Dec. 18, 1962 J. E. THRAP ETAL 3,068,804

PRESSURE LOADED PUMP SEAL

Filed March 21, 1960 2 Sheets-Sheet 1

Fig. 1

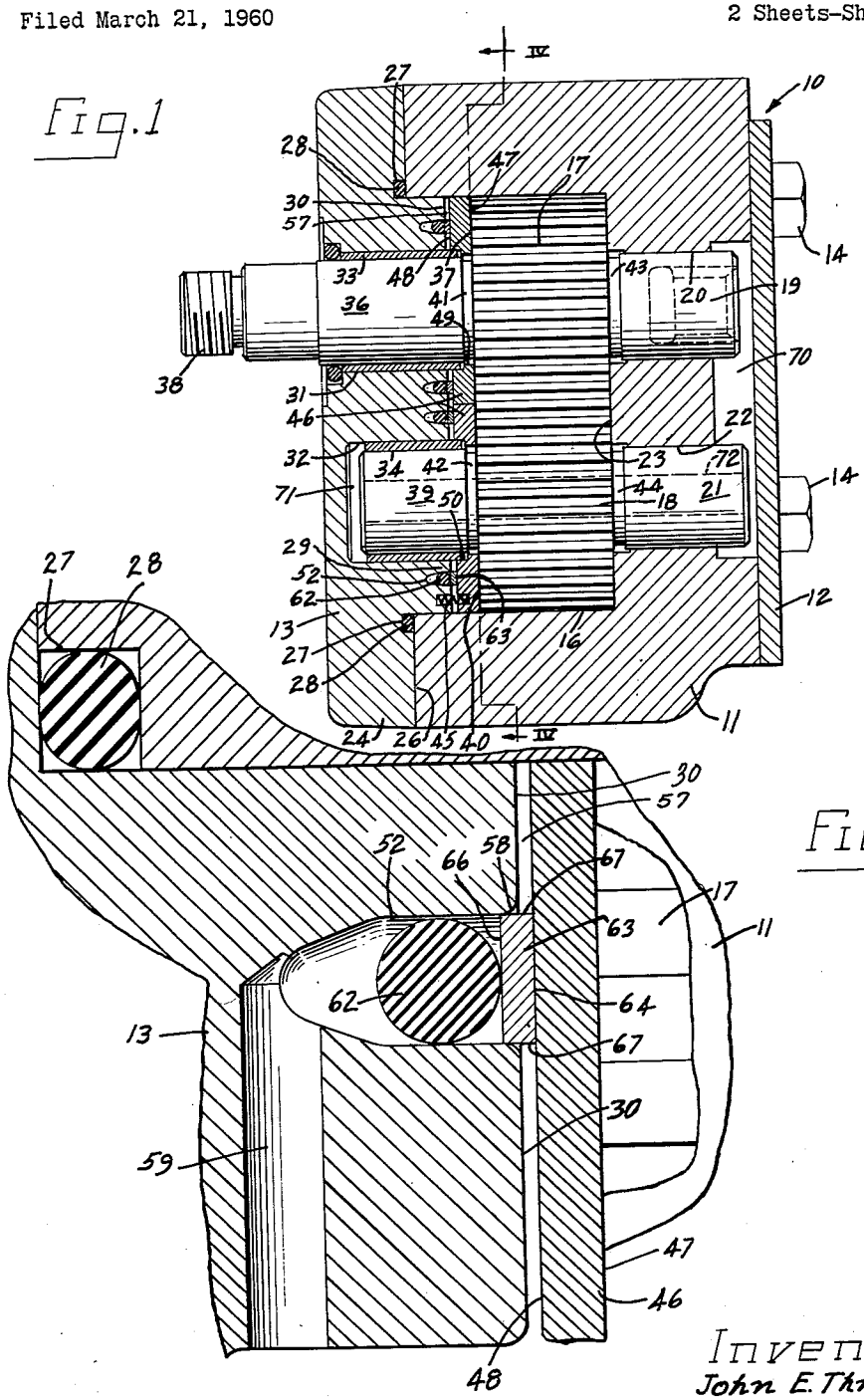


Fig. 2

Inventors
John E. Thrap
Herbert F. Prasse

by Hill, Sherman, Meroni, Gross & Simpson Attys.

