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Davidson

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[54] **SEALING ARRANGEMENT FOR A FLUID PRESSURE DEVICE**

[75] Inventor: **Robert R. Davidson,** Wooster, Ohio

[73] Assignee: **Borg-Warner Corporation,** Chicago, Ill.

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[52] **U.S. Cl.** **418/132;** 418/135; 277/190

[51] **Int. Cl.**..... **F01c 19/08;** F03c 3/00; F04c 15/00

[58] **Field of Search** 418/131, 132, 133, 135; 277/190, 191

[56] **References Cited**

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3,142,260	7/1964	Oliver	418/132
3,348,492	10/1967	Olson et al.	418/131
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Primary Examiner—John J. Vrablik
Attorney, Agent, or Firm—Julian Schachner

[57] **ABSTRACT**

A gear pump is provided with a movable wear plate disposed between the pump gears and housing. A seal member received in a groove formed in the surface of the wear plate adjacent the housing is pressure-loaded during operation and thereby urged into sealing engagement with the housing to define pressure loading zones on the wear plate. The fluid pressure exerted on the wear plate, as determined by the pressure loading zones, urges the wear plate in a direction to load the gears. Preloading means are provided to urge the seal member in one direction toward the housing and in another direction toward one of the side walls of the groove to provide an effective fluid seal when the pump is at rest and during initial operation.

