plate portion 11f held together by means of cap screws 11g. It will thus be apparent that upon objectionable wear occurring in the bushing liner assembly 16, it is only necessary to remove cap screws 11g and separate the main portion 11e from the plate portion 11f in order to readily replace both bearing and seal defining units 17 and 21, thus preserving main body housing 11 for indefinite use.

Turning now to the modification shown in Fig. 4, it will be seen that this modification differs from that of the previous figures only in the additional provision of pressure relief means between the gear side faces and the corresponding annular plates, this relief being employed for the purpose of more effectively accomplishing the required precise over-balance of the flange in the direction of the corresponding gear faces. It may be found in certain instances that the increased area of the motivating outer radial surface 17a of the flange 18, by virtue of the addition of axially extending tubular insert 19 embracing the gear teeth, is not sufficient to give the necessary overbalance in the direction of the gear face. This might be true where tubular portion 19b is given an increased radial thickness in proportion to the radial dimension of plate 118.

It will be observed that Fig. 4 is largely a schematic showing, only one gear being shown, but it being understood that two gears will be employed in the same manner as in Fig. 1, the second gear having been eliminated for the purpose of simplicity. In Fig. 4 a liquid pump indicated generally at 110 comprises a main body housing 111 containing a pair of adjoining substantially cylindrical chambers 111a, only one of which is illustrated, the arrangement being substantially identical to that of Fig. 1. Each of the chambers 111a have radial end walls 111b, and 111c. Communicating with the chambers 111a are inlet 113 and outlet 114. Received within chambers 111a are two gear members 115 (only one being shown), these gear members meshing at the junction of the housing members in the manner shown in Fig. 1. Communicating with chambers 111a are coaxial reduced cross-section bores 111d formed in the end walls 111b and 111c. These reduced coaxial bores receive journals 115a extending from the sides of the gears 115.

Surrounding the gears I have provided an alternative obstruction of wear-resistant liner assembly 116 including a first bonnet-like bearing and pumping seal unit 117 and a second closer liner

5

unit 121. The first bonnet-like bearing and pumping seal unit 117 comprises a first tubular liner portion 119b surrounding the corresponding gear journal and received in the adjacent reduced co-axial bore. A substantially annular radial extending plate 118 is located at the inner terminal of the first tubular liner portion and is received in the corresponding housing chamber 111a with a first outer or back face 117a normally spaced from the adjacent end wall 111b of the housing chamber and forming therewith a motivating pressure chamber for the reception of liquid under pressure effective to actuate said annular plate 118 toward the associated side face of the corresponding gear. For the purpose of increasing the wear life of the pump as well as adding to the total effective pressure responsive area 117a with reference to the opposed area of the inner seal and bearing face 120, I have provided a second enlarged axially extending tubular insert 119 complementary in inner peripheral diameter to the gear teeth and corresponding in outer diameter to the receiving outer chamber. The axial terminal 119a of this tubular insert is spaced from the adjacent end wall 111c of the housing to provide for axial adjustment of the bonnet-like insert unit 117.

The second bearing and pumping seal unit 121 comprises a second radially extending annular plate 122 having a second back face 124 in engagement with the adjacent radial wall of the corresponding chamber and a second radially extending inner face 123 engaging in bearing and pumping seal relation with the radial side face of the corresponding gear. The radial outer periphery 122a of this second annular plate is preferably received in the open terminal of the second tubular liner 119 in liquid sealed relation. The tubular liner 119 is arranged for axial adjustment with reference to the embraced annular flange 122.

Pressure generated by gear unit 115 is directed through passage 125 past ball check valve 125a to the motive chamber in pressure contact with radial outer face 117a of flange 118 and is effective to overbalance flange 118 in the direction of bearing and pumping seal engagement with the corresponding gear side face. Donut seals 119c are interposed between the journal bearing insert 119b and the reduced cross-section co-axial bore 111d. A similar passage 126 and ball check valve 126a places inlet passage 113 in communication with the motive chamber, the ball check valves 125a and 126a functioning to make the pump automatically reversible.

