Dec. 9, 1969 W. E. MARIETTA 3,482,524

PUMP OR MOTOR

Filed June 12, 1968

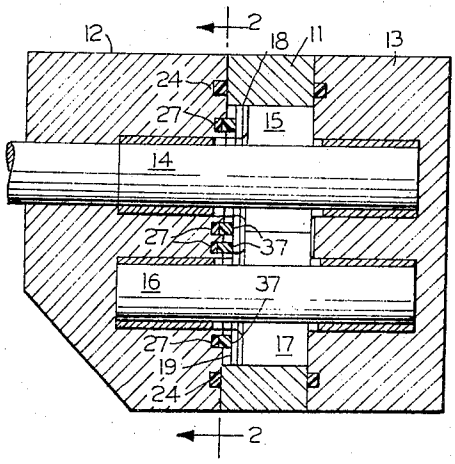

FIG.1

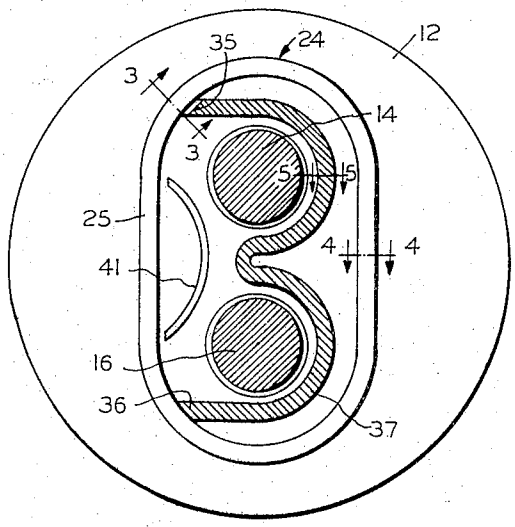

FIG.2

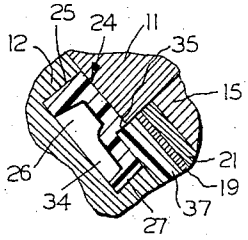

FIG.3

FIG.4

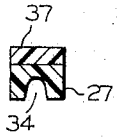

FIG.5

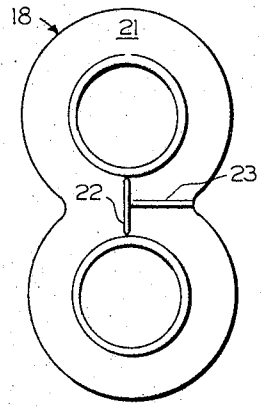

FIG.6

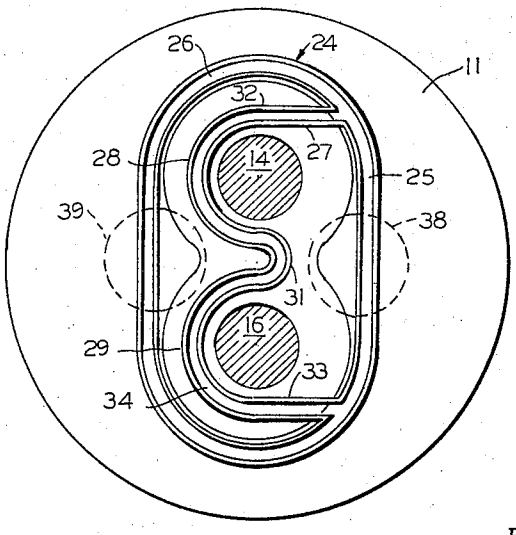

FIG.7

INVENTOR
WALTER E. MARIETTA

BY Wodge and Dom

ATTORNEYS

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PUMP OR MOTOR

Walter E. Marietta, Cary, Ill., assignor to General Signal Corporation, a corporation of New York

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U.S. Cl. 103—126 1 Claim

ABSTRACT OF THE DISCLOSURE

A gear pump or motor includes a die cast multi-part housing. A wear plate is received in the impeller cavity in the housing and is axially movable to bear against the side faces of the gears. An integral sealing member seals against leakage between the housing parts and includes a second portion of reduced thickness shaped generally like the numeral 3. The sealing member is mounted in grooves formed in the pump cover, and a backup member, also shaped like the numeral 3, is received in the groove and overlies the reduced thickness portion. This backup member projects from the groove so as to engage the face of the wear plate. The ends of the backup member engage and seal against shoulder formed on the sealing member and also engage and seal against the wall of the impeller cavity. The backup member thus defines isolated pressure balancing areas on the outer face of the wear plate sized and shaped to control the force with which the wear plate is urged against the side faces of the gears. The backup member is axially movable to take up wear and clearance.