5 Claims, 18 Drawing Figures

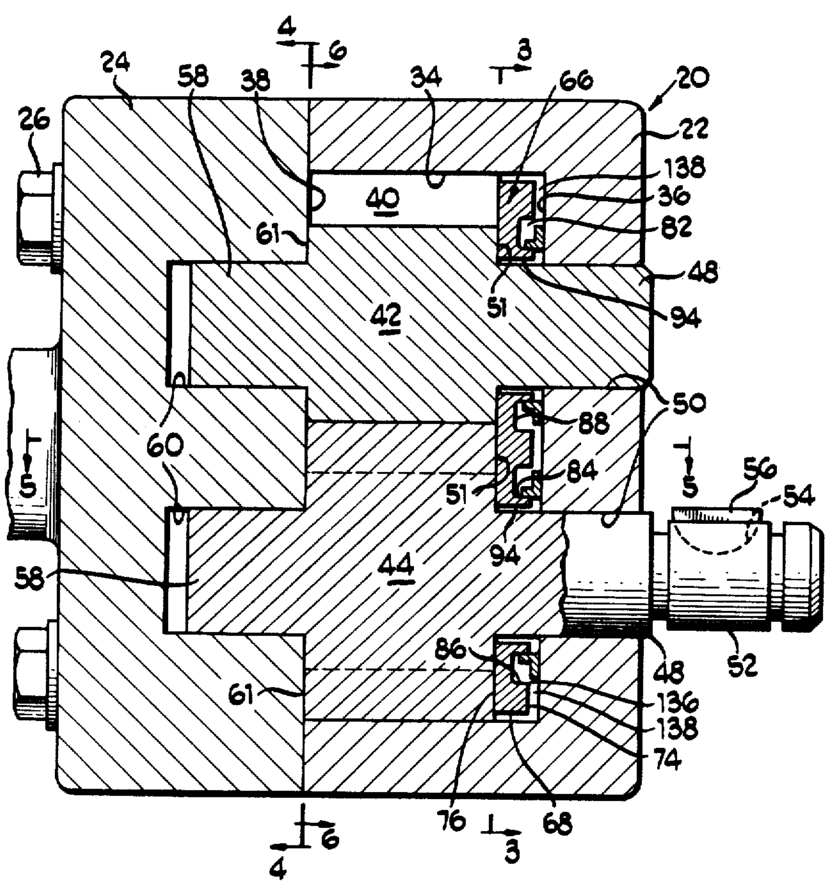


Fig 1

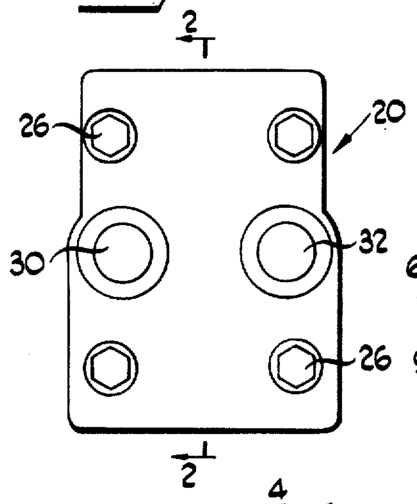


Fig 3

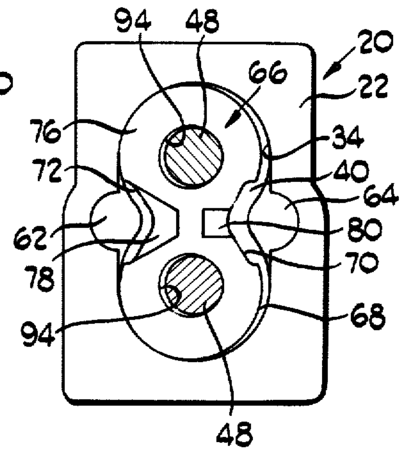
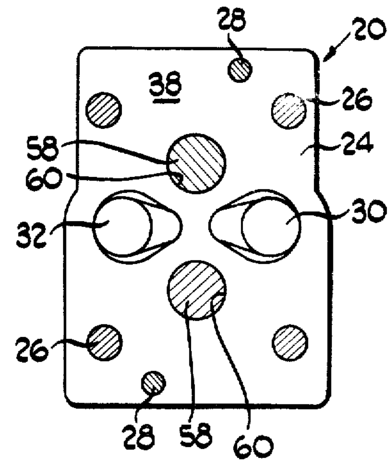


