April 8, 1969 G. L. NOELL ET AL 3,437,048

GEAR PUMP

Filed Aug. 9, 1967

FIG. 1

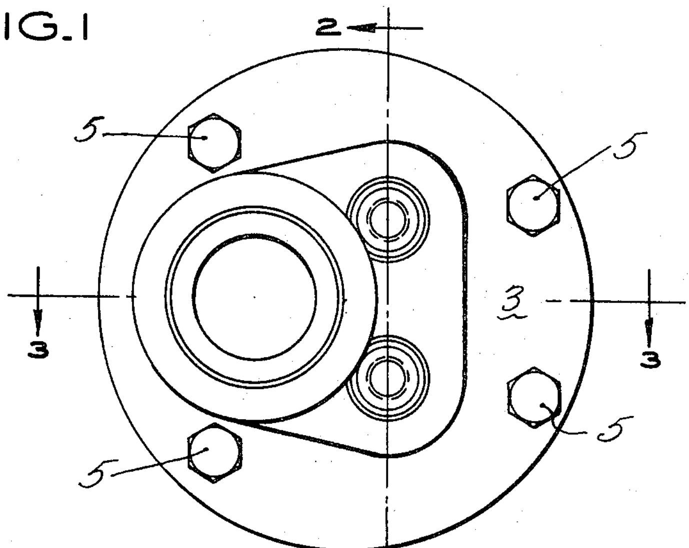

FIG. 2

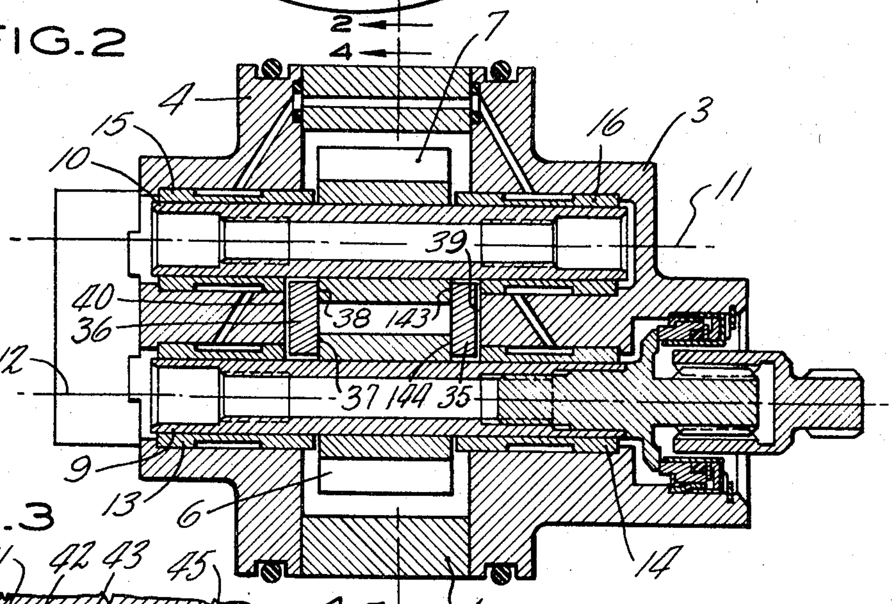

FIG. 3

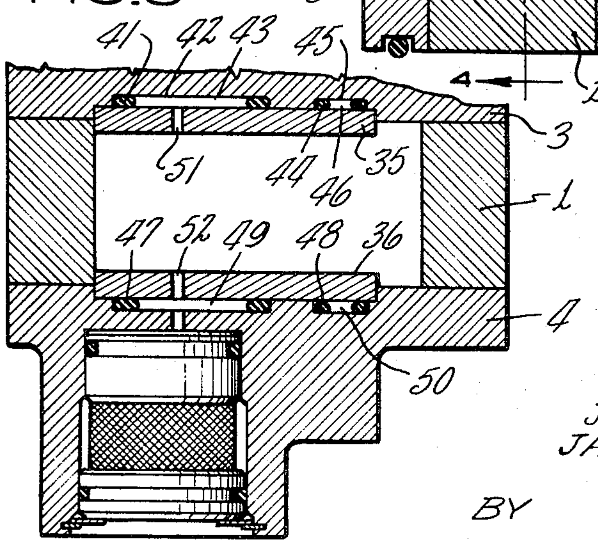

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FIG. 4

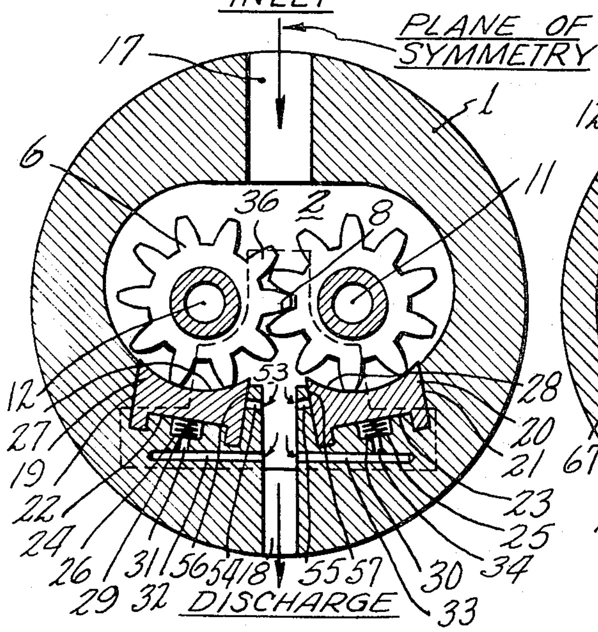

FIG. 5

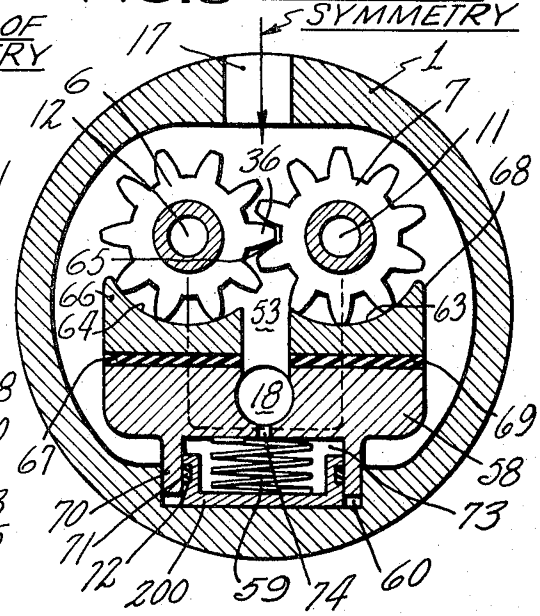

FIG. 6

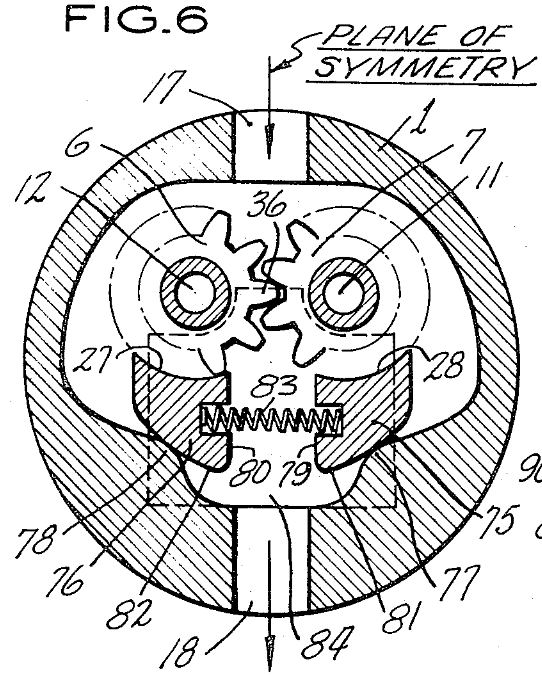

FIG. 7

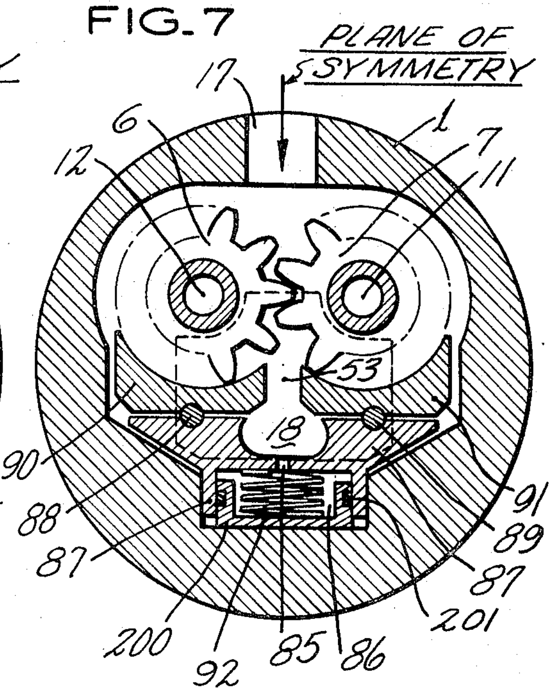

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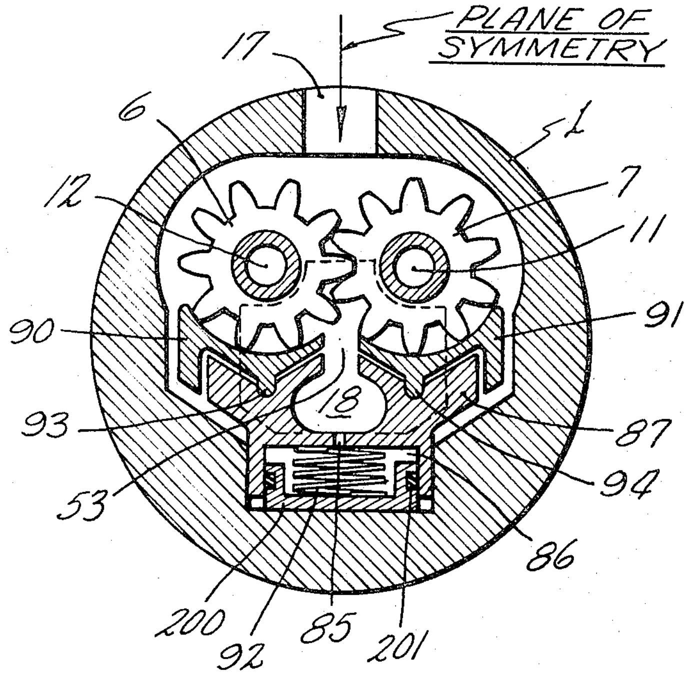
FIG. 8



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GEAR PUMP

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ABSTRACT OF THE DISCLOSURE

A gear pump having a driver gear and a driven gear capable of pumping fluids containing highly abrasive contaminants. Separate movable elements engaging the periphery of the driver gear and driven gear respectively adjacent the pump discharge such that each element is self-positioned with respect to its respective gear to apply continuous peripherial sealing engagement during independent movement of the gears.

