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LE ROY A. DIFFORD
THREE-GEAR PUMP WITH MOVABLE ELEMENTS HAVING
PLURALITY OF SEALING FORCES

3,427,985

Filed Aug. 9, 1967

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FIG. 1

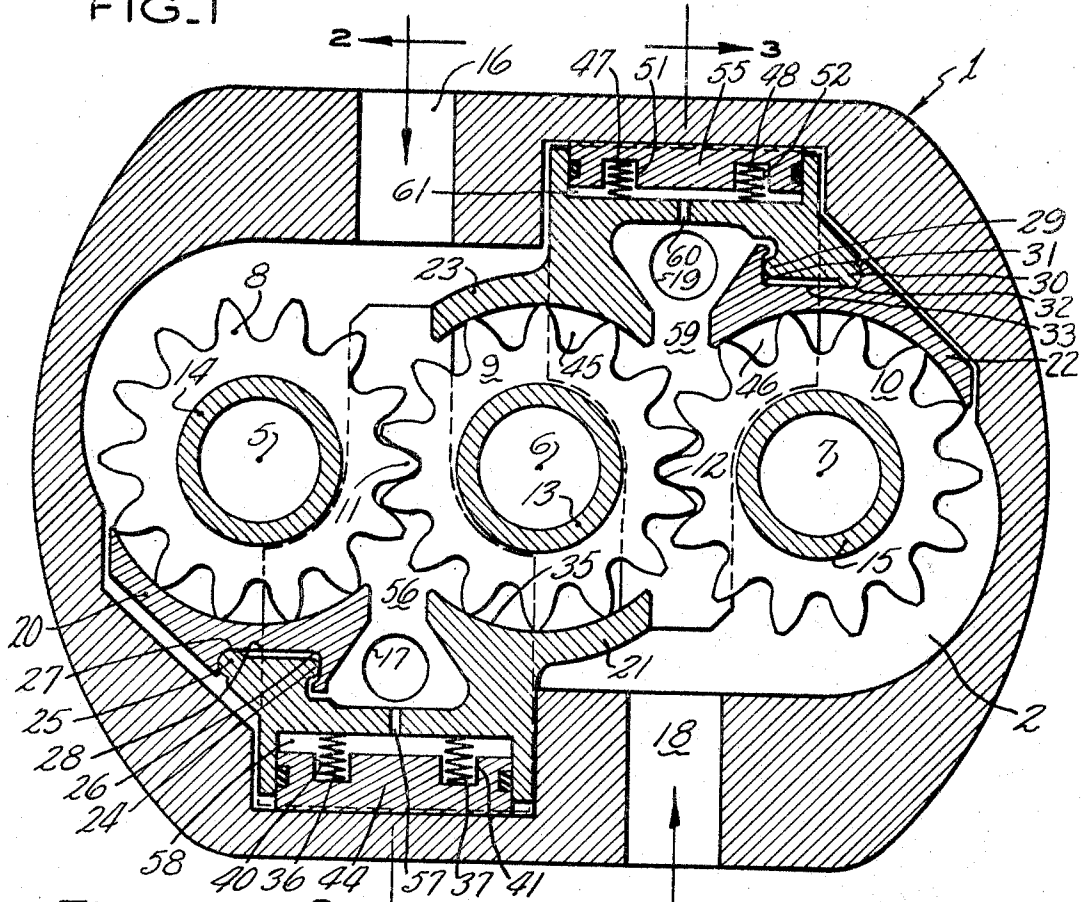


FIG. 2

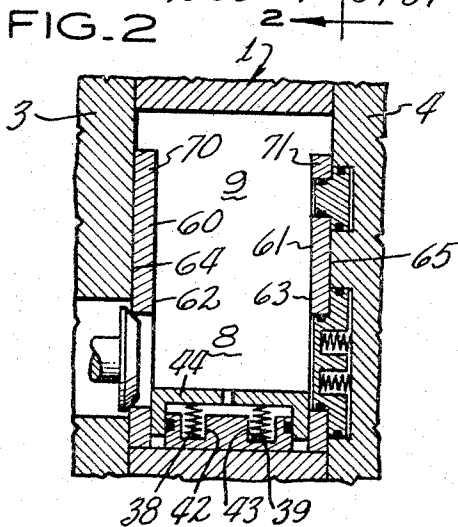
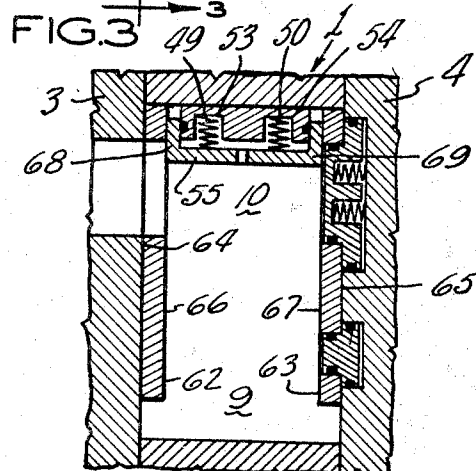