The important distinction between the present form of insert liner assembly 116 of Fig. 4 and that of the preceding figures resides in the provision of pressure relieving means indicated generally at 140. This relieving arrangement results in a more precise and effective overbalance of radial flange 118 in the direction of the gear side face. Relief 140 preferably comprises the formation of an annular channel 141 readily machined or otherwise formed in the radial bearing and seal face 120 and positioned radially inwardly of the roots of the gear teeth. The exact size of this annular relief 141 is best determined by the cut and try method. By removing successive increments and trying the result, it is readily possible to ascertain the exact amount of material to be removed and the optimum size of relief 141. In addition to the provision of this annular relief it is important to place this relief in communication with a zone of pressure lower

6

than that in communication with the motive chamber and I prefer to accomplish this by forming axially extending splines or passages 142 in the inner periphery of tubular portion 119b. Passage 142 leads to passage 143 and alternatively through passage 144 or 145 and corresponding ball check valves 144a and 145a to the zone of lower pressure depending upon the direction of rotation of gear unit 115.

It will thus appear that while for most installations the simple form of construction shown in Fig. 1 will suffice, I have also provided the arrangement disclosed in Fig. 4 for effecting a more precise overbalancing pressure differential in the direction of the gear side face.

While I have disclosed my invention in connection with certain specific embodiments thereof, I intend that this be by way of example and not limitation, the scope of my invention being defined by the appended claims.

I claim:

1. In a liquid pump comprising: means defining a main outside body housing composed of a first material and having a chamber therein, an inlet leading into and an outlet leading from said chamber; means including a rotary liquid displacement member in said chamber effective to draw liquid in said inlet and force the same out of said outlet; means defining a completely enclosing wear-resistant readily replaceable liner assembly received in said chamber in enclosing relation about said rotatable liquid displacement member, including a first bonnet-like bearing and pumping seal unit, said first unit comprising a radially extending annular plate having a first back face normally spaced from the adjacent end wall of said chamber forming therewith a motive pressure chamber for the reception of liquid under pressure for actuating said annular plate axially toward said rotary liquid displacement member, said first unit further comprising an axially extending tubular liner portion embracing the outer radial periphery of said rotary member, said tubular liner merging with the radial outer portion of said first annular plate and terminating at the opposite axial extremity thereof in spaced relation to the adjacent end wall of said chamber to provide for limited axial adjustment of said first unit, said radial annular plate also having a first front face engageable in bearing and pumping seal relation with said rotary liquid displacement member, a second bearing and pumping seal unit comprising a second radially extending annular plate having a second back face in engagement with the adjacent wall of said chamber and a second inner face engageable in bearing and pumping seal relation with said rotary fluid displacement member; and means placing said motive chamber in communication with liquid pressure generated by said liquid displacement means for maintaining said first inner face of said first radial annular plate in bearing and pumping seal relation with said rotary displacement member and said rotary displacement member in turn in bearing and pumping seal relation with said second inner face of said second radial annular plate.

2. In a liquid pump comprising: means defining a main body housing containing a pair of adjoining substantially cylindrical chambers having radial end walls, said housing also having an inlet leading to and an outlet leading from said chambers; a toothed gear member in each of said housing chambers, said gear members meshing at the juncture of said housing

7

chambers; coaxial bores in the end walls of said housing chambers forming reduced extensions of said housing chambers, said gear members having journals extending from the opposite sides thereof into said reduced bores; means defining a gear enclosing wear-resistant readily replaceable liner assembly received in each of said chambers and bores about said gears and journals, each of said assemblies including a first bonnet-like bearing and pumping seal unit, said first unit comprising a first tubular liner portion surrounding the corresponding journal and received in said reduced bore, a substantially annular radially extending plate portion at the inner end of said first tubular liner portion received in the corresponding housing chamber, said first annular plate having a first back face normally spaced from the adjacent end wall of said chamber forming therewith a motive pressure chamber for liquid under pressure for actuating said annular plate toward the associated side face of said gear, a second axially extending tubular liner of larger diameter than said first tubular liner portion, said second tubular liner merging with the radial outer portion of said annular plate and terminating at the opposite axial extremity thereof in spaced relation to the adjacent radial end wall of said chamber to provide for limited axial adjustment of said first unit, the inner periphery of said tubular liner embracing the teeth of the associated gear in pumping seal relation, said first radial annular plate also having a first radially extending inner face engaged in bearing and pumping seal relation with the adjacent side face of said gear, a second bearing and pumping seal unit comprising a second radially extending annular plate having a second back face in engagement with the adjacent wall of said chamber and a second radially extending inner face engaged in bearing and pumping seal relation with the adjacent side face of the corresponding gear; and means placing said motive chamber in communication with a liquid pressure generated by said gears for maintaining the inner face of said first radial annular wall in bearing and pumping seal relation with the adjacent side face of said gear and the opposite side face of said gear in bearing and pumping seal relation with said second radially extending inner face of said second radial annular plate.