Background of the invention

This invention pertains to gear pumps of the kind comprising a housing, a pair of meshed tooth gears mounted for rotation in the housing, an inlet port in the housing at one side of the point of interengagement of the teeth of said gears and an outlet in the housing at the other side of said point of intermesh, wherein the gear pump can be utilized to pump a fluid containing highly abrasive contaminants.

When the inlet port of a gear pump containing an intermeshing driven gear and a driver gear is connected to a source of liquid, rotation of the gears in one direction will cause the liquid to be drawn through the inlet port into the hosuing and carried around in the pocket between adjacent teeth of both gears and the housing before discharge through the outlet port. The liquid is drawn into the housing due to the increasing free space between the housing adjacent the inlet port as the teeth of the two gears move out of engagement, and is discharged due to the decreasing free space within the housing adjacent the outlet port as the teeth move into engagement, inlet and outlet ports being substantially isolated from one another by the small clearances between the teeth of the gears and the housing.

The volumetric efficiency of such a gear pump depends upon the closeness of the fit between the tips of the gear teeth and the enclosing housing. When such a gear pump is utilized to pump a fluid containing a highly abrasive contaminant, the clearance between the tips of the gear teeth and the surrounding housing rapidly becomes enlarged and the pump volumetric efficiency falls off.

One well known method of providing a solution to this problem of rapid high wear is to insert a wear block in the pump housing adjacent the pump outlet. This wear block is urged by discharge pressure into engagement with the periphery of the gear teeth adjacent the pump discharge area. The wear block and the gear teeth are made of an extremely hard wear resistant material, such as tungsten carbide. The peripherial engagement of the gear teeth and the mating wiping surfaces of the wear block present an extremely durable surface that can withstand the highly abrasive action of the contaminated fluid.

It is well known that the conventional construction of gear pumps produces an area of high pressure adjacent the pump outlet and an area of low pressure adjacent the pump inlet. This variation in hydraulic pressure is applied against the gear periphery resulting in a vectored load on the gear shaft bearings. The magnitude of the load im-

posed on the gear shaft bearings by the unbalanced hydraulic pressure between outlet and inlet is somewhat dependent upon the particular gear side plate design or construction utilized in each particular application. However, some form of bearing load is an absolute and cannot be eliminated from gear pump operation.

Conventional gear tooth pumps utilizing a wear block require that at least two teeth per gear be in sealing contact or engagement with the wear block at any instant of time in order to provide proper orientation of the wear block with respect to the gear and to enhance smooth guidance of the gear teeth onto the wear block. On single piece wear blocks having two spaced apart wiping faces with at least two teeth of each gear in sealing engagement with its respective wiping face at any instant, a minimum total of five teeth of the combined gears must run against the two wiping faces of the wear block. The number of teeth contacting a given wiping face alternates between two and three; the other wiping face is similarly engaged but fully out of phase in its contact with the gear teeth. The resulting load fluctuations on the wear block cause failure within that portion of the wear block connecting the two wiping faces. Failure is a particularly acute problem with the hard, notch sensitive, brittle metals, such as tungsten carbide, chosen for their properties of high hardness and resistance to abrasion by contaminants present in the pumped fluid.

Gear pumps utilizing hard metal wear blocks inserted in the discharge area of the pump have the wear blocks so constructed that arcuate surfaces of the wear blocks are concentrically positioned in relation to the periphery of the respective gear teeth. The arcuate surfaces of the single piece wear block are machined to be concentric with their respective gear tooth periphery upon initial assembly of the pump. The load imposed upon the gear shaft bearings by the hydraulic pressure unbalance causes the bearing journal interface to wear and the gears to move apart. The single piece wear block having its arcuate surfaces fixed with respect to each other as well as prior art split wear blocks cannot track the movement of the gears caused by bearing journal interface wear thereby causing poor gear tooth guidance and loss of peripherial sealing action.

It has been found that the one piece wear block failure problem and the wear block tracking and peripherial engagement problem caused by bearing journal interface wear resulting in reduced sealing and poor tooth guidance can be controlled by positioning adjacent the pump outlet a movable peripherial sealing device having separate elements with arcuate surfaces engaging the periphery of their respective gears. Each separate element is aligned in a direction such that it can follow the gear movement that results from gear shaft bearing journal interface wear. Continuous peripherial sealing of each individual element is maintained by a loading force provided by a combination of discharge pressure and mechanical biasing.