FIG. 3



INVENTOR
LEROY A. DIFFORD
BY Radford W. Luther
ATTORNEY

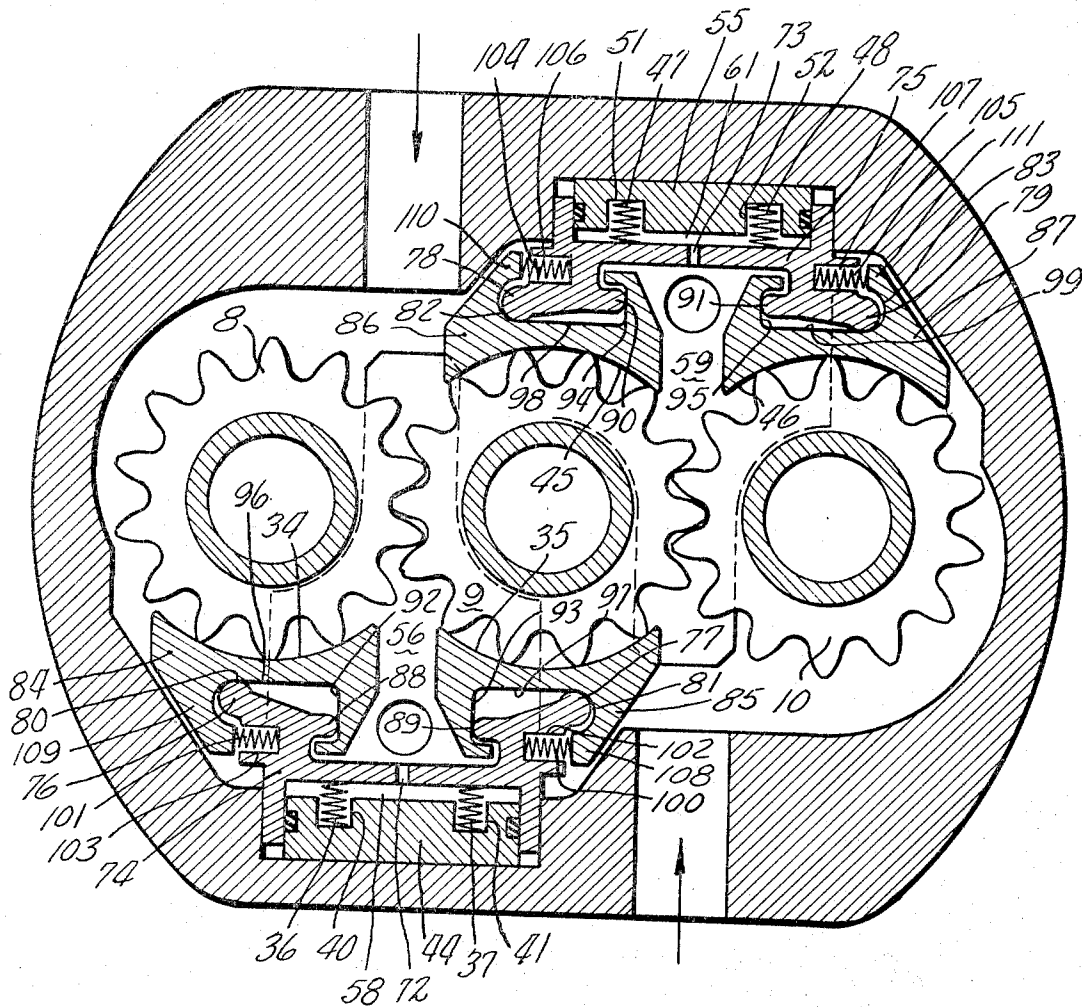
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FIG. 4