Dec. 18, 1962 J. E. THRAP ETAL 3,068,804

PRESSURE LOADED PUMP SEAL

Filed March 21, 1960 2 Sheets-Sheet 2

Fig. 4

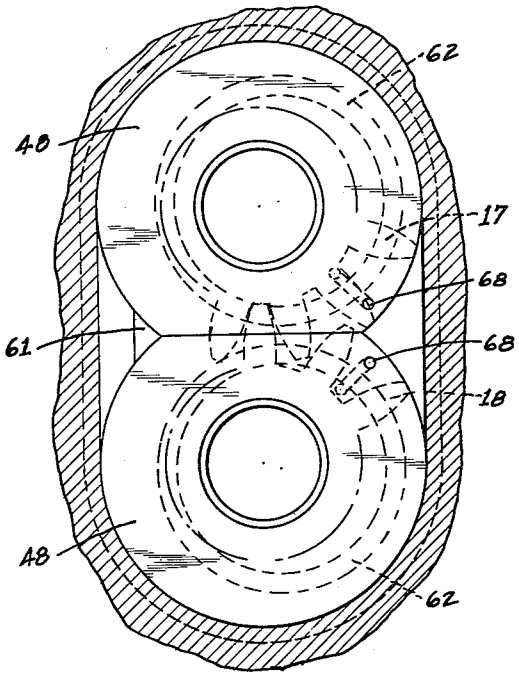
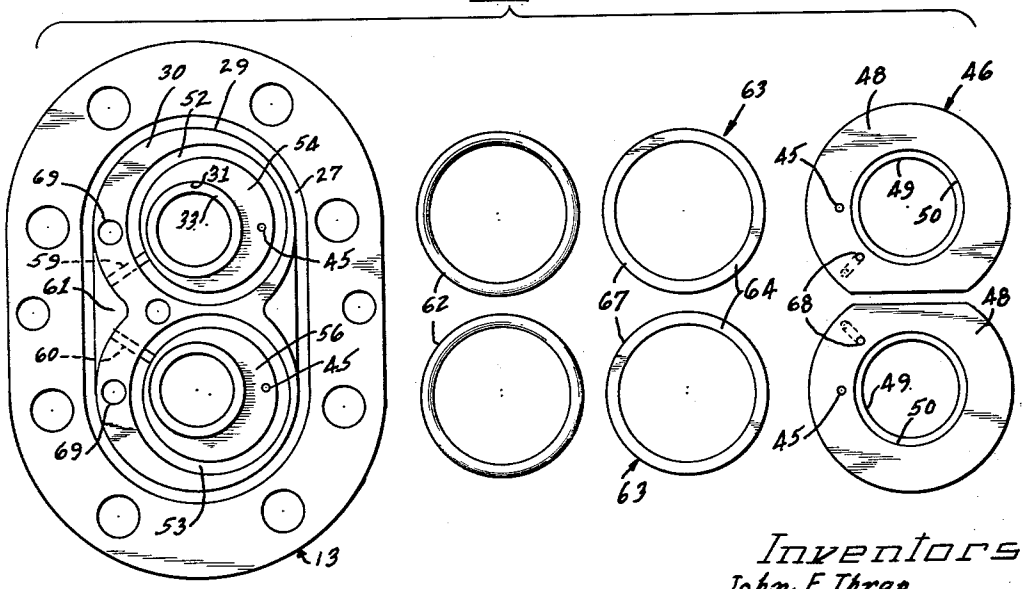


Fig. 3



Inventors
John E. Thrap
Herbert F. Prasse

by Hill, Sherman, Meroni, Gross & Simpson Attys.

United States Patent Office

3,068,804

Patented Dec. 18, 1962

3,068,804

PRESSURE LOADED PUMP SEAL

John E. Thrap, Willoughby, and Herbert F. Prasse, Gates Mills, Ohio, assignors to Thompson Ramo Wooldridge Inc., Cleveland, Ohio, a corporation of Ohio

Filed Mar. 21, 1960, Ser. No. 16,423
9 Claims. (Cl. 103—126)

This invention relates generally to pressure-loaded pumps and more particularly relates to a pump characterized by a housing member such as a cover plate having a grooved wall containing axially loaded sealing means in the grooves movable outwardly of the grooves against an end plate member to form inner and outer pressure zones, one of which may be supplied with pump-generated pressure and eccentrically offset to balance the unequal pressure forces developed in the pumping cavity of the pump.

It is an object of the present invention to provide a pump having a sealing arrangement which eliminates the use of a movable journal bushing.