SUMMARY OF THE INVENTION

Leakage along the side faces of the impellers of a gear pump or motor is difficult to control because it is affected by distortion of the pump housing under pressure, by wear, and by assembly tolerances which are difficult to maintain without expensive machining. It has been proposed in the prior art to provide an axially movable wear plate biased into contact with at least one side face of each gear. Commonly it is biased against the gear face by an unbalanced pressure force. It is recognized that the force imbalance may not be great or excessive wear and friction will result. It is desirable to use die castings for the housing parts, because expensive and time consuming machining can be eliminated. In a multi-part die cast housing, the assembled housing defines an impeller cavity whose axial dimension is subject to substantial variation in size, because the tolerances in each part of a die cast housing cannot be as closely maintained as they can be in a machined housing. The present invention relates to an uncomplicated, relatively inexpensive sealing means which permits use of an axially movable wear plate subject to controlled unbalanced pressures in a high pressure, high performance gear pump or motor having die cast housing parts.

Essentially, the invention relates to a single sealing member which provides a first seal part which protects against leakage from the impeller cavity between mating faces of the housing parts and a second seal part which defines isolated pressure areas on the outer face of an axially movable wear plate biased against the side faces of the gears. A part of the second seal is formed integrally with the first seal, but unlike that seal, must accommodate axial movement to take up wear between the gears and the wear plate. It must also accommodate itself to variations of the end clearance between the wear plate and housing cover part which result from dimensional variations in the die cast parts. It is particularly difficult to maintain a seal in the region where the second sealing member passes from confinement between stationary housing parts to confinement between a housing part and the avially movable wear plate. According to the invention, the second seal includes a major portion which overlies the impeller cavity and has a thinner section than the remainder of the seal. A backup member made of a hard phenolic or resin impregnated fabric is confined between the wear plate and the thin major portion. This backup member is positioned so as to be intersected by a plane passing through the interengaging faces of the housing parts; thus, part of the backup member lies in the impeller cavity and part lies, together with the second seal, in a groove formed in the cover. The ends of the backup member are pressure biased to seal partly against shoulders on the seal member and partly against the wall of the impeller cavity. This seals against leakage around the ends of the backup member and is essential in a high performance pump or motor. The backup member also prevents extrusion of the seal from the groove.

The invention will be described having reference to the accompanying drawing which shows a preferred embodiment of the invention in somewhat simplified form as it would be embodied in a pump.

FIG. 1 is a sectional view of the pump, the plane of section passing through the axes of the shafts.

FIG. 2 is a transverse section taken on line 2—2 of FIG. 1.

FIG. 3 is a fragmentary, sectional view on the line 3—3 of FIG. 2.

FIG. 4 is a detail view in section on the line 4—4 of FIG. 2 showing the housing seal.

FIG. 5 is a detail view in section on line 5—5 of FIG. 2.

FIG. 6 is an elevation showing the gear-engaging face of the wear plate.

FIG. 7 is an end view of the pump looking to the right in FIG. 1 with the adapter cover removed, but with the seal member shown in the position it assumes in the assembled pump.

As shown in FIG. 1, the pump housing comprises a main portion **11**, an adapter cover **12** and an end cover **13**; preferably these parts are all die cast. A driven shaft **14** is jounralled in the adapter cover **12** and end cover **13** and traverses the impeller cavity. A gear impeller **15** is mounted thereon. An idler shaft **16** is also journalled in covers **12** and **13** and carriers a gear impeller **17** which meshes with impeller **15**. Shafts **14** and **16** are parallel with one another. Appropriate sealing means (not shown) are provided around that end of shaft **14** which extends outward through the adapter cover **12**. A wear plate **18** engages the side faces of impellers **15** and **17**. Plate **18** includes an outer portion **19** of steel and inner bronze face **21** bonded to portion **19**. As shown in FIG. 6, the bronze face **21** of the wear plate is provided with intersecting lubricating grooves **22** and **23**. Groove **23** communicates with a region of the impeller cavity in which discharge pressure exists. Pumped liquid is thus delivered to and serves to lubricate the shafts journals.