INVENTOR
LEROY A. DIFFORD
BY Radford W. Luther
ATTORNEY

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THREE-GEAR PUMP WITH MOVABLE ELEMENTS HAVING PLURALITY OF SEALING FORCES

Le Roy A. Difford, Simsbury, Conn., assignor to Chandler
Evans, Inc., West Hartford, Conn., a corporation of
Delaware

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12 Claims

ABSTRACT OF THE DISCLOSURE

A gear pump for pumping fluids containing highly abrasive contaminants having a center gear and two outer gears intermeshing with the center gear, separate pivotable movable elements positioned adjacent each pump outlet and engaging each of the outer gears, with pivotable element subject to a plurality of forces, one of said forces applied outboard the pivot point of each element such that each element is self-positioned with respect to its mating gear during independent movement of each of the outer gears and each element engages the periphery of its mating gear to maintain peripheral sealing engagement of the outboard extremity of each element under all pump operating conditions.

Background of the invention

This invention pertains to gear pumps utilized to pump a fluid containing highly abrasive contaminants wherein the pump comprises a housing with three intermeshing gears disposed therein. The three interengaging gears are arranged in a manner such that one gear, hereinafter called the intermediate or center gear, meshes with the other two gears. The center gear has substantially equal and opposite forces acting upon it; hence the hydraulic forces do not bias said center gear against any particular part of the center gear bearing journal interface. This invention further pertains to a three-gear pump wherein separate movable elements adjacent each pump outlet engage the periphery of each outer gear in a one-to-one relationship to maintain continuous peripheral sealing engagement during independent movement of the outer gears. The construction of a gear pump having separate movable elements that trackably engage the periphery of independently movable gears is described in U.S. Patent application of inventors Noell, Cygnor and Sundberg entitled "Gear Pump" filed on even date herewith and assigned to the same assignee as the instant application. Reference may be had to said application for detailed description and explanation of the construction and operation of a gear pump having independently movable gears with separate pivotable movable elements urged into engagement with the periphery of each independently movable gear to maintain continuous peripheral sealing engagement during independent movement of the gears.

It was found during certain pump operating conditions that pivotable movable elements constructed in accordance with the teachings of the aforementioned Noell, Cygnor and Sundberg invention may be cyclically lifted several thousands of an inch on the outboard extremity at a point where the gear teeth enter the movable element thereby resulting in a marked decrease in volumetric efficiency. The cyclic lifting phenomenon experienced by the outer extremity of the pivotable movable element is described in U.S. Patent Application of Inventors Godwin Noell and LeRoy A. Difford entitled "Gear Pump With Movable Elements Having a Plurality of Sealing Forces" filed on even date herewith and assigned to the same assignee as the instant application.

Reference may be had to said Noell-Difford application

for a detailed description and explanation of the cyclic lifting phenomenon and the construction and operation of a gear pump having various species of pivotably movable elements provided with an independent load outboard of the pivot contact point to control the forces tending to lift the outer extremity of the pivotable movable element from engagement with the mating periphery of the gear teeth.

The aforementioned construction relates to two gear pumps wherein the loads imposed upon the gear shaft bearings by the hydraulic pressure unbalance cause the bearing journal interface of both gears to wear, thus causing both gears to move apart. Similarly, the structure utilized to correct the cyclic lifting phenomenon relates to a two-gear pump wherein both gears are subject to force unbalances that cause journal bearing interface wear on both gears and thus cause the two gears to move apart.

In the case of the instant pump employing three gears, the forces acting upon the intermediate or center gear are substantially equal and opposite so that the center gear is not biased against any particular part of the gear bearing journal interface. Since the forces acting upon the center gear are substantially equal and opposite, the pressure balanced center gear does not tend to move from its initial location and therefore does not require a pivotable movable element to compensate for wear movement of this center gear.

It is apparent that a structure such as shown in FIGURE 1 provides an organization wherein a pivotable movable element provides continuous peripheral sealing engagement with each independently movable outer gear subject to movement due to wear of the gear bearing journal interface while that portion of the pivotable movable element engaging the periphery of the load balanced center gear is structurally integral with the common discharge pressure responsive load producing portion of the complete pivotable movable sealing means. This integral structural relationship is utilized to counteract the cyclic forces tending to pivotably lift the outer extremity of that portion of the element in peripheral sealing engagement with the center gear.