Another object of the present invention is to provide a pressure-loaded gear pump wherein a simplified balanced pressure loading arrangement may be provided.

Yet another object of the present invention is to provide a sealing arrangement in a pressure-loaded gear pump utilizing a grooved die cast cover plate to establish separated pressure zones arranged to balance unequal pressure forces developed in a pumping cavity.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings in which a preferred structural embodiment of a pressure-loaded gear pump incorporating the principles of the present invention are shown by way of illustrative example.

On the drawings:

FIGURE 1 is a cross-sectional view of a pump incorporating the principles of the present invention;

FIGURE 2 is an enlarged fragmentary cross-sectional view illustrating additional details of construction of the pump of FIGURE 1;

FIGURE 3 is an exploded view showing the structural components utilized in the sealing arrangement of the present invention; and

FIGURE 4 is a fragmentary sectional view taken generally on line IV—IV of FIGURE 1.

As shown on the drawings:

The pump of the present invention is indicated generally at 10 and comprises a housing consisting of fastened together components including a body member 11 closed at one end by a closure 12 and closed at its opposite end by a cover member 13. Suitable fastening means may be employed for holding the housing components 11, 12 and 13 together such as the fasteners shown at 14.

The housing has the usual pump inlet and pump outlet and includes a pumping chamber 16 formed therebetween so that a rotary fluid displacement means taking the form of a driver gear 17 and a driven gear 18 may be rotatably meshed within the pumping chamber 16, and thereby operated to move the fluid under pressure from the inlet zone of the pump to the outlet zone thereof.

If desired, the rotary fluid displacement means may be constructed in the form of two part gears including a hub part pressed on a shaft part. In any event, as shown herein, the driver gear 17 includes a gear shaft extension 19 rotatably journaled in a bearing surface 20 formed in the body member 11. The driven gear 18 includes a gear shaft extension 21 rotatably journaled in a bearing surface 22 formed in the body member 11. The body member 11 is further provided with a thrust face 23 which

engages and seals against an adjoining gear side face of the respective driver and driven gears 17 and 18.

In accordance with the principles of the present invention, the cover member 13 may conveniently take the form of a die cast member including a flange portion 24 having an abutment surface 26 engaging against the body member 11 and grooved as at 27 to receive a sealing member 28, thereby to establish a completely sealed relation between the cover member 13 and the body member 11.

The cover member 13 is particularly characterized by an axially extending boss portion 29 sized to be received within the internally recessed portion of the body member 11 forming the pumping chamber 16 and having a wall indicated at 30 (FIGURES 1 and 2).

The cover member 13 is formed with a shaft opening 31 and a shaft recess 32 in which are press fit a pair of non-movable bushings or sleeves forming bearings and indicated respectively at 33 and 34. Thus, the bearing sleeve 33 journals a shaft extension 36 extending axially away from a gear side face 37 formed on the driver gear 17. The shaft extension 36 has a portion extending outwardly of the cover member 13, thereby to form a coupling portion 38 so the pump may be connected to a source of driving power for rotatably operating the gears 17 and 18.

The driven gear 18 has a shaft extension 39 extending axially from the gear side face 40 and is journaled in bearing sleeve 34.

The bearing sleeves 33 and 34 are pressed in the respective shaft opening 31 and shaft recess 32 in such a manner as to have a protruding portion extending axially beyond the wall 30. If desired, the shaft extension 36 may be relieved as at 41 adjacent the gear side face 37 and the shaft extension 39 may be relieved as at 42 adjacent the gear side face 40. In like manner, the shaft extension 19 may be relieved as at 43, while the shaft extension 21 may be relieved as at 44. It will be understood that the relief portions 41—43 may be omitted without departure from the spirit of this invention.

Interposed between the gear side faces 37 and 40 and the wall 30 there is provided a pair of floating end plate members which are of generally identical construction and hence identified herein by the same reference numeral 46. Each floating end plate member 46 has a front sealing face 47 for engaging and sealing against an adjoining gear side face 37 or 40, and a rear motive surface 48. Moreover, each end plate member 46 is formed with a shaft opening 49 formed with a counterbored recess 50 adapted to receive and retain the protruding portions of the respective bearing sleeves 33 and 34.

