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J. F. MURRAY ET AL

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HIGH PRESSURE PUMP

Filed June 30, 1949

3 Sheets-Sheet 1

Fig. 1

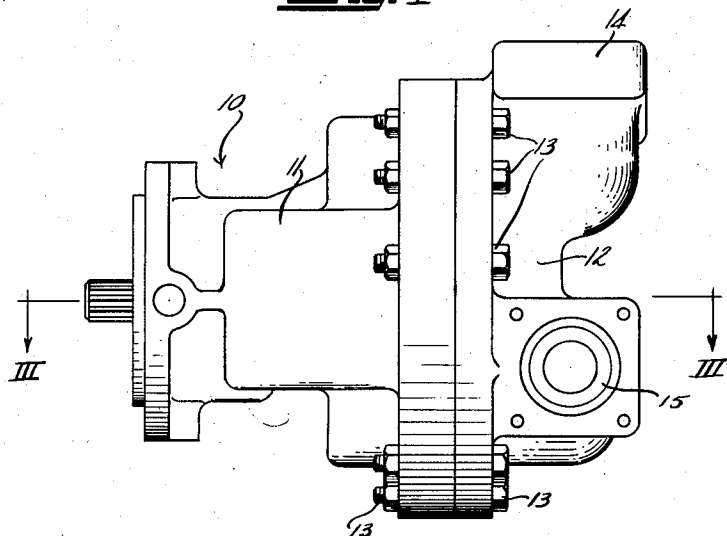


Fig. 6

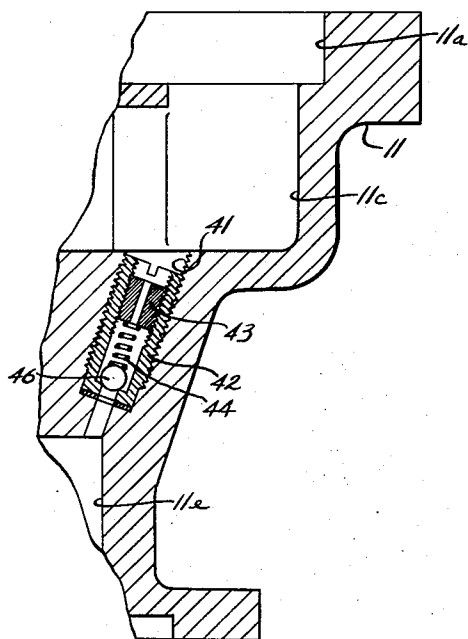
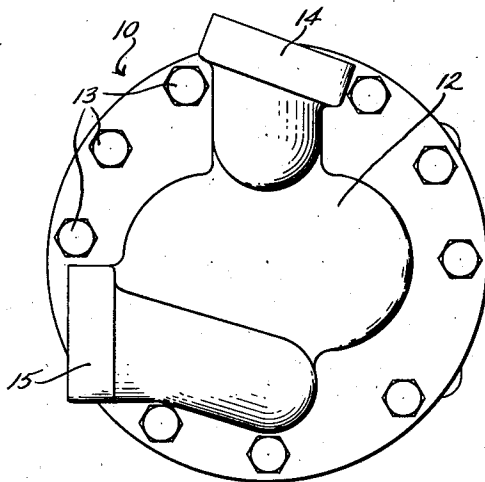