Summary of the invention

This invention pertains to a gear pump that can pump a fluid containing a highly abrasive contaminant and continue to maintain a high volumetric efficiency after the pump has been run a long time. According to the invention, the gear pump of the kind specified is characterized by an outlet port formed with separate peripherial sealing elements positioned adjacent the outlet. One of the elements engages the periphery of at least two teeth of one gear and the other element engages the periphery of at least two teeth of the second gear, with both elements independently loaded by discharge pressure and mechanical biasing means to thereby generate first and second vectored forces that continually position both the first and second members into peripherial tooth sealing engagement.

Accordingly, it is an object of the present invention to provide an improved gear pump for pumping contaminated fluids containing a highly abrasive contaminant that will maintain maximum volumetric efficiency despite excessive wear that would ordinarily result to the peripherial engaging surfaces.

Another object of this invention is to provide a gear type pump wherein separate movable elements are positioned adjacent the outlet, and each element is held in peripherial sealing engagement with at least two teeth of its respective mating gear by fluid under pressure, the position of each element relative to the periphery of the gear teeth of its respective gear being self-adjustable by a vectored force independently, continuously aligning each element.

Another object of this invention is to provide a gear pump having independently loaded elements for each gear positioned adjacent the pump outlet that are not subject to stress failure.

Still another object of this invention is to provide a gear pump having an independently pivotably movable element for each gear positioned adjacent the pump outlet and loaded by discharge pressure such that each element is aligned in a direction such that it can follow gear movement anticipated to result from gear shaft journal interface wear.

Still another object of this invention is to provide a gear pump that has an element positioned adjacent the pump outlet with separate surfaces engaging the periphery of each gear and each surface independently articulated to permit each surface to attenuate the transverse cyclic stressing and simultaneously follow limited gear run-out.

A specific object of this invention is to provide a gear pump having separate elements for each gear located adjacent the pump outlet, each element engaging the periphery of at least two teeth of its respective gear with each element held in position by a combination of discharge pressure and mechanical biasing force such that a vectored force generated through each element to thereby continuously position each element in constant peripherial tooth sealing engagement with its respective gear.

A more specific object of this invention is to provide a gear pump having an independently loaded wear block for each gear positioned adjacent the pump outlet, each wear block independently aligned such that it can follow gear movement anticipated to result from gear support journal wear and simultaneously eliminate the structural failure resulting from transverse cyclic stresses that are associated with one piece wear blocks having two wiping surfaces.

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

Description of the drawings

The following is a brief description of the drawings accompanying the detailed description of the instant invention.

FIGURE 1 is a front view of a first form of pump incorporating the present invention.

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-sectional view along the line **4—4**.

FIGURE 5 is a detailed cross-sectional view in accord with this invention having a first alternate form of movable peripherial sealing assembly.

FIGURE 6 is a detailed cross-sectional view in accordance with this invention having a second alternate form of movable peripherial sealing assembly.

FIGURE 7 is a detailed cross-sectional view in accordance with this invention having a third form of movable peripherial sealing assembly.

FIGURE 8 is a detailed cross-sectional view in accordance with this invention having a fourth form of movable peripherial sealing assembly.

Referring now to the drawings and first generally to all of the forms shown. In the following general description, like parts are designated throughout by like numerals.

Referring to the example shown in FIGURES 1, 2, 3 and 4, 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 **5**. Rotatably mounted about axes of rotation **11** and **12** in cavity **2** of housing **1** are a pair of intermeshing gears **6** and **7** engaging one another at an area of intermesh indicated generally at **8**. Shaft **9** drives gear **6** through a key (not shown). Shaft **10** is keyed to driven gear **7** such that shaft **10** and gear **7** rotate in unison responsive to rotative movement of driver gear **6**. Shaft **9** and shaft **10** are journaled in bearings **13**, **14**, **15** and **16** respectively with a close running fit such that axes of rotation **11** and **12** are maintained substantially parallel. Gears **6** and **7** are disposed in cavity **2** such that an inlet **17** is formed on one side of the intermesh **8** and an outlet **18** is formed on the opposite side of the intermesh **8** so that the rotary fluid displacement means comprising the intermeshing gears **6** and **7** will operate to move the fluid medium acted upon by the pump from the inlet **17** to the outlet **18**. As is clearly indicated in FIGURES 2 and 4, the outer diameter of the gears **6** and **7** at the tips or periphery of the gear teeth are disposed in relation to the peripherial wall of cavity **2** adjacent the pump inlet such that there is a pronounced clearance between the periphery of each of the gear teeth and the adjacent 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 peripherial tooth sealing adjacent the pump outlet **18** there is provided in accordance with the teachings of this invention a novel movable peripherial sealing means engaging the periphery of both the driver gear and the driven gear. In this particular embodiment, a movable sealing means takes the form of first and second movable members **19** and **20** respectively positioned on opposite sides of outlet **18**. The housing **1** is provided with a pair of cavities **21** and **22** adjacent the pump outlet and positioned on opposite sides of said pump outlet. Cavities **21** and **22** surround portions of movable elements **20** and **19** respectively to form chambers **23** and **24** therebetween. Cavities **21** and **22** are cantedly positioned on opposite sides of outlet **18** and slideably engage movable elements **20** and **19** respectively to independently align elements **19** and **20** toward gears **6** and **7** respectively in a direction such that movable elements **19** and **20** can follow the independent movement of gears **6** and **7** that results from gear shaft journal wear.