As will be noted upon referring to FIGURE 3 in connection with FIGURE 1, the end plate members 46 are each in the configuration of a generally circular plate, but each is provided with a flattened chordal portion 51, thereby to provide adjoining abutment surfaces so when assembled in the pump the two end plate members 46, 46, in effect, form a figure 8-shaped end plate member. If desired, an integral one-piece end plate member could be utilized. The usual spring loading means to initially load the end plate means into sealing relation is shown at 45.

In accordance with the principles of the present invention, the wall 30 is particularly characterized by the provision therein of sealing means outwardly of the respective shaft openings, thereby to form by engagement with the rear face 48 inner and outer pressure zones adapted to communicate with different pressure sources within the pump so that the end plate members 46 will be pressure loaded against the gear side faces 37 and 40 during operation of the pump.

More specifically, the wall 30 is formed with annular grooves, for example, a groove 52 outwardly of the shaft opening 31 and a groove 53 outwardly of the shaft recess

32. As is most clearly shown in FIGURE 3, the grooves 52 and 53 are eccentrically offset relative to the respective axes of the shaft opening 31 and the shaft recess 32 towards the inlet side of the pump, thereby to divide the area of the wall 30 into an inner zone 54 prescribed by the groove 52 and an inner zone 56 prescribed by the groove 53, and an outer zone 57 which extends from the outside of the respective grooves 52 and 53 to the edge of the wall 30.

As is most clearly shown in FIGURE 2, the grooves are provided with rounded entrant portions 58. The cover member 13 is also provided with drilled passages shown at 59 and 60 and extending between the discharge zone of the pump, indicated at 61, to the respective grooves 52 and 53, so that pump-generated pressure may be communicated into the bottom of the grooves 52 and 53. Furthermore, discharge pressure from the zone 61 will be communicated over the entire area outwardly of the O ring sealing rings 62, 62.

Referring now specifically to the enlarged sectional view of FIGURE 2, it will be noted that each groove 52 and 53 receives a sealing means which may include an O ring sealing member 62 sized in cross-section dimension to be approximately the same width as the width of the corresponding groove. The O ring sealing member 62, like each corresponding groove 52 or 53 is circumferentially continuous and corresponds in size and shape to the groove.

The sealing means further includes a wafer-type ring member indicated generally at 63. The wafer-type ring 63 has a front face 64 which engages against the rear face 48 of the end plate 46 and further includes a pressure face 66 preferably of a width corresponding to the width of the groove with which the ring 63 is associated, either the groove 52 or the groove 53. The wafer-type ring 63 further includes side faces 67, 67 which slidably engage the walls of the corresponding groove 52 or 53.

The wafer ring 63 is preferably made of a material endowed with flexibility. Good results have been obtained by making the ring of a laminated phenolic material such as Micarta or formica, although it will be appreciated that other materials can be used with equal facility.

In accordance with this invention the area inside of the O ring sealing members 62, 62 is at reduced pressure. Although various means of accomplishing such objective are possible in a pump, one exemplary embodiment is shown on FIGURE 4. The end plate members 46, 46 are each formed with a passage 68 to communicate the area inwardly of each O ring sealing member 62 to inlet pressure. Note the passages 68 extend angularly into the inlet area near the point of mesh of the rotary gears 17 and 18. The wall 30 is provided with additional spring bottoming recesses 69, formed in the enlarged outer area 57 near the discharge zone, if necessary.

In operation, the spring means 45 urge the sealing means into sealing engagement to effect the initial prime. Afterwards fluid at discharge pressure generated by the pump 10 is directed from the gear cavity at the discharge zone 61 through the passages 59 and 60 to the grooves 52 and 53. Such pressurized fluid being fed behind the sealing means formed by the O ring sealing member 62 and the wafer-type seal 63 pressure loads such sealing means generally outwardly of the respective grooves 53 and 52, and into sealing engagement with the rear face 48 of the end plate members 46, 46. There is thus formed a sealing barrier providing the separate zones of pressure on the rear face 48 of the end plate members 46, 46, namely, the zones at lower pressure 54, 56 and the zone at increased pressure 57.

In this connection, it may be noted that various areas within the pump housing are maintained at reduced pressure, for example, the area indicated at 70 inside of the closure 12 and the area 71 in the cover member 13, which communicates with the area 70 through a through passage 72 formed in the shaft of the driven gear 18. The areas 54 and 56 inwardly of the sealing means in the grooves 52 and 53 will likewise be at a reduced pressure, while the area 57 outwardly of the grooves 52 and 53 will be at increased pressure.