Fig. 2



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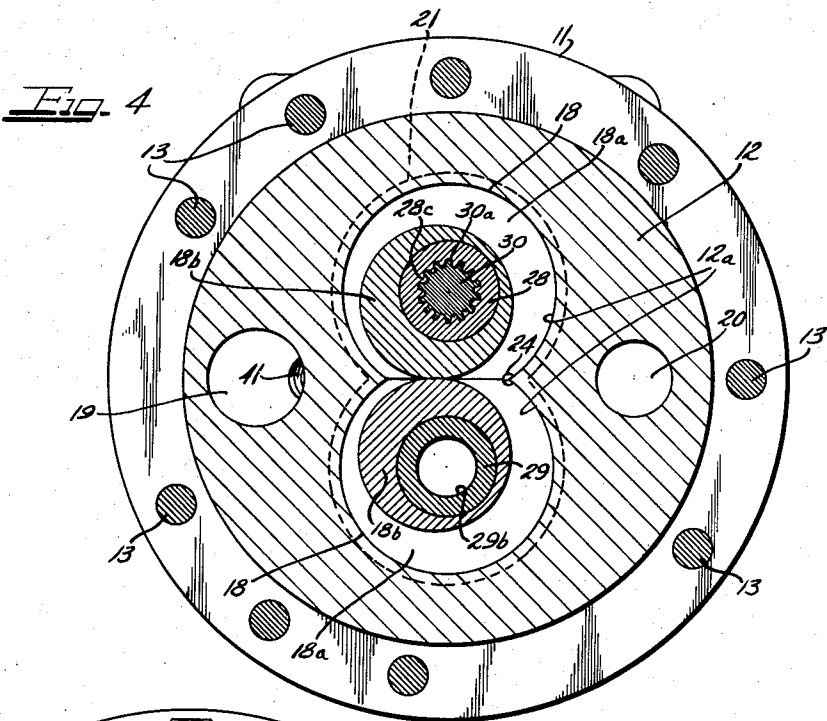
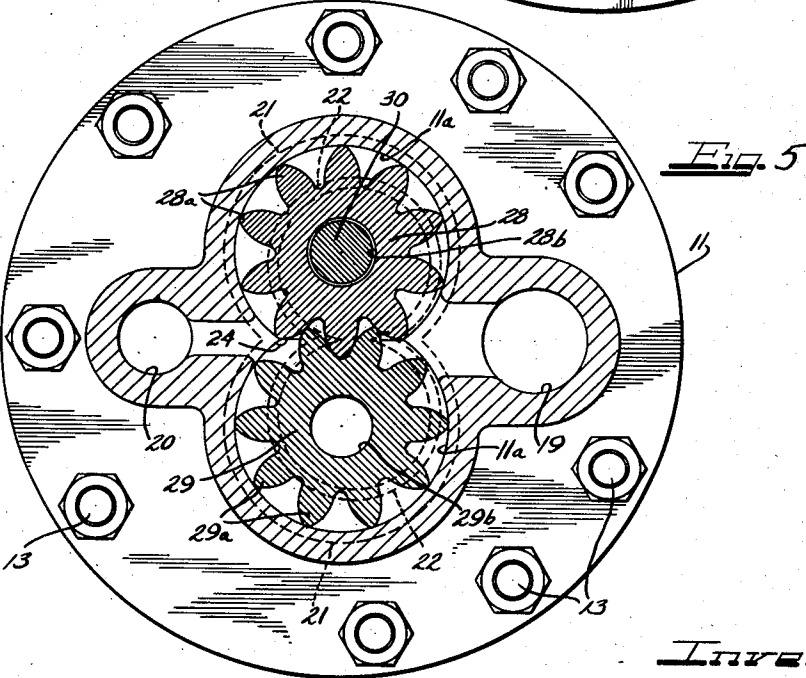
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HIGH PRESSURE PUMP

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1 Claim. (Cl. 103—126)

This invention relates generally to high pressure positive displacement pumps equipped with pressure loaded end plates constructed and arranged to balance the variable forces tending to move the plates outwardly from the pumping chamber with opposed forces tending to move the plates toward the pumping chamber. Specifically, the invention relates to a high pressure gear pump wherein one end of the gears is journaled in floating bearings having integral end plate portions. One face of the end plate portions increases in area from the inlet to the outlet side of the pump and is exposed to a sufficiently high pressure to promote uniform loading and prevent cocking or binding of the bearings.

Heretofore, pressure-loaded fuel pumps in which minimum clearance is maintained between the gears or the rotors and the end plates by bleeding high pressure to the back side of the end plates have been deficient because an exact balance is not accomplished between the separating force and the force tending to maintain a sealed relation between the end plates and the rotors. Consequently, in the pump structures heretofore provided this separating force has varied from a minimum at a point adjacent the inlet port to a maximum at a point adjacent the discharge port and has resulted in excessive wear conditions and improper pressure distributions.