It has been found that the portion of the movable peripheral sealing means in engagement with the pressure balanced center gear is subjected to load fluctuations that can cause failure of that portion of the structure connecting the arcuate wiping face with the common loading portion of the structure; accordingly an alternate structure is provided whereby a separate pivotable element engages the periphery of the force balanced center gear. However, whatever form of separate pivotable element is used, a second independent force applied outboard of the pivot sealing point must be applied to each pivotable element to prevent the lifting of the outer extremity of the pivotable movable element.

It has been found that a structure utilizing a spaced apart pivot and force protuberances to provide a second independent point of force application through said force protuberance while maintaining a separate pivot sealing point provides a simplified configuration that is characterized by a movable peripheral sealing means utilizing no other pivotable element loading means other than the single discharge pressure responsive loading member.

Summary of the invention

This invention pertains to a three-gear pump that is capable of pumping fluids containing highly abrasive contaminants and continues to maintain high volumetric efficiency after the pump has run for a protracted period of time. According to the invention, the gear pump of the kind specified is characterized by three gears arranged

in a manner such that one gear meshes with the other two gears. The gear meshing with the other two gears is called the central or intermediate gear and has substantially equal and opposite forces acting upon it so that it is not biased against any particular portion of the bearing journal interface and subsequently is not subject to gear bearing journal interface wear. To continue to maintain high volumetric efficiency for a protracted period of time when the pump is operated utilizing a fluid containing a highly abrasive contaminant, the gear pump specified by this invention provides a separate pivotable movable sealing element positioned adjacent each pump outlet. One of the elements engages the periphery of at least two teeth of each outer gear and the other element engages the periphery of at least two teeth of the center gear with both elements independently loaded by discharge pressure and mechanical biasing means to thereby generate at least two independent vectored forces applied to each element that continually position each element into peripheral tooth sealing engagement.

Accordingly, it is an object of the present invention to provide an improved three-gear pump having pivotably movable elements adjacent each pump outlet that will maintain maximum volumetric efficiency despite the excessive wear that would ordinarily result to peripheral engaging surfaces when pumping contaminating fluids containing highly abrasive contaminants.

Another object of this invention is to provide a three-gear type pump wherein separate pivotably movable elements are positioned adjacent each pump outlet and each pivotable movable element is held in peripheral sealing engagement with the periphery of one of the outer gears respectively by an independent force applied to each element outboard of the point of pivotable sealing engagement.

Another object of this invention is to provide a three-gear pump wherein separate pivotably movable elements are positioned adjacent each pump outlet and each element is held in peripheral sealing engagement with the periphery of each of the outer gears respectively and opposite peripheral surfaces of the inner gear respectively by the application of an independent force to each element outboard of the point of pivotable sealing engagement.

Another object of this invention is to provide a three-gear pump having separate pivotably movable elements for each outer gear and the opposite peripheral surfaces of said inner gear located adjacent the pump outlet with each pivotable movable element being so configured that two independent means for applying a force to each element are provided such that one force acts through the pivot contact protuberance which also acts as the high pressure sealing surface, and a second force is applied outboard of the sealing point to thereby expose the minimum portion of the wear block to discharge pressure and simultaneously provide a loading configuration that will maintain the outboard extremity of each of the pivotable movable elements in continuous sealing engagement with the periphery of the mating gear teeth of the outboard gears and the opposite surfaces of the inner gear respectively under all conditions of operation.

Many other advantages and features of the invention will become manifest to those well versed in the art upon making reference to the description which follows.

Description of the drawings

FIGURE 1 is a cross-section of a three-gear pump having a pivotable movable peripheral sealing assembly positioned adjacent each pump outlet.

FIGURE 2 is a sectional view along the line 2—2.

FIGURE 3 is a sectional view along the line 3—3.

FIGURE 4 is a cross-section in accord with this invention showing a first alternate form of movable peripheral sealing assembly.

Referring now to the drawings and generally to all of

the forms shown in the following description, like parts are designated throughout by like numerals.