Thus, the end plate members 46, 46 will be pressure-loaded by a non-uniformly applied axial thrust which varies proportionately from the inlet side of the pump to the outlet side of the pump, thereby to counterbalance the unequal pressure forces developed in the pumping cavity 16. Such balanced pressure loading is accomplished without the necessity of utilizing a floating journal bushing because of the simplified grooving and sealing arrangement disclosed herein.

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. A gear pump comprising a casing having a pumping chamber with an inlet and an outlet and including a cover, rotary gears in said chamber having shaft extensions projecting axially outwardly of said gears, said cover having a wall adjacent one side of said chamber and having formed therein a pair of spaced shaft openings receiving said shaft extensions, said wall being grooved radially outwardly of each respective shaft opening, thereby to divide such wall into radially inner and outer areas, a sealing ring in each said groove, and a flexible ring member in each said groove and an end plate means having a shaft opening for each said shaft extension and including a front sealing face for engaging against the adjoining side face of the gears and a rear motive surface engaged by said flexible ring member, and means forming passages in said casing member extending from the discharge side of the pump to the bottoms of said grooves, to load said ring and said ring member against said motive surface, and means to load said motive surface with different pressures over areas separated from one another by said flexible ring members.

2. In a pressure-loaded pump having rotary fluid displacement means therein, a movable plate having a shaft opening and having radial faces on opposite sides of said plate forming a front sealing face for engaging and adjoining side face of the fluid displacement means and a rear face, a cover having a wall spaced from the adjoining rear face of said plate, said wall having a shaft opening formed therein, said wall further having an annular groove formed therein radially outwardly of said shaft opening, an annular O ring sealing member having a cross-sectional dimension corresponding to the width of the groove and received in said groove, and a wafer-type ring member having a width corresponding to the width of the groove and received in said groove, said wafer ring member having a first face engaged by said O ring member and a second face engaged against said movable plate, and means forming a passage in said cover conducting pump-generated pressure to the bottom of said groove to bias said O ring member and said wafer ring member outwardly of said groove toward and against said rear face, and dividing said rear face into radially inner and outer pressure zones.

3. In a pressure-loaded pump having rotary fluid displacement means therein, a movable plate having a shaft opening and having radial faces on opposite sides of said plate forming a front sealing face for engaging and adjoining side face of the fluid displacement means and a rear face, a cover having a wall spaced from the adjoining rear face of said plate, said wall having a shaft opening formed therein, said wall further having an annular groove formed therein radially outwardly of said shaft opening, an annular O ring sealing member having a cross-sectional dimension corresponding to the width of the groove and received in said groove, and a wafer-type ring member having a width corresponding to the width of

the groove and received in said groove, said wafer ring member having a first face engaged by said O ring member and a second face engaged against said movable plate, and means forming a passage in said cover conducting pump-generated pressure to the bottom of said groove to bias said O ring member and said wafer ring member outwardly of said groove toward and against said rear face, and dividing said rear face into radially inner and outer pressure zones, said groove being eccentrically offset relative to the axis of said shaft opening, and means communicating outlet pressure to one of said zones and inlet pressure to the other so said pressure zones will deliver an offset thrust against said movable plate to balance the pressure forces in said pump.

4. In a pressure-loaded pump of the type having rotary gear displacement means, the improvement of

a cover forming part of the pump housing and having a wall spaced adjacent the pump cavity,

an end plate member interposed between said wall and said pump cavity to seal against the adjoining side face of the rotary gear displacement means,

said wall having an annular groove formed therein eccentrically offset with respect to said face,

sealing means in said groove,

and means forming a passage in said cover conducting fluid at pump-generated pressure to the bottom of said groove thereby to bias said sealing means against said end plate to isolate an area offset towards one side of the pump,

and means pressure loading said end plate with pump-generated pressure in said isolated area to balance unequal pressure loads in the pump cavity.

5. As an article of manufacture adapted for use as a housing component of a pressure-loaded gear pump, the improvement of

a cover member having a wall intersected by an opening formed therein as a shaft opening,

said wall having a groove formed therein radially outwardly of said shaft opening but eccentrically offset with respect to the axis of said shaft opening,

means forming a passage in said cover member extending from the bottom of said groove to a zone of pump-generated pressure in the pump for communicating pump-generated pressure to said groove,

and sealing means in said groove and acted upon by the pump-generated pressures behind said sealing means to form together with said cover member an offset pressure zone,

and means subject to the pressures in said zone for delivering a non-uniform axial thrust including

a movable end plate movable on the axis of said shaft opening.

