A floating plate presents a flat flexible plate interface to the registering gear faces and a sealing pack means conforms elastically to bridge the drop-off between the gear height and the depth of the gear pocket in the housing gap between the edge of the pump casing axially adjacent the pumping chamber and a floating pressure plate so that a mechanical translation of pressure force may be uniformly applied to the floating pressure plate.

5 Claims, 4 Drawing Figures
FLOATING PLATE FOR END CLEARANCE SEAL ON GEAR PUMPS

BACKGROUND OF THE INVENTION

1. Field of the Invention
This invention relates generally to a pressure loaded pump and more particularly to an improved pressure loaded pump wherein a pressure plate is hydraulically loaded by means of a sealing pack.

2. The Prior Art
The prior art is represented by the patent of Clark and Druchas U.S. Pat. No. 3,101,673, issued Aug. 27, 1963. The object of the previous art in this field of invention had been directed at providing sufficient deflection in the original plane surface of a bimetal pressure plate to secure a quasi-flat interface with the adjoining side faces of the gears. That approach was limited by lack of uniformity of the deflection patterns since a plate supported at its outer perimeter when loaded does not assume a flat surface; instead, it is bowed at the center and uplifted at the edges. Since a discrete step end clearance exists between each gear and its header face, there is a tendency for leakage to occur at the edges of the gear-pressure plate interface, together with the outward token, loss of volumetric efficiency. Still another problem arises from the use of the flexible side plate with pump assemblies employing aluminum housings and gears with differing thermal expansion characteristics; i.e., aluminum or other similar lower coefficient materials.

SUMMARY OF THE PRESENT INVENTION

The present invention eliminates the major objections of the prior art by utilizing a floating pressure plate which presents a flat, flexible plate interface to the adjoining registering gear faces. Thus, when two external gears are placed in a gear pocket cavity of a housing, a bimetal floating pressure plate is inserted into the cavity adjacent to the gear faces and freely floats in the cavity with peripheral clearance between the plate perimeter and the cavity wall.

Sealing pack means are utilized and energized by means of pump generated pressure so that the drop-off between the gear height and the depth of the gear pocket gap between the edge of the pump casing axially adjacent the pumping chamber and a floating pressure plate is bridged to permit a mechanical translation of pressure force to be uniformly applied to the bimetallic pressure plate.

Through the judicious use of hydraulic pressure forces acting on the plate, it is forced towards the low pressure cavity wall perimeter, thus stopping leakage around the perimeter surface.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view taken through a gear pump incorporating the principles of the present invention.

FIG. 2 is taken on the plane of line II—II of FIG. 1 and illustrates additional details of construction of the sealing means of the present invention.

FIG. 3 is a view taken on line III—III of FIG. 1 and illustrates additional details of the pressure scaling plate in its relationship to the pump cavity as provided in accordance with the principles of the present invention.

FIG. 4 is an enlarged fragmentary cross sectional view generally similar in orientation to the view of FIG. 1 but illustrating additional details of the present invention.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENTS

The pump of the present invention has a housing 10 in which is formed a gear pocket cavity 11 having a depth indicated at H1. There is received within the cavity 11 two external gears 12 and 13 which are in meshing relationship with one another and each of which has corresponding shaft portions 14 and 15 respectively which are appropriately journaled in shaft sleeve bearings 16. The gears have a gear height indicated at H2 which is somewhat less than the height of the gear pocket 11 and indicated at H3, thereby leaving a so-called drop off represented by the dimension Δ D.

It will be understood that the pump of FIG. 1 is provided with the usual inlet and outlet and the gears 12 and 13 are rotatably driven and mesh with one another, thereby to carry fluid through the pumping cavity formed by the gear cavity 11 from the inlet to the outlet.

In accordance with the principles of the present invention, a floating plate is provided to overcome the major objections of the prior art. The bimetal floating plate is indicated generally at 21 and it will be noted that the plate is received in the cavity 11 adjacent to the gear side faces shown at 22 and 23 respectively. The plate 21 freely floats in the cavity 11, i.e., there is peripheral clearance between the plate 21 perimeter and the cavity wall 11. As is more clearly shown in the enlarged view of FIG. 4, the plate 21 may be a bimetallic plate including a sealing face 21a and a main backing body 21b.