Cavities **21** and **22** have cylindrical depressions **25** and **26** respectively contained therein. Sealing members **19** and **20** are continuously urged into peripherial sealing engagement with at least two teeth in the areas **27** and **28** of gears **6** and **7** respectively by suitable means; for example, helical compression springs **29** and **30** received by depressions **26** and **25** respectively. Discharge pressure is communicated from outlet **18** via interconnected passageways **31**, **32**, **33** and **34** to chambers **24** and **23** respectively to provide a fluid force supplemental to that provided by springs **29** and **30**. Said combined fluid and spring force generated by movable elements **19** and **20** generate an independent vectored force through movable elements **19** and **20** respectively that are continuously positioned in substantial proximity to axes of rotation **11** and **12** respectively such that movable elements **19** and **20** are continuously positioned in peripherial tooth sealing engagement with at least two teeth of gears **6** and **7** respectively.

Side members **35** and **36** are positioned intermediate the lateral faces 37, 38, 143 and 144 of gears 6 and 7 respectively and the side surfaces 39 and 40 of end plates 3 and 4 respectively. Seal 41 is located in recess 42 of end plate 3 and positioned intermediate side plate 35 and end plate 3 to form cavity 43. Similarly seal 44 is positioned in recess 45 intermediate side plate 35 and end plate 3 to form cavity 46. Similarly seals 47 and 48 are positioned intermediate end plate 4 and side plate 36 to form chambers 49 and 50. Fluid at discharge pressure is directed through passageways 51 and 52 into chambers 43 and 49 respectively and thence via interconnecting passageway (not shown) to chambers 46 and 50. Side plates 35 and 36 are urged by discharge pressure through chambers 43, 46, 49 and 50 respectively into sealing engagement with the lateral faces of gears 6 and 7 and the end faces of elements 19 and 20 to form a discharge pocket 53 bounded by the intermesh 8 of the teeth of the two gears, peripherial sealing contact 27 and 28 of the periphery of the teeth of gear 6 and movable element 19 and the periphery of the teeth of gear 7 and movable element 20. It has been found that the peripherial sealing between the periphery of the gear teeth and the mating arcuate surfaces of the movable elements 19 and 20 is the critical leakage path with respect to the operation of a gear pump when pumping a fluid medium containing highly abrasive contaminants. This critical peripherial sealing engagement is represented by areas 27 and 28 of FIGURE 4. Accordingly, it is to be understood that the embodiment shown utilizing the two side plates 35 and 36 respectively is representative of but one form of providing the fluidly sealing discharge pocket 53. It has been found that any form of pressure loaded side plate that will urge the lateral surfaces of the gears and the end surfaces of the movable elements into fluid sealing engagement so as to form the fluid sealed discharge pocket 53 will perform satisfactorily when pumping highly abrasive contaminant fluids. Accordingly, side plate mechanisms having surfaces in contact with 100% of the lateral surfaces of the pump gear, as exemplified by Roth, Patent #2,420,622; intermediate housing pressure loading, as exemplified by Gordon, Patent #3,292,550; selective side plate loading, as exemplified by Banker, Patent #2,742,862; or free floating side plate, as exemplified by Trautman, Patent #3,996,999, 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 pocket 53 is formed.

It may be desired to design the pump such that side plate 36 will seal only an inboard portion of peripherial sealing surfaces 28 and 27. Such an arrangement would subject only the inboard peripherial surface of elements 19 and 20 to discharge pressure and would produce a cocking moment on said elements 19 and 20. Discharge pressure is communicated via passages 54 and 55 to the peripherial surfaces 56 and 57 of movable elements 19 and 20 to produce moments on elements 19 and 20 to counter any cocking moment and thereby permit elements 19 and 20 to freely slide in their respective cavities 22 and 21.

FIGURE 5 shows an alternate movable peripherial sealing means for obtaining the necessary continuous peripherial tooth sealing engagement adjacent the pump outlet and simultaneously permitting independent movement of the elements sealingly engaging the periphery of each gear to follow gear movement resulting from gear shaft journal wear. The alternate construction shown in FIGURE 5 comprises a loading member 58 generally urged towards gears 6 and 7 by spring 59 disposed interjacent said load member 58 and recess 60 of housing 1. A pair of flat side plates 35 and 36 simultaneously engage the lateral surfaces 38 and 39 of gears 6 and 7 and the parallel surfaces of loading member 58 to form a dynamically fluidly sealed discharge pocket 53. Side plates 35 and 36 are

initially urged against the lateral surfaces of gears 6 and 7 and the corresponding parallel surface of loading element 58 by the compressive force imposed on an O-ring seal at assembly of end plates 3 and 4 to housing 1. Discharge pressure is communicated via outlet port 18 to the outboard side of side plates 35 and 36 to thereby urge side plates 35 and 36 into sealing engagement with the lateral surfaces of gears 6 and 7 and the corresponding parallel surfaces of movable element 58.

Fluid is carried by the gear teeth interstices from inlet 17 at inlet pressure passed loading element wiping surfaces 63 and 64 contoured to match the peripherial tooth contour of gears 7 and 6 respectively, thence into discharge chamber 53 which is in fluid communication with a discharge port by way of discharge outlet 18. A trapping groove 65 is provided on the inboard face of side plate 36 at the region of the maximum meshing of the gear teeth for purposes well known in the art.