Fig 4



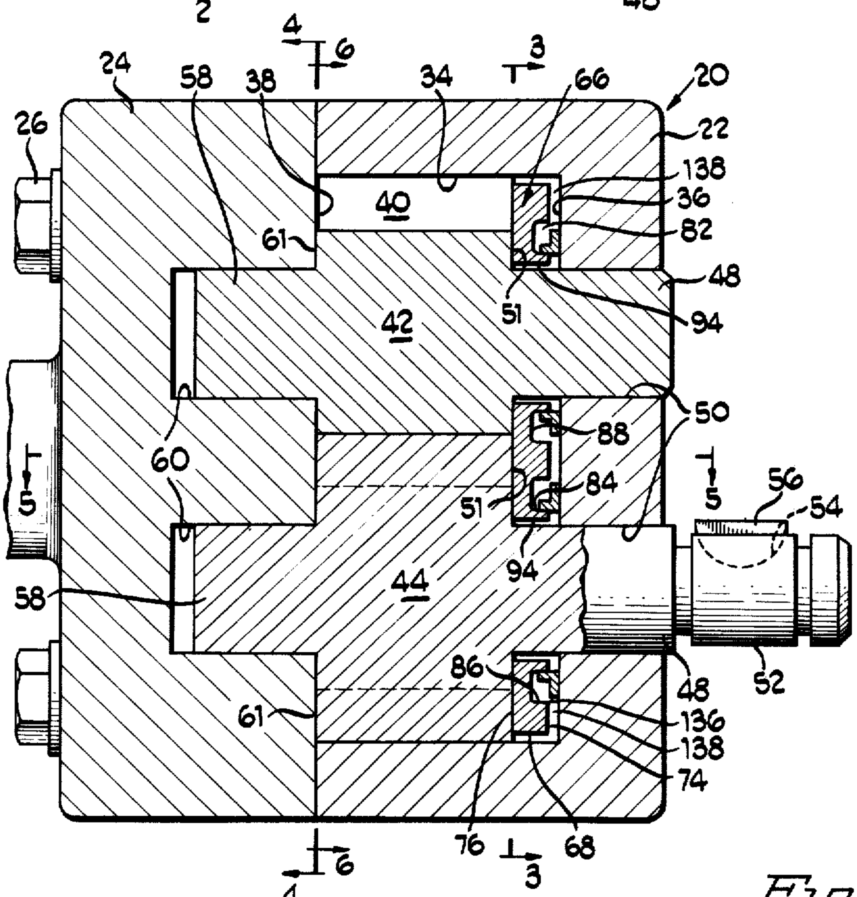


Fig 2

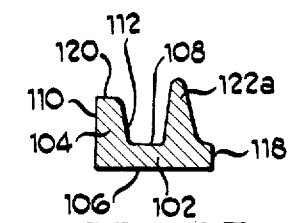


Fig 13

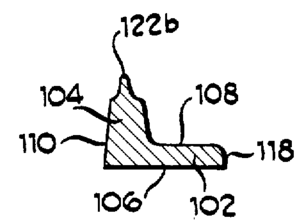


Fig 14

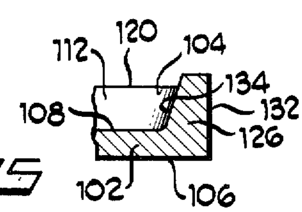


Fig 15

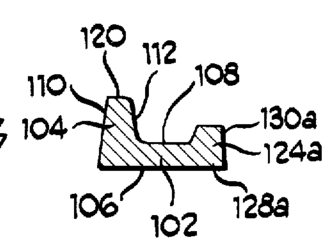


Fig 16

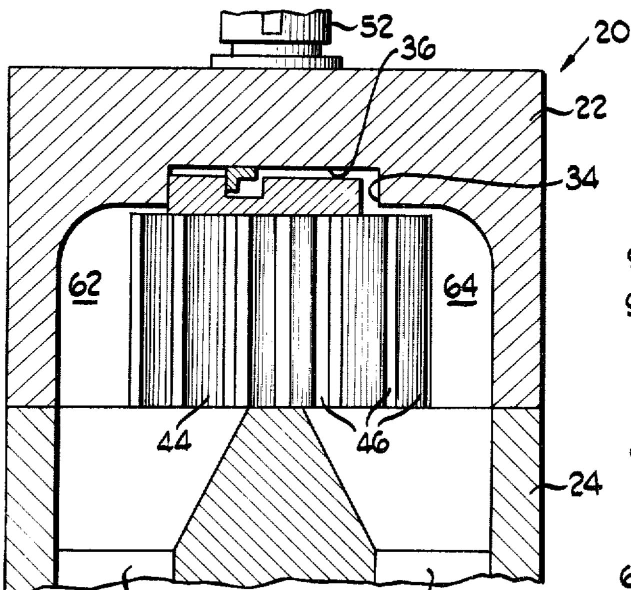
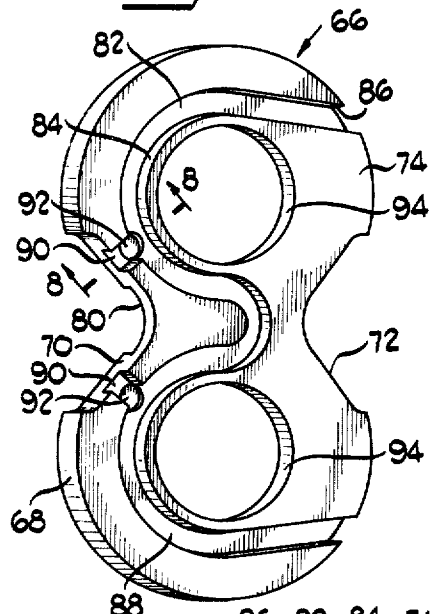