The gear cavity 11 is closed by a cover member 24. The cover member 24 has a radial wall 26 which engages against an adjoining radial wall 27 of the housing 10. A three-piece pump composed of two headers and a center section tied together by bolts may be used in lieu of the two-piece pump shown in the embodiment. The cover member 24 is recessed for accommodating a seal pack in accordance with the principles of the present invention. First of all, there is generally ovaloidal-shaped recess 28 which is somewhat larger than the adjoining gear cavity 11. The outer wall of the ovaloidal recess 28 is shown at 29 and extends generally axially to the deepest point of the recess, terminating in a generally radially extending wall 30. Spaced inwardly of the wall 29 is another generally axially extending wall 31. The walls 29, 30 and 31 together form a channel which is peripherally continuous with respect to the ovaloidal recess 30.

The wall 31 is terminated by a radial wall 32 which is spaced inwardly of both the walls 29 and 31. The cover 24 is additionally recessed as at 33, which recess 33 has a side wall 34 and an end wall 36.

Using the orientation of FIG. 4 and in ascending order from the pressure plate 21, there is first of all provided a flexible paper-type member 40. One satisfactory form of material which can be used for the member 40 is that manufactured and sold under the trade name "Nomex."

Next, there is a steel plate 41. A molded form of paper shown at 42 which may also be made of
A rubber diaphragm is received in the recesses 30 and 33. As shown in FIG. 4, the diaphragm constitutes a sealing web which may be made of a suitable resilient material and is identified at 43. The overall configuration of the diaphragm is similar to that of the pressure plate. Pressure from an opening 44 (FIG. 1) connected to the outlet port enters a cavity provided by the recess 28, thereby energizing the molded legs $L_1$ and $L_2$ of the rubber diaphragm 43 to seal it. The rubber diaphragm 43 is constrained from extruding, or bulging out of its form through the supporting effect of the molded paper form 42. The steel element 41 creates a deformable firm base for direct mechanical pressure on the element 40 which conforms elastically to bridge the gap or drop-off between the gear height $H_2$ and the depth of the pocket $H_1$, represented by the dimension $D$, so that a mechanical translation of pressure force may be uniformly applied to the bimetal plate 21.

It should be noted that, through the judicious use of hydraulic pressure forces acting on the plate 21 at the pressure fields indicated by arrows in FIG. 3 at $P_{11}$ and $P_{12}$ and constituting as shown diagrammatically by the pressure distribution vectors noted in FIG. 3, the plate 21 is forced towards the low pressure cavity wall perimeter, thus stopping leakage around the perimeter surface designated at $S_2$. Thus, the floating plate 21 can be loosely fit to the cavity 11 contour without inducing leakage around the perimeter of the plate 21 from the outlet to the inlet.

It will be apparent to those versed in the art, that while there may be other means for providing the translatory effect to the floating plate 21, the means described represents a sound and effective way of coping with the syndrome of high pressure, high temperature deformation and the failures of the conventional working elements of a gear pump seal pack.

Although minor modifications might be suggested by those versed in the art, it should be understood that we wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of our contribution to the art.

We claim as our invention:

1. In a gear pump, a housing having a radial wall and having a gear pocket cavity with a cavity wall of depth $H_1$, a pair of gears in said gear pocket cavity having a gear height $H_2$ of lesser height than $H_1$, thereby leaving a drop-off $\Delta D$ between said radial wall and the side faces of the gears, a floating plate in said gear pocket cavity in freely floating relation with peripheral clearance between the plate perimeter and the adjoining cavity wall forming a gap, a cover for closing said gear pocket cavity and having a radial wall abuttingly engaging said radial wall of said housing, said cover having formed inwardly of said radial wall an ovaloidal recess somewhat larger than said gear pocket cavity and constituting spaced axially extending walls terminating in a generally radially extending wall to form a peripherally continuous channel, deformable firm base means in said channel comprising in shape to said channel and forming an elastically deformable bridging means to bridge the drop-off gap and $\Delta$ between the housing radial wall and the floating plate, and pressure means including said channel behind said base means and energized by pump-generated pressure to provide transitory mechanical force through said base means to said floating plate only in response to said pump-generated pressure whereby said floating plate and base means seal the side faces of the gears.

2. In a gear pump as defined in claim 1, said deformable firm base means comprising a deflectable metal plate to bridge the gap and drop-off $\Delta$.

3. In a gear pump as defined in claim 1, a flexible paper member underlying said base means to help seal the bridging action of said base means.

4. In a gear pump as defined in claim 1, said pressure means comprising a rubber diaphragm sealing web having legs responsive to pressure energization to seal the channel and acting as a motive surface for receiving pressure loading from the pump-generated pressure.

5. In a gear pump as defined in claim 4, a molded paper form supporting and constraining the rubber diaphragm from extruding or bulging out of its form.

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