According to the features of the present invention, a pump structure is provided wherein uniformly distributed loading may be achieved on the back side of the floating or pressure loaded end plate. In accordance with the provisions of this invention, an exact balance is approached at any point along the periphery between the load tending to force the end plates away from the gears or rotors and the introduced load tending to hold them in contact. By approaching this balance between the various forces working on the end plates, the tendency of the pump bearings to twist in their housings is eliminated, thereby providing for a full and evenly distributed contact between each gear and its associated end plate over an entire mating surface.

A pump constructed in accordance with the teachings of this invention is provided with bearing end plates formed as an integral unit to define end plate portions and tubular bearing portions. Since it is customary to pressure load a gear pump at only one end, the bearing end plates at one end of the pump are fixed non-floating elements having all diameters concentric.

The pressure loaded bearing end plates are constructed with sufficient clearance relative to the pump housing to permit limited axial movement and are so constructed that the outside diameter of the tubular portion forming the bearing is eccentrically displaced and offset with respect to the outside diameter of the end plate portion in a direction toward the inlet of the pump.

Gaskets are fitted around the outside diameters of the end plate portions and the eccentrically displaced bearing portions so as to seal off a pressure chamber lying behind the end plates and an appropriate portion of the pump cover abutting the bearing end plates.

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A small passage or relief defined by the bearing end plates is provided to bleed a unit pressure into the pressure chamber of sufficiently high quantitative value to promote uniform loading. Because of the eccentricity of the diameters of the tubular bearing portions, the area of the back side of the end plate portions exposed to the high pressure in the pressure chamber varies in such a manner as to furnish a balanced load, eliminating the couple tending to twist each bearing end plate in its housing. In this manner, full contact between the gears and the end plate portions over an entire mating surface is insured and wear conditions are greatly improved.

The pump structure of the present invention also contemplates the provision of a housing portion formed on the pump body which defines a seal chamber through which the driver may extend. A pressure retaining valve is provided which connects the seal chamber to the inlet port of the pump so as to maintain a predetermined low pressure in the seal chamber.

According to our invention, passageways are also provided through the gears so the same low seal chamber pressure will be maintained in the cover end of the pump and act on the back end of the bearing end plates to eliminate the possibility of a high pressure pocket.

It is, then, an object of this invention to provide a high pressure gear pump structure wherein a properly distributed load will be automatically applied to the back side of a pressure loaded end plate to compensate for pressure developed in the gear chamber of the pump.

Another object of this invention is to provide a high pressure gear pump structure wherein the twisting couple tending to rotate the bearing end plate in its housing is eliminated so as to improve contact between the gears and end plate over an entire mating surface.

A further object of this invention is to provide a high pressure gear pump structure having an improved arrangement of components whereby satisfactory sealing pressure may be maintained throughout the entire pump without the formation of high pressure pockets.

Many other objects, advantages and features, as well as the specific nature 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 drawings, in which—

Figure 1 is a plan view of a high pressure gear pump embodying the principles of our invention;

Figure 2 is an end elevational view of the pump structure shown in Figure 1;

Figure 3 is a cross-sectional view taken on line III—III of Figure 1;

Figure 4 is a cross-sectional view taken on line IV—IV of Figure 3;

Figure 5 is a cross-sectional view taken on line V—V of Figure 3; and

Figure 6 is an enlarged fragmentary cross-sectional view showing certain details of construction of the pump shown in Figure 1.

As shown on the drawings:

As may be seen on Figures 1 and 2, a high pressure gear pump 10 is provided which includes a body 11 and cover 12. The body 11 and the cover 12 are shaped to define suitably apertured flange portions which may be placed in registry with one another and securely assembled by suitable fastening means 13. The cover 12 further defines an inlet 14 and an outlet 15 which are adapted for cooperation with conventional conduit fittings.

Referring now to Figure 3, the body 11 is shown as comprising an integral element such as a casting or the like and is provided with an irregular hollow bore defining a pumping cavity 11a which terminates in a shoulder 11b. The shoulder 11b defines the limit of a

portion of the body 11 which is formed into two adjacent separate bores 11c.

A reduced diameter portion 11d on one end of the body 11 defines a sealing chamber 11e.