Fig 5

Fig 7



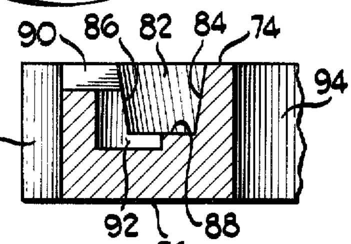


Fig 8

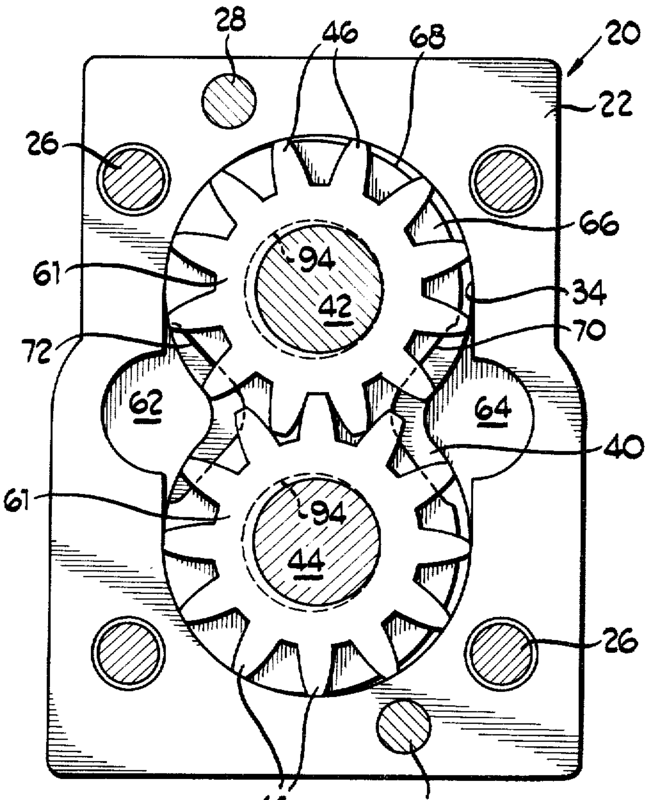
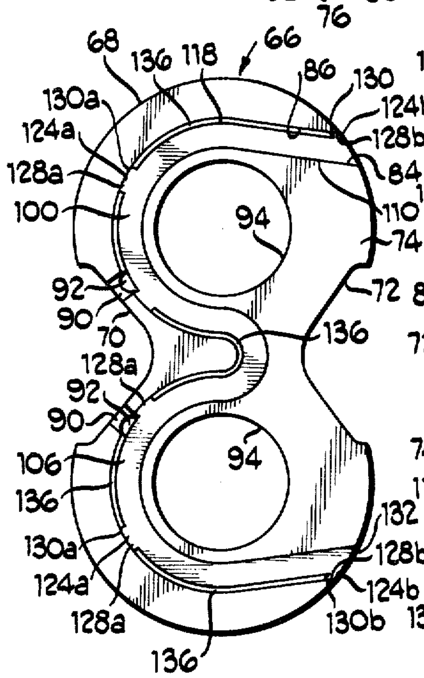