Referring to the example shown in FIGURES 1, 2 and 3, there is provided a pump having a housing 1 defining therein a cavity 2 and a pair of end plates 3 and 4 positioned on opposite sides of housing 1 and secured in fluid tight relation to said housing by a plurality of bolts (not shown). Rotatably mounted about axes of rotation 5, 6 and 7 in cavity 2 in housing 1 are three gears 8, 9 and 10, the center gear 9 intermeshing with the two outer gears 8 and 10 and engaging said outer gears at an area of intermesh indicated generally at 11 and 12. Shaft 13 is rigidly secured to gear 9 by means well known in the art. Shaft 13 drives gear 9 through a source of motive power (not shown) secured to shaft 13. Shaft 14 is secured to gear 8 and shaft 15 is secured to gear 10 such that shaft 14 and gear 8 and shaft 15 and gear 10 respectively rotate in unison responsive to rotative movement of driver gear 9. Shafts 13, 14 and 15 are journaled in bearings (not shown) by means well known in the art with a close running fit such that axes of rotation 5, 6 and 7 are maintained substantially parallel. Gears 8 and 9 are disposed in cavity 2 such that an inlet 16 is formed on one side of intermesh 11, and an outlet 17 is formed on the opposite side of intermesh 11. Similarly, gears 9 and 10 are disposed in cavity 2 such that an inlet 18 is formed on one side of intermesh 12, and an outlet 19 is formed on the opposite side of intermesh 12. The center gear 9 and the outer gears 8 and 10 intermeshing therewith are so arranged that they comprise rotary fluid displacement means that will operate to move the fluid medium acted upon by the center gear and the two outer gears intermeshing therewith from the inlet 16 to the outlet 17 and the inlet 18 to the outlet 19 simultaneously. It is to be understood that inlets 16 and 18 and outlets 17 and 19 can be so interconnected as to provide a single inlet supply conduit to the separate inlets 16 and 18 and similarly manifold outlets 17 and 19 to provide a single outlet conduit.

As is clearly indicated in FIGURE 1, the outer diameter of the gears 8, 9 and 10 at the tips or periphery of the gear teeth are disposed in relation to the peripheral wall of cavity 2 adjacent each pump outlet so that there is a pronounced clearance between the periphery of each of the gear teeth and adjacent the cavity wall. This clearance is provided to reduce the possibility of cavitation at the pump inlet when the pump is operated at high speed. In order to provide peripheral tooth sealing adjacent the pump outlets 17 and 19, there is provided in accordance with the teachings of this invention a novel movable peripheral sealing means engaging the periphery of each outer gear and the center gear respectively adjacent each pump outlet. In this particular embodiment the movable sealing means takes the form of first and second movable elements 20 and 21 respectively positioned on opposite sides of outlet 17, and movable elements 22 and 23 positioned on opposite sides of outlet 19. Movable element 21 is provided with spaced apart elongated protuberances 24 and 25 that engage mating surfaces 26 and 27 of recess 28 of pivotable movable element 20. Similarly, movable element 23 contains spaced apart elongated protuberances 29 and 30 that engage mating surfaces 31 and 32 of recess 33 of pivotable element 22. Peripheral sealing elements 20 and 21 are continuously urged into peripheral sealing engagement with at least two teeth in the areas 34 and 35 of gears 8 and 9 respectively by springs 36, 37, 38 and 39 received by mating depressions 40, 41, 42 and 43 respectively of sealing spacer 44. Similarly, peripheral sealing elements 22 and 23 are continuously urged into peripheral sealing engagement with at least two teeth in the areas 45 and 46 of gears 9 and 10 respectively by springs 47, 48, 49 and 50 received by depressions 51, 52, 53 and 54 respectively of sealing spacer 55. Discharge pressure is communicated from discharge chamber 56 via interconnecting passageway 57 to

variable volume chamber 58 to provide a discharge pressure responsive force supplemental to that provided by springs 36, 37, 38 and 39. Similarly, discharge pressure is communicated from discharge chamber 59 via interconnecting passageway 60 to variable chamber 61 to provide a discharge pressure responsive force supplemental to that provided by springs 47, 48, 49 and 50. Said pressure responsive and spring forces are combined to generate a single force for each organization that is communicated through protuberances 25 and 30 respectively to abutting surfaces 27 and 32 of recesses 28 and 33 respectively. Said forces are then transmitted from surfaces 27 and 32 of pivotable movable elements 20 and 22 respectively to thereby generate moments about pivots 26 and 30 such that the outer extremities of pivotable movable elements 20 and 22 are maintained in continuous sealing engagement with the periphery of their mating gears 8 and 10 respectively. Discharge pressure in chambers 56 and 59 is applied to the inboard surface of pivotable movable elements 20 and 22 from the point of sealing contact with pivots 24 and 29 to the point of peripheral engagement with the teeth of gears 8 and 10 respectively. Discharge pressure is applied to the above-described area of pivotable movable elements 20 and 22 to produce a second moment about pivot points 20 and 24 respectively, said second moments being sufficient to overcome the moments produced by the discharge pressure acting to separate the periphery of the gear teeth and the mating wiping surface of each pivotable movable element. The discharge pressure acting on the inboard surface of elements 20 and 22 also produces a force acting through movable elements 20 and 22 to provide a fluid tight line contact sealing engagement between pivots 24 and 29 and mating abutting surfaces 26 and 31 respectively.

