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Drutchas et al.

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[54] **FLOATING PLATE FOR END CLEARANCE SEAL ON GEAR PUMPS**

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[52] **U.S. Cl.** ..... **418/131**, 277/235 R

[51] **Int. Cl.** ... **F01c 19/08**, F04c 15/00, F04c 27/00

[58] **Field of Search** ..... 418/131, 132, 135; 277/235 R

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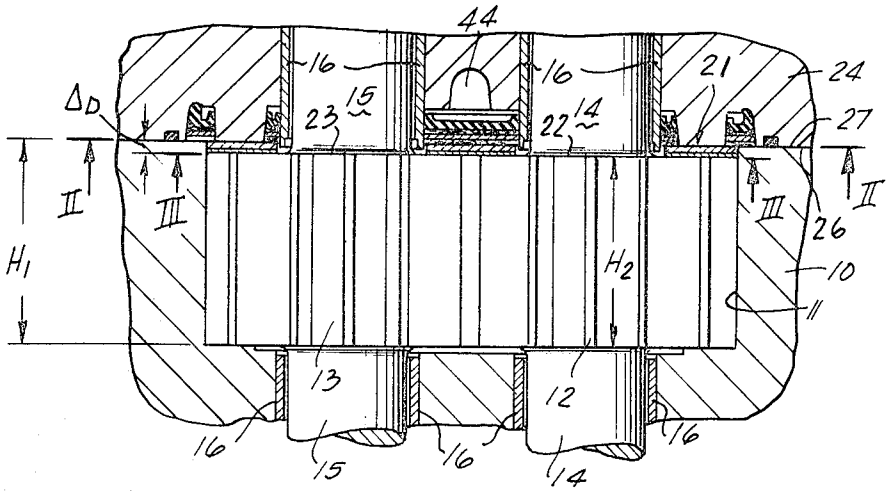
[57] **ABSTRACT**

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



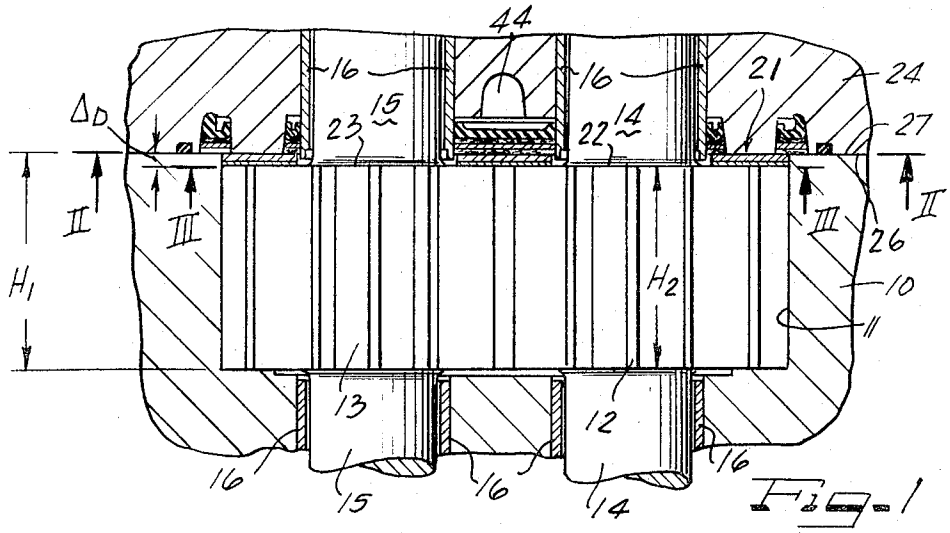


Fig. 1

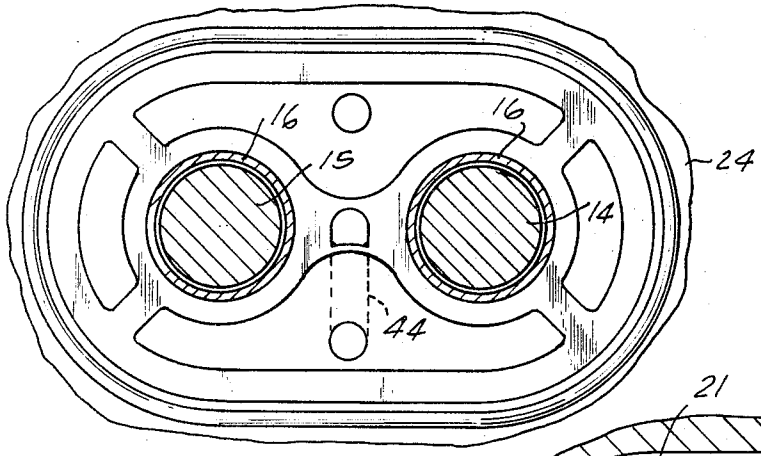


Fig. 2

Fig. 3

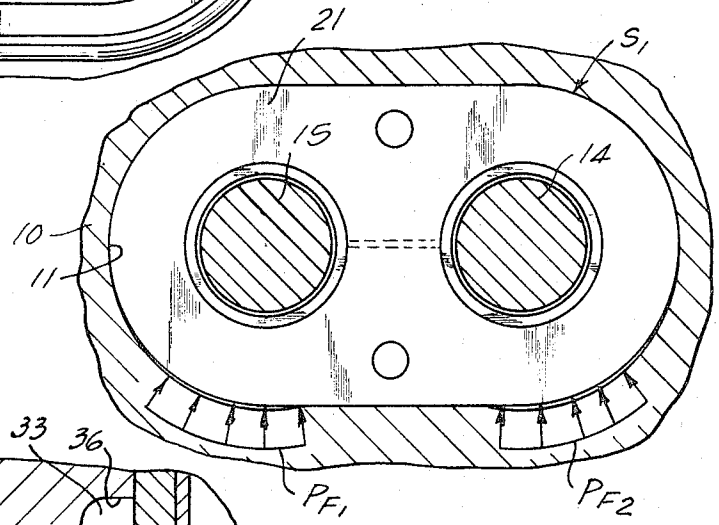
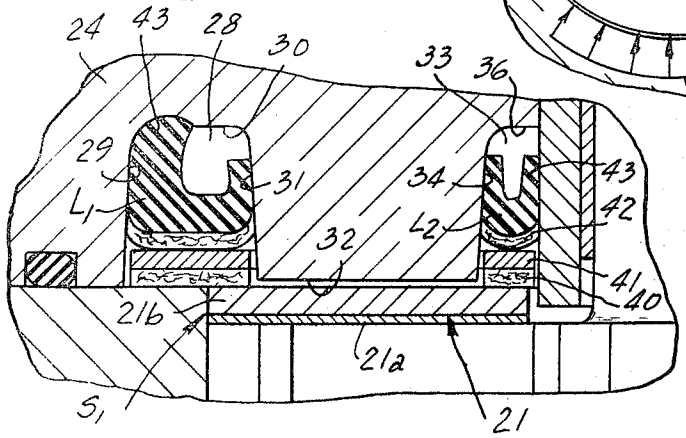


Fig. 4



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 Drutchas 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 entered 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 sealing 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 H_1. 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 H_2 which is somewhat less than the height of the gear pocket **11** and indicated at H_1, 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 **21***a* and a main backing body **21***b.*

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

"Nomex" and completes the complement of parts that constitutes the sealing pack arrangement.

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 pump 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 Δ 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_{F1} and P_{F2} 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_1. 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 Δ 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 conforming in shape to said channel and forming an elastically deformable bridging means to bridge the drop-off gap and Δ 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 Δ.

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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