The seal between the housing parts **11** and **12** is best shown in FIGS. 2 and 7 and reference should be made to FIG. 7. The seal is indicated by general reference numeral **24** and is made of a resilient elastomeric material such as rubber or synthetic rubber. It includes a housing seal portion **25** which is oval and encircles the entire periphery of the impeller cavity. As shown in FIG. 1 the portion **25** is received in a groove formed in the adapter cover **12**. This groove is set back slightly from the periphery of the impeller cavity and the portion **25** received therein is confined between the mating faces of the main portion **11** of the housing and the cover **12**. As shown in FIG. 4, portion **25** of seal **24** is provided with a channel **26**. The channel **26** faces the bottom of the groove in which seal portion **25** is received. The seal **24**

includes a second portion 27 which is generally shaped like an Arabic numeral 3. This portion 27 includes semicircular portions 28, 29, each concentric, respectively, with shafts 14 and 16. The portions 28 and 29 have a diameter somewhat less than the root diameter of the gears. The adjacent ends of portions 28 and 29 are interconnected by a short arcuate portion 31 of seal 27. Tangent portions 32 and 33 extend from the ends of portions 28 and 29 to portion 25 of seal 24. The seal 24, comprising portions 25 and 27, is a monolithic structure. As shown in FIG. 5, the seal portion 27 is provided on its bottom face with a channel 34. This channel is in communication with channel 26 as shown in FIG. 7. Throughout a major portion of its length, seal portion 27 is of less depth than seal portion 25. The transition between the depth of portion 27 and that of portion 25 occurs where portion 27 crosses the wall of the impeller cavity. Shoulders 35 and 36 are formed at the transition point as shown in FIG. 2. The portion 27 is received in a groove in the adapter cover 12 and through the major portion thereof, between shoulders 35 and 36, is entirely within that groove. The seal portion 25 and shouldered portions of seal portion 27 protrude from the groove in the cover 12 to provide sealing contact with the mating face of housing part 11. A backup member 37 (see FIG. 2) overlies the thinner portion of seal portion 27. Member 37 is made of a hard phenolic resin or may include a fabric impregnated with the phenolic resin. Its thickness is such that its exposed face stands proud both of the groove in adapter cover 12 and of the shoulders 35 and 36. As shown in FIG. 1, this backup member 37 seals against the outer face of wear plate 18 and is resiliently biased against the wear plate by the seal portion 27.

The arrangement of parts in the region of shoulders 35 and 36 is best shown in FIG. 3. The adapter cover is indicated at 12 and has formed in it communicating grooves which receive the seal member 24 including portions 25 and 27 provided with the communicating channels 26 and 34. Backup member 37 has its end bearing in part against shoulder 35 and in part against the wall of the impeller cavity in the housing part 11. The steel face 19 of wear plate 18 bears against the face of backup member 37, and the bronze face 21 thereof bears against the side face of gear 15.

The pump has an inlet port 38 and an outlet port 39 which extend through cover 13. A resilient arcuate dam 41 (see FIG. 2) is mounted in a groove in cover 12 and seals against the face 19 of wear plate 18. This dam 41 will permit liquid to leak around its ends to the inlet 38, but will restrict flow sufficiently to insure that the shaft journals are kept liquid filled and thus lubricated. No significant backpressure is developed by the restriction at the ends of dam 41.

Operation

Shaft 14 is driven in any suitable manner. Liquid will be pumped from inlet 38 to outlet 39 by gears 15 and 17. While the upper and lower peripheral portions of wear plate 18 are closely fitted to the walls of the pumping cavity, liquid under pressure will leak from the impeller cavity between these surfaces. As shown in FIG. 6, the wear plate is shaped somewhat like the numeral 8, and liquid entering the space between the cover 12 and wear plate 18 will be in communication with both the inlet and the outlet. The backup member 37 divides this space into two pressure zones. As will be apparent from FIG. 2, inlet pressure will act over a major portion of the left hand half of the wear plate 18, while outlet pressure will act over the major portion of the right hand half. The resilient seal member 24 biases the backup member 37 into contact with the outer face of the wear plate 18. During operation of the pump, liquid will pass from the impeller cavity around the edges of the wear plate and outward between the mating faces of housing parts 11 and 12, along the inner peripheral edge of seal member 25 into the channel 26. Pressure in this channel will seal the outer peripheral edge of seal member 25 against the outer wall of the groove in which it is mounted, and thus the liquid cannot escape. Pressure will develop in channel 26 and in channel 34 with which it is in communication. This fluid pressure in channel 34 acting beneath the seal portion 27 will cause its edges to seal against the walls of the groove and will urge seal portion 27 axially against the backup member 37 whereby a seal is created between the wear plate 18 and the backup member to prevent leakage between the pressure zones. It is necessary that the different pressure areas on the outer face of the wear plate be maintained isolated from one another in order that a controlled axial force will be developed on the wear plate 18 so as to maintain the latter tight against the side faces of gears 15 and 17 and to urge the gears axially against the other end wall of the impeller cavity formed by the cover 13. This pressure isolation is provided by the backup member 37 and the seal portion 27. As shown in FIG. 2, the backup member overlies the entire part of portion 27 which is between shoulders 35 and 36. The pressure in channel 34 holds portion 27 tightly against backup member 37 and urges member 37 tightly against the wear plate. This insures against leakage between the two pressure zones as mentioned.