3. In a pressure loaded gear pump: means defining a main housing of a first composition formed with a pair of parallel intersecting cylindrical chambers, an inlet to one side of said intersecting area and an outlet from the other side thereof, pairs of reduced coaxial bores in the opposed end walls of said cylindrical chambers; means defining an auxiliary housing liner assembly of wear-resistant metal received in each of said chambers, each assembly including a first bonnet-like bearing and pumping seal unit having a first tubular neck liner portion received in the corresponding one of said reduced bores in sealed axially adjustable relation thereto, a first radial flange portion, the outer face of which is spaced from the adjacent end wall of the main housing to form an auxiliary motive pressure chamber, and a second enlarged tubular liner portion extending axially of the corresponding cylindrical chamber with the open terminal thereof in spaced relation to the end wall of said chamber to provide for limited axial adjustment of said bonnet unit, a second closure bearing and pumping seal unit having a second tubular neck liner portion received in the reduced

8

bore adjacent the open end of said enlarged tubular liner portion, a second radial flange portion received with the outer periphery in fluid sealed relation within said open end of said enlarged tubular portion; a pair of gears received in said enlarged tubular portions of said bonnet members in completely enclosed relation therein, means defining an inlet to and an outlet from said enlarged tubular members corresponding to said main housing inlet and outlets; and means placing said auxiliary pressure chambers in communication with liquid pressure generated by said gears for forcing the inner face of said first radial flange into pumping seal relation with the corresponding gear side face.

4. In a liquid pump comprising means defining a main body housing containing a pair of adjoining substantially cylindrical chambers having radial end walls, said housing also having an inlet leading to and an outlet leading from said chambers; a toothed gear member received in each of said housing chambers, said gear members meshing at the juncture of said housing chambers; coaxial bores in the end walls of said housing chambers forming reduced extensions of said housing chambers, said gear members having journals extending from the opposite sides thereof into said reduced bores; means defining a gear enclosing wear-resistant readily replaceable liner assembly one received in each of said chambers and bores about said gears and journals, each of said assemblies including a first bonnet-like bearing and pumping seal unit, said first unit comprising a first tubular liner portion surrounding the corresponding gear journal and received in said reduced bore, a first substantially annular radially extending plate portion at the inner terminal of said first tubular liner portion received in the corresponding housing chamber, said first annular plate portion having a first back face normally spaced from the adjacent end wall of the associated chamber forming therewith a motive pressure chamber for liquid under pressure for actuating said first annular plate toward the associated side face of said gear, a second larger axially extending tubular liner, said second tubular liner merging with the radial outer portion of said first annular plate and terminating at the opposite axial extremity thereof in spaced relation to the adjacent radial end wall of said corresponding chamber to thus provide for limited axial adjustment of said first unit in floating relation to the embraced gear, the external diameter of said enlarged tubular liner being complementary to the inner periphery of the associated chamber and the inner periphery thereof being complementary to the enclosed gear teeth embracing the same in pumping seal relation, said first radial annular plate also having a first radially extending inner face engaged in bearing and pumping seal relation with the adjacent side face of the associated gear, a second bearing and pumping seal unit comprising a second radial extending annular plate having a second back face in engagement with the adjacent wall of the associated chamber and a second radially extending inner face engaged in bearing and pumping seal relation with the adjacent side face of the corresponding gear, the radial outer periphery of said second annular plate being received in the open terminal of said enlarged tubular liner providing for axial adjustment of said enlarged tubular liner in liquid sealed relation to said second radially extending annular plate; and means placing said motive chamber in com-

munication with a liquid pressure generated by said gears for maintaining the inner face of said first radial annular walls in bearing and pumping seal relation with the adjacent side face of the associated gear and the opposite side face of said gear in bearing and pumping seal relation with said second radially extending inner face of second radial annular plate.