Side members 60 and 61 are positioned intermediate the lateral faces 62, 63, 70 and 71 of gears 8 and 9 respectively and the side surfaces 64 and 65 of end plates 3 and 4 respectively. Similarly, side members 66 and 67 are positioned intermediate the lateral faces 62, 63, 68 and 69 of gears 9 and 10 respectively and the side surfaces 64 and 65 of end plates 3 and 4 respectively. Fluid at discharge pressure is directed to the area intermediate the outboard surfaces of the side members 60, 61, 66 and 67 and the adjacent side surfaces of end plates 3 and 4 respectively such that side plates 60, 61, 66 and 67 are urged into sealing engagement with the lateral faces of gears 8, 9 and 10 respectively to form discharge pockets 56 and 59 bounded by the intermesh 11 of the gear teeth of gears 8 and 9, the intermesh 12 of the gear teeth 9 and 10, peripheral sealing contact 34 and 35 and 45 and 46 respectively. It has been found that the peripheral sealing between the periphery of the gear teeth and the mating arcuate surfaces of elements 20, 21, 22 and 23 is the critical leakage path with respect to the operation of a three-gear pump when pumping a fluid medium containing highly abrasive contaminants. This critical peripheral sealing engagement is represented by areas 34, 35, 45 and 46 of FIGURE 1. Accordingly, it is to be understood that the embodiment shown utilizing the four side plates 60, 61, 66 and 67 is representative of but one form of providing the fluidly sealing discharge pockets 56 and 59. It has been found that any form of loaded side plate that will urge the lateral surfaces of the gears and the end surfaces of the movable elements into fluid sealing engagement with the corresponding mating surfaces of the side plates so as to form the fluid sealed discharge pockets 56 and 59 will perform satisfactorily when pumping highly abrasive contaminated fluids. Accordingly, side plate mechanisms having surfaces in contact with 100% of the lateral surfaces of the pump gear, as exemplified by Roth, Patent No. 2,420,622; intermediate housing pressure loading, as exemplified by Gordon, Patent No. 3,292,550; selective side plate loading, as exemplified by Banker, Patent No. 2,742,862; or free floating side plates, as exemplified by Trautman, Patent No. 2,996,999, may all be used with equally satisfactory results so long as the side plate or

plates urge the opposite lateral surfaces of the gears and the end surfaces of the movable elements into sealing engagement with the side plates or the mating surfaces of the end plates such that fluidly sealable discharge pockets 56 and 59 are formed.

It is to be understood in the case of a three-gear pump the forces acting upon the center gear 9 are substantially equal and opposite so that the center gear is not biased against any particular part of the gear bearing journal interface. Accordingly, the movable elements 21 and 23 are moved into peripheral sealing engagement with opposed sectors of the periphery of gear 9 by a single vectored force through each of elements 21 and 23 to maintain said elements 20 and 23 in peripheral sealing engagement with gear 9. Since the arcuate portion of elements 21 and 23 that engage the periphery of gear 9 are a structurally integral part of that portion of element 21 that produces the discharge pressure responsive load communicated to pivotable elements 20 and 22 respectively, the outer extremities of elements 21 and 23 do not tend to cyclically lift out of engagement with the peripheral sealing portion of gear 9.