Fig 6



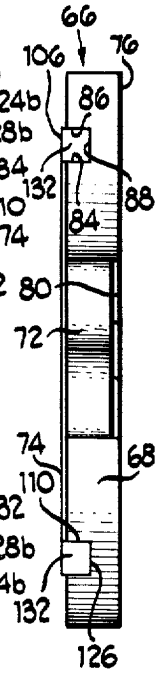


Fig 9

Fig 9A

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SHEET 3

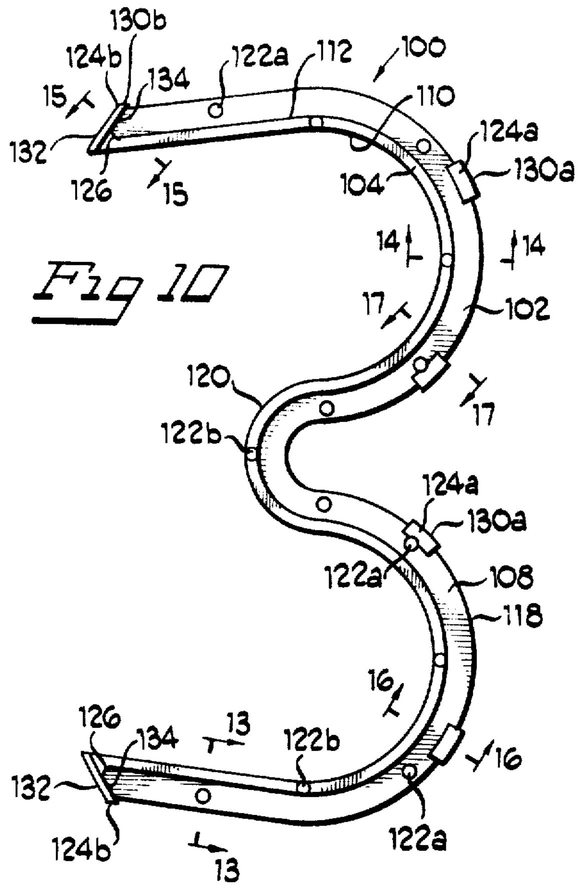

Fig 10

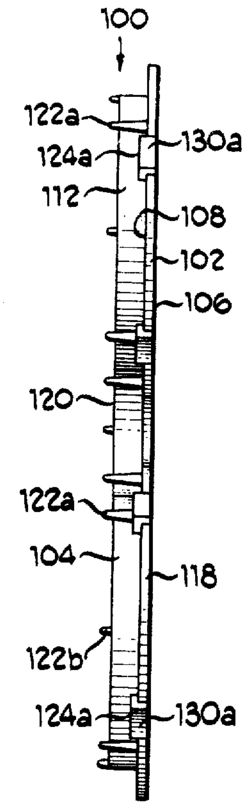

Fig 11

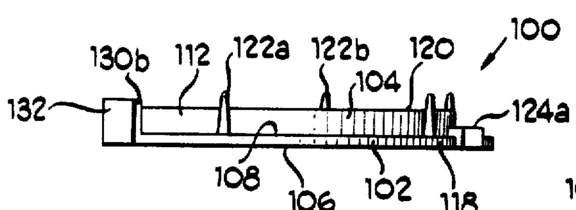

Fig 12

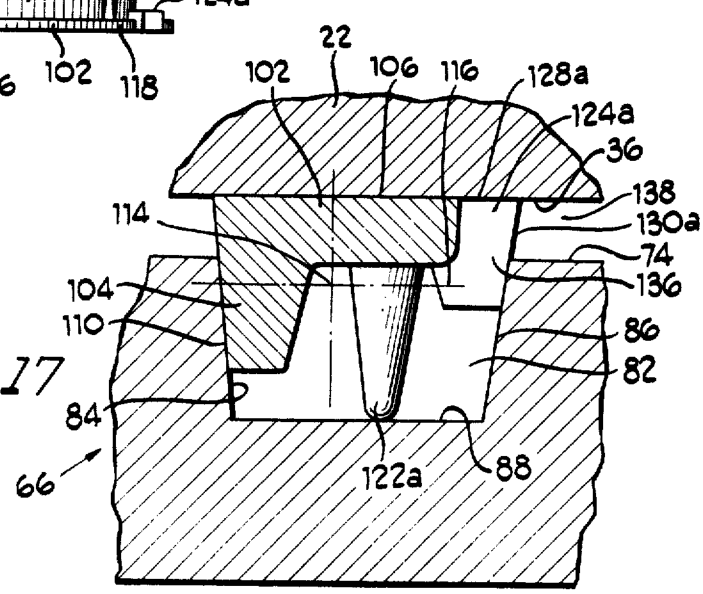

Fig 17

SEALING ARRANGEMENT FOR A FLUID PRESSURE DEVICE

BACKGROUND OF THE INVENTION

This invention relates to a sealing arrangement for a fluid pressure device, and more particularly, to a sealing arrangement for a rotary, fluid-pressure energy-translating device of the positive-displacement type which includes gear pumps and motors, lobe-type pumps and motors, rotating-plunger pumps and motors, and moving-vane pumps and motors.

Such devices may be provided with a pressure-loaded wear or thrust plate disposed between the housing and the rotary working element or elements, the plate being adapated to load, and form a seal with, the working element during operation, thereby enhancing the efficiency of the pump by acting to maintain the integrity of the pressure differential across the working element.