The cover 12 is provided with a series of counterbores, one of which being formed to define a portion of the pumping cavity 12a. The pumping cavity 12a terminates in a shoulder 12b which, in turn, bounds a reduced diameter bore 12c. The end portions of the cover 12 are suitably counterbored as at 12d to define a pair of spring recesses.

The present invention contemplates the provision of end plates and bearings which are made in one integral unit and are interposed between the rotors or gears and the pump housing. These integral units will be referred to hereinafter as "bearing end plates."

Since the pressure loading of a high pressure gear pump need only be applied at one end of the pump, a pair of bearing end plates 17 are provided which define end plate portions 17a adapted to be seated in the pumping cavity 11a of the body 11 in abutting relationship to the shoulder 11b. The bearing end plates 17 are further provided with reduced diameter tubular bearing portions 17b which are concentric with the end plate portions 17a and which are adapted to be snugly received in the double bores 11c of the body 11.

On the cover end of the pump, a pair of bearing end plates 18 are provided which define end plate portions 18a adapted to be seated within the pumping cavity formed by the bore 11a of the body and the bore 12a of the cover. The bearing end plates 18 are further provided with eccentrically disposed tubular bearing portions 18b which are offset with respect to the outside diameter of the end plate portions 18a in a direction toward the inlet of the pump. This construction can best be appreciated by reference to Figures 4 and 5 which show the body 11 suitably apertured as at 19 to define an inlet in communication with the inlet 14 defined by the cover 12 and also suitably apertured as at 20 to define an outlet or discharge which is placed in communication with the outlet 15 defined by cover 12.

It may be noted that the bearing end plates 18 are constructed with sufficient clearance relative to the housing provided by the body 11 and cover 12 as to permit a limited axial movement.

Figures 3 and 4 show a figure-eight shaped gasket 21 fitted around the outside diameters of the end plate portions 18a of the bearing end plates 18. A smaller figure-eight shaped gasket 22 is fitted around the eccentrically displaced outside diameters of the tubular bearing portions 18b of the bearing end plates 18. In this manner, a pressure chamber 23 is sealed off behind the end plate portions 18a of the bearing end plates 18 in the locale of the face defined by the shoulder 12b formed in the cover 12.

The pressure chamber 23 is placed in communication with the pump discharge by means of a small passage or relief 24 (Fig. 4) defined by the bearing end plates 18. A unit pressure equal to the discharge pressure developed by the pump may, therefore, be bled through the passage or relief 24 in to the pressure chamber 23.

In order to place an initial load on the bearing end plates 18, a pair of spring retainers 26 apertured as at 26a may be provided to lie in abutting relationship to the tubular bearing portions 18b of the bearing end plates 18. A pair of coil springs 27 may be mounted on the spring retainers 26 and respectively seated in each of the spring recesses 12d formed in the cover 12.

As may be seen on Figures 3 and 5, a driver gear 28 having a plurality of radially spaced teeth 28a is journaled in the bearing end plates 17 and 18 situated in the upper portions of the pump 10 (using the plane of reference of Fig. 3). A driven gear 29 having a plurality of teeth 29a is journaled in the bearing end plates 17 and 18 situated in the lower portion of the pump 10 in the intermeshing relationship with the driver 28.

It will be evident that the eccentricity of the tubular bearing portions 18b of the end plate bearings 18 results in the definition of an irregular exposure area in the chamber 23 by the end plate portions 18a of the bearing end plates 18. This area is figure-eight shaped as shown in Figure 4, but increases in width from the inlet to the outlet sides of the pump. Since fluid pressure in the pressure chamber 23 is exerted equally in all directions, the irregular exposure area of the exposed face in the chamber 23 will result in a balancing of pressures on opposite sides of the plate. Any twisting couple tending to twist the end plate portions 18a in the housing will be eliminated, thereby providing for full contact between the mating surfaces lying between the gears and the end plate portions associated therewith.

The gears 28 and 29 have hollow bores 28b and 29b, respectively. The hollow bore 28b is internally splined along a portion of its length as at 28c. A driver 30 splined as at 30a is drivingly keyed to the driver gear 28 at the locale of the splined bore 28c and extends outwardly from the driver gear 28 through the sealing chamber 11e formed in the body 11.