Contoured surface 64 engaging similar contoured peripherial surface of gear 6 comprises one surface of an abrasion resistant tungsten carbide block 66 which is bonded by means of adhesive to a resilient elastomeric pad 67; similarly contoured surface 63 in sealing engagement with mating peripherial surface of gear 7 comprises one surface of an abrasion resistant tungsten carbide block 68 which is bonded by means of adhesive to a resilient elastomeric pad 69. Elastomeric pads 67 and 69 are in turn similarly bonded to a steel loading block 58 having an extension 70 therein, the inner periphery which axially slideably sealably engages a seal element 71 sealingly retained by groove 72 of spacer 200 to form a fluid tight variable volume cavity 73 containing spring 59. Discharge pressure is communicated to chamber 50 via passageway 74 to urge loading element 58 towards gears 6 and 7 responsive to discharge pressure. A restriction (not shown) in passageway 74 prevents a rapid flow of fluid therethrough, thus attenuating any rapid movement of loading member 58 in response to rapid movement of carbide sealing elements 63 and 64. The relative movement between sealing elements 63 and 64 and loading element 58 being taken up and attenuated by elastic compression and extension by resilient spacers 67 and 68.

Discharge pressure within chamber 60 urges sealing elements 63 and 64 into sealing engagement with the periphery of gears 7 and 6 respectively such that regardless of the magnitude of the pump discharge pressure a net force is always present to urge loading element 58 towards gears 6 and 7.

FIGURE 6 discloses still another alternate arrangement wherein the two peripherial sealing elements 75 and 76 pivotably engage protuberances 77 and 78 respectively. Spring 83 is positioned intermediate elements 75 and 76 so as to urge elements 75 and 76 apart and pivot element 75 about protuberance 77 and element 76 about protuberance 78 such that peripheral engaging surface 27 of gear 6 and surface 28 of gear 7 are sealingly engaged by the corresponding arcuate surfaces of movable elements 76 and 75. Discharge pressure is applied to the inboard faces 79 and 80 and to the rear faces 81 and 82 of peripherial sealing elements 75 and 76 respectively to provide a force supplemental to that provided by spring 83 to thereby form a line contact fluid tight seal between element 75 and protuberance 77 and element 76 and protruberance 78. The combination of the mechanical spring force and the force responsive to discharge pressure acting on movable elements 75 and 76 produce a force vector for each movable element whereby elements 75 and 76 acting through their respective pivot protuberances 77 and 78 pivotably engage peripheral sealing surfaces 27 and 28 of gears 6 and 7 such that the loading force vectors can be reoriented to permit movable elements 75 and 76 to follow any movement of the peripherial gear surfaces caused by the shift in the gear axes of rotation 11 and 12 due to wear of the gear shaft bearings. Side plates 35 and 36 sealingly engage the lateral faces of gears 6 and 7 and the corresponding parallel faces of pivotable elements **75** and **76** outboard of the line contact sealing engagement of protuberances **77** and **78** with the corresponding mating surfaces of pivotable elements **75** and **76** to thereby form a fluidly sealing discharge chamber **84**.

FIGURE 7 discloses still another alternate arrangement wherein discharge pressure is communicated via passageway **85** to chamber **86** of movable loading element **87** to thereby generate a force that is communicated through pivot pins **88** and **89** to movable peripherial sealing elements **90** and **91**. Seal element **201** is positioned intermediate the inner periphery of loading element **87** and the mating surface of spacer **200** to form a fluid tight pressure chamber **86**. Discharge pressure is communicated to chamber **86** via passageway **85** to slideably sealably urge loading element **87** towards gears **6** and **7**. A spring **92** is received in chamber **86** such that loading element **87** is urged towards gears **6** and **7** by a spring produced force supplemental to the force produced responsive to discharge pressure. The combined spring and discharge pressure produced forces acting on load element **87** are transmitted through pivot pins **88** and **89** to movable peripherial sealing elements **90** and **91** respectively. Peripheral sealed elements **90** and **91** pivotably move about pivot pins **88** and **89** such that the vectored forces acting through pivotable elements **90** and **91** are continuously directed substantially adjacent axes of rotation **12** and **11** respectively to thereby permit the arcuate surfaces of elements **90** and **91** to track any movement of the peripherial engaging surfaces of gears **6** and **7** caused by a shift of the axes of rotation **11** and **12** due to wear of the gear shaft journal. Side plates, as described in detail in the previous embodiments, seal the lateral faces of gears **6** and **7** and the corresponding parallel faces of pivotable movable elements **90** and **91** outboard of pivot pins **88** and **89** to form fluidly sealable discharge chamber **53**. The loading forces responsive to discharge pressure in chamber **86** and spring **92** acting on loading element **87** are transmitted through pivot pins **88** and **89** to pivotable movable elements **90** and **91** such that a line contact fluid tight seal is formed between loading element **87** and pivotable movable elements **90** and **91** to thus prevent the leakage of discharge pressure from discharge pocket **53** past pivot pins **88** and **89** to inlet **17**.