FIGURE 4 shows an alternate movable peripheral sealing means for obtaining the necessary continuous peripheral tooth sealing engagement adjacent each pump outlet and simultaneously permitting independent movement of the arcuate portion of the elements sealingly engaging the periphery of the center gear 9. The alternate construction shown in FIGURE 4 discloses an arrangement wherein discharge pressure is communicated via passageways 72 and 73 from discharge chambers 56 and 59 respectively to variable volume areas 58 and 61 of movable loading elements 74 and 75 to thereby generate a force that is communicated to pivotable protuberances 76, 77, 78 and 79 to abutting surfaces 80, 81, 82 and 83 respectively. Said force is then transmitted from surfaces 80, 81, 82 and 83 of pivotable movable elements 84, 85, 86 and 87 respectively to thereby urge elements 84, 85, 86 and 87 into peripheral sealing engagement with gears 8, 9 and 10 respectively. Said loading means 74 and 75 have elongated pivots 88, 89, 90 and 91, said elongated pivots being spaced apart with pivotable protuberances 76, 77, 78 and 79 respectively and engaging abutting surfaces 92, 93, 94 and 95 of recesses 96, 97, 98 and 99 respectively. Pivotable sealing elements 84, 85, 86 and 87 are continuously urged into peripheral sealing engagement in areas 34, 35, 45 and 46 of gears 8, 9 and 10 respectively by springs 36, 37, 47 and 48 received in depressions 40, 41, 51 and 52 of spacers 44 and 55 respectively. The force provided by said springs is supplemental to the pressure responsive force of variable volume chambers 58 and 61. Said pressure responsive and spring forces are combined to produce a single force for each organization that is transmitted through load points 76, 77, 78 and 79 to abutting surfaces 80, 81, 82 and 83 to thus generate first vectored forces through elements 84, 85, 86 and 87 that are continuously positioned in substantial proximity to axes of rotation 5, 6 and 7 respectively. Springs 100 and 101 are received in cavities 102 and 103 of loading element 74. Similarly, springs 104 and 105 are received in cavities 106 and 107 of loading element 75. Said springs 100 and 101 engage elongated protuberances 108 and 109 of elements 85 and 84 respectively such that second independent moments are generated about pivots 89 and 88 and abutting surfaces 93 and 92 to maintain the outer extremities of movable elements 85 and 84 in continuous sealing engagement with the periphery of mating gear teeth of gears 9 and 8. Similarly, springs 104 and 105 engage elongated protuberances 110 and 111 of elements 86 and 87 respectively such that second independent moments are generated about pivots 90 and 91 and abutting surfaces 94 and 95 to maintain the outer extremities of movable elements 86 and 87 in continuous sealing engagement with the periphery of the mating gear teeth of gears 10 and 9 respectively.

What I claim is:

1. A gear pump comprising a housing having a pumping cavity and a closure at each end, said pumping cavity having at least two inlets and two outlets, three intermeshing gears including an intermediate and two outer gears rotatably disposed in said cavity, said housing being provided with a plurality of journaling means for each of said gears such that the respective axes of rotation of all of said gears are substantially parallel and located in a plane passing through the axes of the two outer gears, a plurality of movable peripheral tooth sealing means, at least one side plate axially urged into engagement with the lateral faces of said gears such that said housing, gears, movable peripheral sealing means and side plate sealingly enclose a plurality of high pressure chambers, each of said movable peripheral sealing means having a first movable element engaging the periphery of said intermediate gear, a second element engaging the periphery of an outer gear and pivotably engaging said first movable element, said first element responsive to discharge pressure loading both said first element and said second element toward said gears to produce a stable peripheral tooth sealing engagement adjacent each of said pump outlets.

2. A gear pump for pumping highly abrasive liquids comprising a casing having a closure at each end and three intersecting bores having parallel axes, rotary gear fluid displacement means including a center gear and two outer gears disposed in said bores, said gears having an intermesh at each intersection of said bores, means providing an inlet on one side of each intermesh and an outlet on the opposite side of each intermesh, movable peripheral sealing means positioned adjacent each outlet, at least one side plate urged into engagement with the lateral surfaces of said gears such that said housing, gears, movable sealing means and side plate sealingly enclose a plurality of high pressure discharge chambers, each of said movable peripheral sealing means having a first member engaging the periphery of said center gear, a second member pivotably contacting said first member and engaging the periphery of one of said outer gears, said first member responsive to discharge pressure moving both said first and second members toward said gears to produce a stable peripheral tooth sealing engagement adjacent each of said pump outlets.

3. A gear pump as defined in claim 1, wherein said movable gear periphery sealing means is continuously urged by spring means toward said gears for peripheral sealing engagement therewith.

4. A gear pump as defined in claim 3, wherein said first member has spaced apart pivot and loading protuberances engaging the surfaces of a recess in said second member such that a moment is formed through said loading protuberance about said pivot, and said first member responsive to discharge pressure coacts with said pivotable second member to produce a moment through said loading protuberance about said pivot and simultaneously move said first and second members into peripheral sealing engagement with said center and said outer gears respectively.