5. In a pressure loaded liquid pump comprising: means defining a main body housing containing a pair of adjoining substantially cylindrical chambers having radial end walls, said housing also having an inlet leading to and an outlet leading from said chambers; a toothed gear member in each of said housing chambers, said gear members meshing at the juncture of said housing chambers; coaxial bores in the end walls of said housing chambers forming reduced extensions of said housing chambers, said gear members having journals extending from the opposite sides thereof into said reduced bores; means defining a gear enclosing wear-resistant readily replaceable liner assembly received in each of said chambers and bores about said gears and journals, each of said assemblies including a first bonnet-like bearing and pumping seal unit, said first unit comprising a first tubular liner portion surrounding the corresponding gear journal and received in said reduced bore, a substantially annular radially extending plate portion at the inner terminal of said first tubular liner portion received in the corresponding housing chamber, said first annular plate having a first back face normally spaced from the adjacent end wall of said chamber forming therewith a motive pressure chamber for liquid under pressure effective to actuate said annular plate toward the associated side face of the corresponding gear, means effective to increase the wear life of the pump and increase the total effective pressure responsive area of said first annular plate back face with reference to the area of the corresponding gear side face, said last named means including a second axially extending tubular liner of larger diameter than said first tubular liner portion, said second tubular liner merging with the radial outer portion of said annular plate and terminating at the opposite axial extremity thereof in spaced relation to the adjacent radial end wall of said chamber to provide for limited axial adjustment of said first unit, the inner periphery of said enlarged tubular liner embracing the gear teeth of the associated gear in pumping seal relation and the outer periphery of said enlarged tubular liner being complementary in diameter to the enclosing chamber and functioning as an elongated liquid seal therewith, said first radial annular plate also having a first radially extending face engaged in bearing and pumping sealing relation with the adjacent side face of said gear, a second bearing and pumping seal unit comprising a second radially extending annular plate having a second back face in engagement with the adjacent wall of said chamber and a second radially extending inner face engaged in bearing and pumping seal relation with the adjacent side face of the corresponding gear, the radial outer periphery of said second annular plate receiving the open terminal of said second tubular liner in liquid sealed axially adjustable relation thereabout; and means placing said motive chamber in communication with a liquid pressure generated by said gears for maintaining the inner face of said first radial annular wall in bearing and pumping seal relation with the adjacent side

face of said gear and the opposite side face of said gear in bearing and pumping seal relation with said second radially extending inner face of said second radial annular plate.

6. In a pressure loaded liquid pump comprising: means defining a main body housing containing a pair of adjoining substantially cylindrical chambers having radial end walls, said housing also having an inlet leading to and an outlet leading from said chamber; a toothed gear member in each of said housing chambers, said gear members meshing at the juncture of said housing chambers; coaxial bores in the end walls of said housing chambers forming reduced extensions of said housing chambers, said gear members having journals extending from the opposite sides thereof into said reduced bores; means defining a gear enclosing wear-resistant readily replaceable liner assembly received in each of said chambers and bores about said gears and journals, each of said assemblies including a first bonnet-like bearing and pumping seal unit, said first unit comprising a first tubular liner portion surrounding the corresponding gear journal and received in said reduced bore, a first substantially annular radially extending plate portion at the inner terminal of said first tubular liner portion received in the corresponding housing chamber, said first annular plate having a first back face normally spaced from the adjacent end wall of said chamber forming therewith a motive pressure chamber for liquid under pressure effective to actuate said annular plate toward the associated side face of the corresponding gear, means effective to increase the wear life of the pump and increase the total effective pressure responsive area of said first annular plate back face with reference to the area of the corresponding gear side face, said last named means including a second axially extending tubular liner of larger diameter than said first tubular liner portion, said second tubular liner merging with the radial outer portion of said annular plate and terminating at the opposite axial extremity thereof in spaced relation to the adjacent radial end wall of said chamber to provide for limited axial adjustment of said first unit, the inner periphery of said enlarged tubular liner embracing the gear teeth of the associated gear in pumping seal relation and the outer periphery of said enlarged tubular liner being complementary in diameter to the corresponding chamber receiving the same and functioning as an elongated liquid seal therewith, said first radial annular plate also having a first radially extending inner face engaged in bearing and pumping seal relation with the adjacent side face of the corresponding gear, a second bearing and pumping seal unit comprising a second radially extending annular plate having a second back face in engagement with the adjacent radial wall of the corresponding chamber and a second radially extending inner face engaged in bearing and pumping seal relation with the adjacent side face of the corresponding gear, the radial outer periphery of said second annular plate receiving the open terminal of said second tubular liner in liquid sealed axially adjustable relation thereabout; means placing said motive chamber in communication with a liquid pressure generated by said gears for maintaining the inner face of said first radial annular wall in bearing and pumping seal relation with the adjacent side face of said gear and the opposite side face of said gear in bearing and pumping seal relation with said second radially extending inner face of said