FIGURE 8 shows an alternate construction for pivoting movable peripherial sealing elements **90** and **91** on loading element **87** wherein pivot pins **88** and **89** are replaced by pivot protuberances **93** and **94** at the apex of a convex peripherial surface opposite the arcuate surface of elements **90** and **91** engaging corresponding peripherial surfaces of gears **6** and **7** respectively. The elongated protuberances **93** and **94** of movable peripherial sealing elements **90** and **91** respectively engage depressions in the concave surfaces of loading element **87** receiving the convex surfaces of elements **90** and **91** such that elements **90** and **91** pivotably engage loading element **87**. A clearance is provided between the mating convex surfaces of elements **90** and **91** and the corresponding concave surfaces of loading element **87** such that elements **90** and **91** pivot about pivotable protrusions **93** and **94** to conform to any angular positional deviation of the axes of rotation **11** and **12** of gears **6** and **7**. The force transmitted from loading element **87** to pivotable protuberances **93** and **94** and thence to pivotable elements **90** and **91** produces a line contact fluid tight seal between protuberances **93** and **94** and loading element **87** such that leakage of high pressure fluid from discharge pocket **18** past pivot points **93** and **94** to inlet **17** is prevented.

What we claim is:

1. A gear pump comprising a housing and enclosing a chamber, a pair of intermeshing gears supported on parallel axes for rotation in said chamber, movable pressure loaded peripherial sealing means for said gears, at least one pressure loaded side plate urged into engagement with the lateral faces of said gears and said peripherial sealing means to sealingly divide said chamber into a high pressure portion and a low pressure portion, said peripherial sealing means having a first element having a first resultant vectored force impressed thereon, said first force continuously positioned in substantial proximity to the axis of rotation of said first gear, and a second element having a second resultant vectored force impressed thereon, said second force continuously positioned in substantial proximity to the axis of rotation of said second gear, loading means independent of pump pressure continuously forcing the entire arcuate surfaces of said first element and said second element into peripherial tooth sealing engagement, having pivot pins intermediate said first and second elements and said loading means, said pins pivotally engaging said first and second elements respectively and said loading means.

2. A gear pump comprising a housing and enclosing a chamber, a pair of intermeshing gears supported on parallel axes for rotation in said chamber, movable pressure loaded peripherial sealing means for said gears, at least one pressure loaded side plate urged into engagement with the lateral faces of said gears and said peripherial sealing means to sealingly divide said chamber into a high pressure portion and a low pressure portion, said peripherial sealing means having a first element having a first resultant vectored forced impressed thereon, said first force continuously positioned in substantial proximity to the axis of rotation of said first gear, and a second element having a second resultant vectored force impressed thereon, said second force continuously positioned in substantial proximity to the axis of rotation of said second gear, loading means independent of pump pressure continuously forcing the entire arcuate surfaces of said first element and said second element into peripherial tooth sealing engagement, having first and second elements in pivotal socketed engagement with said loading means.

3. A gear pump comprising a housing having two parallel cylindrical intersecting bores and means for providing a closure for each end of said housing, a driver and a driven gear each having an axis of rotation, said gears journaled in said housing such that said axes of rotation are parallel, a plane of symmetry intermediate and equidistant from said axes of rotation and positioned transverse a plane passing through said axes of rotation, said gears having an intermesh at the intersection of said bores, an inlet on one side of said intermesh and an outlet on the opposite side of said intermesh, movable peripherial sealing means positioned adjacent said outlet, at least one side member loaded at one surface to thereby urge the opposite surface into engagement with the lateral surfaces of said gears and said peripherial sealing means to thereby sealingly enclose a high pressure discharge chamber, said movable peripherial sealing means formed adjacent said outlet to include a pair of cavities formed in said housing, each of said cavities having a peripherial wall inclined to said plane of symmetry and an end closure, a first movable member positioned in one of said cavities opposite said end closure to form a first chamber, a second movable member positioned in the other of said cavities opposite said end closure to form a second chamber, discharge pressure connected to said first and second cavities such that first and second vectored forces generated by said first and said second movable members responsive to discharge pressure are continuously positioned in substantial proximity to the respectively axes of rotation and are directed along a convergent path with respect to each other, discharge pressure applied to the peripherial wall of each of said cavities such that third and fourth vectored forces transverse said first and second vectored forces respectively and directed outward from said plane of symmetry are generated to thereby simultaneously load said first and second members toward said gears and in opposition to first and second member cocking moments to produce

a maximum unit force adjacent the gear tooth exit area of said first and said second members and thereby effect stable peripherial tooth sealing engagement adjacent said pump outlet.

4. A gear pump comprising a housing having a bore and means providing a closure for each end of said housing, a driver gear and a driven gear each of said gears having an axis of rotation, said gears disposed in said bore and journaled in said housing such that said axes of rotation are parallel, said gears having an intermesh intermediate said axes of rotation, an inlet on one side of said intermesh and an outlet on the other side of said intermesh, movable peripherial sealing means positioned adjacent said outlet, at least one pressure loaded side plate urged into engagement with the lateral surfaces of said gears and said movable peripherial means to sealingly enclose a high pressure chamber, said movable peripherial sealing means having a first element engaging the periphery of said driver gear, a second element engaging the periphery of said driven gear, first and second resilient means fluidly sealingly engaging said first and second elements respectively, loading means fluidly sealingly engaging said first and second resilient means and responsive to discharge pressure independently flexibly loading both said first and second elements into peripherial tooth sealing engagement.