5. A gear pump as defined in claim 4, wherein discharge pressure urges said pivotable second member into pivotable engagement with said pivot protuberance with sufficient force to produce a line contact high pressure fluid seal between said pivot protuberance and the engaging surface of said pivotable second member.

6. A gear pump comprising, a housing having a plurality of parallel cylindrical intersecting bores and opposed end closures, a train of spur gears including a center gear and two outer gears, each of said gears having integral stub shafts extending therefrom and an axis of rotation, said gears disposed in said bores and journaled in said housing such that said axes of rotation are positioned parallel to each other, said gears having an intermesh at each intersection of said bores, means providing an inlet

on one side of each intermesh and an outlet in one of said end closures on the opposite side of each intermesh, movable peripheral sealing means positioned adjacent each outlet, a pair of pressure loaded side plates urged into engagement with the lateral surfaces of said gears, and said movable peripheral sealing means to sealingly enclose a plurality of high pressure discharge chambers, one of said outlets fluidly connected to each of said discharge chambers, each of said peripheral sealing means having a first member engaging the periphery of said center gear, a second member pivotably contacting said first member and engaging the periphery of one of said outer gears, said first member responsive to discharge pressure moving both said first and said second members toward said gears to produce a stable peripheral tooth sealing engagement adjacent each of said pump outlets.

7. A gear pump as defined in claim 6, wherein said first movable member has spaced apart pivot and loading protuberances engaging abutting surfaces of a recess in said second pivotable member such that a moment is formed through said loading protuberance about said pivot, said first member responsive to discharge pressure coacts with said pivotable second member to produce said moment through said loading protuberance about said pivot and said pivotable second member responsive to discharge pressure is urged into pivotable engagement with said pivot protuberance with sufficient force to produce a line contact fluid seal between said pivot protuberance and the mating surface of said pivotable second member.

8. A gear pump as defined in claim 7, wherein said side plates sealingly engage the lateral faces of said first and said second members outboard of said pivot protuberance line contact fluid seal and inboard of said load protuberance engagement with said pivotable second member.

9. A gear pump comprising a housing having a pumping cavity and opposed end closures, three intermeshing gears including an intermediate and two outer gears disposed in said cavity and journaled in said housing such that the axes of rotation of all of said gears are positioned parallel to each other, an intermesh between said intermediate gear and each of said outer gears, an inlet on one side of each intermesh and an outlet on the opposite side of each intermesh, movable peripheral sealing means positioned adjacent each outlet, at least one side plate urged into engagement with the lateral surfaces of said gears such that said housing, gears, movable sealing means and side plate sealingly enclose a plurality of high pressure discharge chambers, each of said movable peripheral sealing means having a loading member, a first member engaging the periphery of said intermediate gear and pivotably engaging said loading member, a second member engaging the periphery of one of said outer gears and pivotably engaging said loading member, said loading member responsive to discharge pressure moving both said first and second members toward said gears to produce a stable peripheral tooth sealing engagement adjacent each of said pump outlets.

10. A gear pump as defined in claim 9, wherein said loading member has a plurality of spaced apart pivot and loading protuberances engaging the respective surfaces of recesses in said first and second members such that responsive to discharge pressure said loading member coacts to form a moment through said loading protuberances about said pivots in said first and second members respectively, and simultaneously move said first and second members into peripheral sealing engagement with said center and outer gears respectively.

11. A gear pump as defined in claim 10, wherein each of said loading members contains at least two opposed cavities positioned on opposite sides of each of said outlets, resilient means received by each of said cavities and coacting with said first and second pivotable members respectively to continuously produce a moment through

each of said first and second members about said pivots, and resilient means positioned intermediate each of said loading members and said housing thereby generating a second force through said loading members urging each of said first and second pivotable members toward said center gear and said outer gears respectively.

12. A gear pump comprising a housing having a pumping chamber, three intermeshing gears including an intermediate and two outer gears supported on substantially parallel axes of rotation in said chamber, a plurality of movable peripheral tooth sealing means, at least one sideplate axially urged into engagement with the lateral faces of said gears and said peripheral sealing means to sealingly divide said chamber into at least two high pressure portions and two low pressure portions, each of said peripheral sealing means including a first element engaging the periphery of said intermediate gear, a second element engaging the periphery of an outer gear and loading means independent of pressure continuously forcing the entire arcuate surfaces of each of said first

elements and each of said second elements into peripheral tooth sealing engagement.

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