11

second radial annular plate and means defining a relief recess between the gear side face and said first radial inner face of said first annular plate and means for placing the same in communication with a zone of lower pressure than that generated by said gears.

7. In a pressure loaded liquid pump comprising: means defining a main body housing containing a pair of adjoining substantially cylindrical chambers having radial end walls, said housing also having an inlet leading to and an outlet leading from said chambers; a toothed gear member in each of said housing chambers, said gear members meshing at the juncture of said housing chambers; coaxial bores in the end walls of said housing chambers forming reduced extension of said housing chambers, said gear members having journals extending from the opposite sides thereof into said reduced bores; means defining a gear enclosing wear-resistant readily replaceable liner assembly received in each of said chambers and bores about said gears and journals, each of said assemblies including a first bonnet-like bearing and pumping seal unit, said first unit comprising a first tubular liner portion surrounding the corresponding gear journal and received in said reduced bore, a substantially annular radially extending plate portion at the inner terminal of said first tubular liner portion received in the corresponding housing chamber, said first annular plate having a first back face normally spaced from the adjacent end walls of said chamber forming therewith a motive pressure chamber for liquid under pressure effective to actuate said annular plate toward the associated side face of the corresponding gear, means effective to increase the wear life of the pump and increase the total effective pressure responsive area of said first annular plate back face with reference to the area of the corresponding gear side face, said last named means including a second axially extending tubular liner of larger diameter than said first tubular liner portion, said second tubular liner merging with the radial outer portion of said annular plate and terminating at the opposite axial extremity thereof in spaced relation to the adjacent radial end wall of said chamber to provide for limited axial adjustment

12

of said first unit, the inner periphery of said enlarged tubular liner embracing the gear teeth of the associated gear in pumping seal relation and the outer periphery of said enlarged tubular liner being complementary in diameter to the enclosing chamber and functioning as an elongated liquid seal therewith, said first radial annular plate also having a first radially extending inner face engaged in bearing and pumping sealing relation with the adjacent side face of said gear, a second bearing and pumping seal unit comprising a second radially extending annular plate having a second back face in engagement with the adjacent wall of said chamber and a second radially extending inner face engaged in bearing and pumping seal relation with the adjacent side face of the corresponding gear, the radial outer periphery of said second annular plate receiving the open terminal of said second tubular liner in liquid sealed axially adjustable relation thereabout; means placing said motive chamber in communication with a liquid pressure generated by said gears for maintaining the inner face of said first radial annular wall in bearing and pumping seal relation with the adjacent side face of said gear and the opposite side face of said gear in bearing and pumping seal relation with said second radially extending inner face of said second radial annular plate, a relief recess formed in said first inner radial face of said first annular plate located radially inwardly of the roots of the gear teeth and means placing said relief recess in communication with a zone of lower pressure than that generated by said gears.

JOHN A. LAUCK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,927,395	Edwards	Sept. 19, 1933
2,202,912	Johnson	June 4, 1940
2,345,975	Herman	Apr. 4, 1944
2,346,761	Johnson	Apr. 18, 1944
2,395,824	Herman	Mar. 5, 1946
2,412,588	Lauck	Dec. 17, 1946