The driver 30 is provided with an enlarged diameter portion 30b which defines a seal face and is adapted to lie within the confines of the sealing chamber 11e. The enlarged diameter portion 30b terminates in a shaft flange 30c which is so shaped as to define an arcuate face of predetermined spherical radius. The end of the driver 30 may be suitably splined as at 30d for connection to conventional driving means.

A substantially cylindrical flange seal housing 31 provided with an inwardly extending annular shoulder 31a is seated within the sealing chamber 11e. The shoulder 31a may be provided with a suitable circumferential slot to receive an O-ring type gasket 32 cooperatively engageable with the walls of the sealing chamber 11e.

A thrust ring 33 concaved on one face thereof for cooperative bearing engagement with the arcuate face of the shaft flange 30c of the driver 30 is positioned within the bore defined by the seal housing 31 and a seal cover 34 defining a shaft aperture 34a is placed in abutting relationship to the thrust ring 33 to enclose the end of the pump 10.

A conventional seal assembly may be provided for the pump structure 10 to cooperate with the sealing face presented by enlarged portion 30b of the driver 30 and includes a ring of packing material 36 shaped to define an annular abutment 36a engageable with flat shoulder portion of the shaft flange 30c. An O-ring type gasket 37 is carried by the ring 36 for cooperative sealing engagement with the bore defined by the seal housing 31. An annular cup ring 38 housing resilient means such as springs 39 is arranged to abut the shoulder 31a and spring press the ring 36 through a retainer 40 against the shaft flange 30c.

Referring particularly to Figures 4 and 6, it will be noted that the body 11 defines a bore or an aperture 41 which may be suitably threaded and which extends between the seal chamber 11e and the inlet side of the pump.

A valve including an externally and internally threaded sleeve 42, a set screw 43, a spring 44 and a ball 46 is mounted within the bore or aperture 41 and may be adjusted to respond to a predetermined pressure value so as to maintain a low pressure in the seal chamber 11e.

The low pressure maintained in the seal chamber 11e by means of the pressure relief valve may likewise be maintained on the back end of the bearing end plates 18 in the locale of the spring recesses 12d formed in the cover 12 by virtue of the passageways defined by the internal bore 29b of the gear 29 and the apertures 26a of the spring retainers 26. Thus, the possibility of a high pressure pocket forming in the locale adjacent the back end of the bearing end plates 18 is eliminated.

It will be evident to those versed in the art that we have described a high pressure gear pump structure affording

improved resistance to wear, friction, and leakage by providing pressure balanced end plates with exposed areas which increase in extent from the inlet to the outlet sides of the pump, and which provides for improved pressure distribution throughout the pump to eliminate the formation of undesirable high pressure pockets.

It is contemplated that various modifications to the preferred embodiment herein shown and described by way of illustrative example only may be suggested to those versed in the art and it should be understood, therefore, that we do not propose to be specifically limited to the specific pump structure herein disclosed, but desire to embrace all structures as reasonably come within the spirit and scope of our contribution to the art.

We claim as our invention:

A high pressure gear pump comprising, in combination, a body and a cover forming a pumping chamber and having an inlet and an outlet communicating therewith, a driver and a driven gear housed in said pumping chamber, pressure-loaded bearing end plates in said chamber, one plate for each gear, each of said end plates having an end plate portion with a front sealing surface and a rear motive surface and each of said end plates having a tubular bearing portion eccentrically aligned relative to the end plate portion thereof towards a pump inlet to provide a graduated area on said rear motive surface increasing in size from the inlet to the outlet side thereof, spring loading means between said cover and said pressure-loaded end plates to pre-load said end plates, said pressure-loaded end plates and said cover arranged in

spaced alignment to provide a pressure chamber behind said end plate portions, a passage formed in and extending through said end plate portion of each of said bearing end plates and intersecting said front sealing surface on the outlet side of said pump and intersecting said graduated area of said rear motive surface at the wider dimensions thereof, thereby to maintain pump generated discharge pressure on said rear motive surface, and gasket means in said cover member around the end plate portions and the bearing portions of a pair of said pressure-loaded end plates for a corresponding driver and driven gear to seal the fluid in the pressure chamber.

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