Liquid at discharge pressure acts on the right side of backup member 37 (referring to FIG. 2) and urges it to the left. This force holds the ends of backup member 37 tightly against the shoulders 35 and 36 and against the wall of the impeller cavity. This tight engagement of the ends of member 37 precludes leakage of liquid under pressure around these ends between the two pressure zones. Liquid under pressure in channel 27 will act against the inner walls of shoulders 35 and 36 (see FIG. 3) to augment the seal between member 24 and backup member 37. The member 37 and the groove which receives it are so dimensioned that member 37 will prevent extrusion of member 24 from the groove. At the same time, backup member 37 has enough clearance in the groove that it may move laterally into sealing contact with both the impeller cavity's wall and the shoulders 35 and 36. The end sealing of backup member 37 is essential to maintenance of predetermined unbalanced pressure forces on wear plate 18 so that it will seal against undesired leakage along the side faces of the gears. The member 37 also must be able to move axially to take up wear occurring during use of the pump. The thickness of member 37 is of such that it will always be at least partially within groove 18 when the pump is assembled and even if the die cast parts are somewhat oversized in axial dimensions. The portion of the backup member which lies within the groove has a dimension not smaller than the tolerable wear of wear plate 18 so that in normal use of the pump the backup member 37 will be engaged by the walls of the groove. The member 27 and its channel 34 are sufficiently resilient and deformable to insure that this requirement will always be met regardless of whether the die cast parts are of size close to either the upper or lower tolerance limit where the tolerances are of a magnitude which can be maintained employing usual die casting techniques.

The gear pump of the present invention is capable of maintaining discharge pressures on the order of 3,000 pounds per square inch. In the past, it has not been possible to use die cast housing parts in a gear pump intended for use with discharge pressures of this magnitude. The use of die cast housing parts enables rapid, relatively inexpensive production of the pump. As stated earlier, the invention may also be embodied in a gear motor and no limitation to its use in a pump is intended.

Although I have described in detail one embodiment of the inventive concept, it should be understood that the following claim provides the real measure of the scope of the invention.

What is claimed is:

1. In a gear pump or motor of the type having a multi-part housing including a cover and a main housing, an impeller cavity in the main housing and in which gear impellers are mounted for rotation on shafts journalled in said housing parts, and an axially movable wear plate received in said cavity, bearing against the side faces of said impellers and characterized by sealing and balance means comprising

(a) an endless sealing member of elastomeric material received in a groove formed in that face of the cover which engages the main housing and serving to seal against leakage from said cavity between said cover and the main housing part;

(b) a second sealing member formed in one piece with the first sealing member and including two generally semi-circular portions each arranged coaxially with a corresponding shaft, each semi-circular portion having its ends lying substantially on a line passing through the axes of said shafts and having a diameter less than the root diameter of the gears, a short arcuate portion interconnecting the adjacent ends of said two semi-circular portions, and tangent portions, one extending from each of the spaced ends of said semi-circular portions to the endless member, said second sealing member received in a second groove formed in the cover and connected with the first groove, said sealing members being bottomed in said grooves, a major portion of the second sealing member overlying the impeller cavity, that portion having a thickness such that it is received entirely within the second groove, the ends of said tangent portions having an outer surface coplanar with the outer surface of the endless member and forming shoulders at the ends of the major portion of the second sealing member;

(c) a thin, relatively hard backup member congruent to and overlying the major portion, said member projecting from the second groove and abutting against and biasing the wear plate into engagement with the side faces of the gears, each end of the backup member abutting in part against the wall of the impeller cavity and in part against a corresponding one of said shoulders whereby leakage around said ends is prevented;

(d) a pressure fluid receiving channel formed in the bottom face of both endless sealing members;

(e) a low pressure connection communicating with said cavity on the same side of said line as are the tangent portions; and

(f) a high pressure connection communicating with said cavity on the other side of said line.

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ROBERT M. WALKER, Primary Examiner

WILBUR J. GOODLIN, Assistant Examiner