6. In a pressure-loaded pump having rotary fluid displacement means therein,

a movable plate having a shaft opening and having

radial faces on opposite sides thereof forming a front sealing face for engaging an adjoining side face of the fluid displacement means and a rear face,

a cover having a wall spaced from the adjoining rear face of said plate,

said wall having a shaft opening therein,

a fixed bushing in said shaft opening of said wall and having

a portion protruding axially outwardly of said wall,

said plate having an annular counterbored recess in said rear face receiving said portion of said bushing,

said wall having an annular groove formed therein radially outwardly of said shaft opening,

an O ring sealing means in said groove, and means forming a passage in said cover conducting pump-generated pressure to the bottom of said groove to bias said sealing means outwardly of said groove towards and against said rear face, thereby forming a barrier,

and means supplying different pump-generated pressures to opposite sides of said barrier to form radially inner and outer pressure zones on said rear face.

7. In a pressure-loaded pump having rotary fluid displacement means therein,

a movable plate having a shaft opening and having

radial faces on opposite sides thereof forming a front sealing face for engaging an adjoining side face of the fluid displacement means and a rear face,

a cover having a wall spaced from the adjoining rear face of said plate,

said wall having a shaft opening therein,

a fixed bushing in said shaft opening of said wall and having

a portion protruding axially outwardly of said wall,

said plate having an annular counterbored recess in said rear face receiving said portion of said bushing,

said wall having an annular groove formed therein radially outwardly of said shaft opening,

an O ring sealing means in said groove and means forming a passage in said cover conducting pump-generated pressure to the bottom of said groove to bias said sealing means outwardly of said groove toward and against said rear face, thereby forming a barrier separating radially inner and outer pressure zones on said rear face,

said groove being eccentrically offset,

and means delivering different pump-generated pressure to said inner and outer zones so that said pressure zones will impart an offset thrust to balance the pressure forces in said pumping chamber.

8. In a pressure-loaded pump having rotary fluid displacement means therein,

a movable plate having a shaft opening and having radial faces on opposite sides of said plate forming a front sealing face for engaging an adjoining side face of the fluid displacement means and a rear face,

a cover having a wall spaced from the adjoining rear face of said plate,

said wall having an annular groove formed therein radially outwardly of said shaft opening,

an O ring sealing means in said groove,

and means forming a passage in said cover conducting pump-generated pressure to the bottom of said groove to bias said sealing means outwardly of said groove toward and against said rear face to form separate radially inner and outer pressure zones on said rear face,

and means communicating inlet pump pressures to one of said zones and

pump-generated outlet pressure to the other of said zones.

9. In a pressure-loaded pump having rotary fluid displacement means therein, a movable plate having a shaft opening and having radial faces on opposite sides of said plate forming a front sealing face for engaging an adjoining side face of the fluid displacement means and a rear face,

a cover having a wall spaced from the adjoining rear face of said plate,

said wall having an annular groove formed therein radially outwardly of said shaft opening,

an O ring sealing means in said groove,

and means forming a passage in said cover conducting pump-generated pressure to the bottom of said groove to bias said sealing means outwardly of said groove toward and against said rear face to form radially inner and outer pressure zones on said rear face, said groove being eccentrically offset,

and means communicating pump-generated discharge pressure to one of said zones and pump inlet pressure to the other of said zones so said pressure zones will

impart an offset thrust to balance the pressure forces in the pump.

References Cited in the file of this patent

UNITED STATES PATENTS

1,780,109	Berglund	Oct. 29, 1930
2,044,873	Beust	June 23, 1936
2,649,740	Murray et al	Aug. 25, 1953
2,696,172	Compton	Dec. 7, 1954
2,702,509	Garnier	Feb. 22, 1955
2,707,441	Drennen	May 3, 1955
2,728,301	Lindberg	Dec. 27, 1955
2,787,224	Udale	Apr. 2, 1957
2,809,592	Miller et al	Oct. 15, 1957
2,824,524	Banker	Feb. 25, 1958
2,967,487	Nagely	Jan. 10, 1961
3,003,426	Lauck	Oct. 10, 1961

FOREIGN PATENTS

706,979	Great Britain	Apr. 7, 1954
769,763	Great Britain	March 13, 1957
782,701	Great Britain	Sept. 11, 1957
1,060,496	France	Nov. 18, 1953