5. A gear pump, as defined in claim 4, wherein said first and second resilient means are elastomeric spacers bonded to said first element and said loading means, and said second element and said loading means respectively, to thereby provide flexible fluid tight sealing engagement therebetween.

6. A gear pump, as defined in claim 4, wherein said loading means is continuously urged by spring means toward said gears.

7. A gear pump, as defined in claim 4, wherein said first and second elements are tungsten carbide units each having a separate arcuate wiping surface continually engaging the peripherial surfaces of at least two teeth of said driver gear and driven gear respectively.

8. A gear pump, as defined in claim 7, wherein said first and second elements each have a surface opposite said arcute surface bonded to a first surface of separate elastomeric spacers and a tool steel loading element bonded to the surface opposite said first surfaces of each of said spacers to form a fluid tight integral structure and thereby provide flexible relative orientation of said arcuate surfaces with respect to the periphery of said gears.

9. A gear pump comprising a housing having a bore and means providing a closure for each end of said housing, a driver gear and a driven gear, each of said gears having an axes of rotation, said gears disposed in said bore and journaled in said housing such that said axes of rotation are parallel, said gears having an intermesh intermediate said axes of rotation a plane of symmetry intermediate an equidistant from said axes of rotation, an inlet on one side of said intermesh, an outlet on the opposite side of said intermesh, movable peripherial sealing means positioned adjacent said outlet, at least one side plate urged into engagement with the lateral surfaces of said gears and said movable peripherial means to sealingly enclose a high pressure discharge chamber, said housing having first and second parallel linear protuberances adjacent said outlet and located on opposite sides of said plane of symmetry, said protuberances positioned at a greater distance from said plane of symmetry than said corresponding axes of rotation, said movable peripherial sealing means having a pivotable first element engaging the periphery of said driver gear and a pivotable second element engaging the periphery of said driven gear, resilient means positioned intermediate said first and second elements pivotably moving said first and second elements about said first and second protuberances respectively toward said gears to thereby produce a stable peripherial tooth sealing engagement having a maximum unit force adjacent the gear tooth exit area of said first and said second elements.

10. A gear pump, as defined in claim 9, wherein said first and second elements responsive to said resilient means and discharge pressure are urged into engagement with said first and second protuberances respectively to form a line contact fluid tight seal between each of said protuberances and the mating surface of said respective pivotable element.

11. A gear pump comprising a housing having a bore and mean providing a closure for each end of said housing, a driver gear and a driven gear each of said gears having an axes of rotation, said gears disposed in said bore and journaled in said housing such that said axes of rotation are parallel, said gears having an intermesh intermediate said axes of rotation, an inlet on one side of said intermesh, an outlet on the opposite side of said intermesh, movable peripheral sealing means positioned adjacent said outlet, at least one side plate urged into engagement with the lateral surfaces of said gears and said movable peripheral sealing means to sealingly enclose a high pressure discharge chamber, said movable peripherial sealing means having a pivotable first element engaging the periphery of said driver gear, a pivotable second element engaging the periphery of said driven gear, means responsive to discharge pressure pivotably engaging both said first and second elements and loading both said first element and said second element toward said gears to produce a stable peripheral tooth sealing engagement adjacent said pump outlet, wherein a first pivot pin is positioned intermediate said first element and said pressure responsive means, and a second pivot pin is positioned intermediate said second element and said pressure responsive means to thereby permit independent pivotable movement of said first and said second elements about said first and second pivot pins respectively.

12. A gear pump, as defined in claim 11, wherein spring means constantly urge said movable peripherial sealing means toward said gears.

13. A gear pump comprising a housing having a bore and means providing a closure for each end of said housing, a driver gear and a driven gear each of said gears having an axes of rotation, said gears disposed in said bore and journaled in said housing such that said axes of rotation are parallel, said gears having an intermesh intermediate said axes of rotation, an inlet on one side of said intermesh, an outlet on the opposite side of said intermesh, movable peripherial sealing means positioned adjacent said outlet, at least one side plate urged into engagement with the lateral surfaces of said gears and said movable peripherial sealing means to sealingly enclose a high pressure discharge chamber, said movable peripherial sealing means having a pivotable first element engaging the periphery of said driver gear, a pivotable second element engaging the periphery of said driven gear, means responsible to discharge pressure pivotably enagaging both said first and second elements and loading both said first element and said second element toward said gears to produce a stable peripherial tooth sealing engagement adjacent said pump outlet, wherein said first element has an arcuate surface engaging the periphery of one of said gears and inclined surfaces opposite said arcuate surface having a periphery forming a convex surface having an elongated protuberance at the apex thereof, and wherein said second element has an arcuate surface engaging the periphery of the other of said gears and inclined sufaces opposite said arcuate surface having a periphery forming a convex surface having an elongated protuberance at the apex thereof, said pressure responsive means has a pair of concave depressions receiving the convex surfaces of said first and second elements respectively such that said first and second elements abut said pressure responsive means and are independently

pivotable about said first and second elongated protuberances.

14. A gear pump, as defined in claim **13**, wherein said pressure responsive means is constantly urged toward the gears by spring means.

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