Gear pumps so constructed are described and illustrated in U.S. Pat. No. 3,348,492, issued Oct. 24, 1967 to G. D. Olson et al., and U.S. Pat. No. 3,371,615, issued Mar. 5, 1968 to A. E. Pettyjohn et al., both assigned to the assignee of the present invention. In each of the various sealing arrangements disclosed in these patents, the wear plate is movable axially relative to the working elements; that is, the intermeshing pump gears, and a groove is provided in the surface of the wear plate adjacent an inner surface of the housing which forms an end surface of the pressure chamber or working cavity of the pump. The opposite surface of the wear plate is adjacent the side faces of the gears. A seal means received in the groove has a sealing surface disposed to engage the adjacent housing surface. Access channels are provided in the wear plate to admit fluid to the groove from the high-pressure side of the working cavity so that, when the pump is in operation, fluid pressure urges the seal outwardly relative to the groove and against the adjacent end surface in sealing relation therewith to define predetermined pressure loading zones on the wear plate, whereby fluid pressure exerted on the wear plate, as determined by the pressure loading zones, acts to urge the wear plate away from the end surface and against the side faces of the gears. The side faces of the gears opposite the faces engaged by the wear plate are, in turn, urged against the opposite end surface of the working cavity. In this manner the pump is pressureloaded during operation for enhanced efficiency, the particular configurations of the wear plate, the groove and the seal means determining the pressure loading zones on the wear plate in a pattern to effectively oppose the fluid forces which arise at various operating speeds.

The several sealing arrangements disclosed in the aforementioned patents also provide a preloading capability; that is to say, the seal means in each embodiment is formed to cooperate with the walls of the groove to provide a mechanical force in a direction to urge the sealing surface of the seal means into engagement with the adjacent end surface when the pump is at rest, thereby establishing the pressure loading zones from the outset of operation of the pump.

Reference may be had to the aforementioned patents for additional features and details of construction and operation, many of which may be useful in conjunction with the present invention and in fluid pressure devices in which the present invention may be employed or incorporated.

SUMMARY OF THE INVENTION

In accordance with the present invention, the seal means is provided with a second sealing surface extending inwardly relative to the groove from the aforementioned sealing surface and formed to engage one of the side walls of the groove. The seal means is provided with preloading means adapted to engage the other side wall to exert a preloading force on the seal means in a transverse direction relative to the groove and normal to the aforementioned preloading force, whereby the seal means and the first-mentioned side wall cooperate to provide a mechanical seal which assists in defining and maintaining the pressure loading zones along the wear plate during initial operation of the fluid pressure device.

In a preferred embodiment, intervals are formed between the seal means and the other side wall of the groove, the intervals admitting fluid pressure to the groove throughout a substantial portion of the length thereof during operation.

These and other features and advantages of the invention will be apparent from the ensuing description taken in conjunction with the accompanying drawings.

THE DRAWINGS

In the drawings:

FIG. **1** is an end view of a gear pump incorporating the features of the invention;

FIG. **2** is an enlarged sectional view taken along the line **2—2** of FIG. **1**;

FIG. **3** is a reduced sectional view taken along the line **3—3** of FIG. **2**;

FIG. **4** is a reduced sectional view taken along the line **4—4** of FIG. **2**;

FIG. **5** is a partial sectional view taken along the line **5—5** of FIG. **2**;

FIG. **6** is a sectional view taken along the line **6—6** of FIG. **2**;

FIG. **7** is a perspective view of a wear plate forming an element of the gear pump of FIGS. **1** to **6**;

FIG. **8** is an enlarged, partial sectional view taken along the line **8—8** of FIG. **7**;

FIG. **9** is a plan view of the wear plate of FIG. **7** showing a seal member assembled therewith;

FIG. **9A** is a side view of the assembly of FIG. **9**;

FIG. **10** is an enlarged plan view of the seal member taken from a side thereof opposite to that shown in FIG. **9**;

FIG. **11** is a side view of the seal member of FIG. **10**;

FIG. **12** is an end view of the seal member of FIGS. **10** and **11**;

FIG. **13** is an enlarged cross sectional view of the seal member taken along the line **13—13** of FIG. **10**;

FIG. **14** is an enlarged cross sectional view of the seal member taken along the line **14—14** of FIG. **10**;

FIG. **15** is an enlarged cross sectional view of the seal member taken along the line **15—15** of FIG. **10**;

FIG. **16** is an enlarged cross sectional view of the seal member taken along the line **16—16** of FIG. **10**; and

FIG. **17** is a greatly enlarged cross sectional view of the seal member taken along the line **17—17** of FIG. **10** and inverted, with portions of adjacent structures shown in cross section.

THE PREFERRED EMBODIMENT

Referring to FIGS. **1** to **6**, there is shown a simple gear pump 20 which is well suited to employ the features of the present invention, although it will be apparent that the invention can be applied with facility to other fluid pressure devices; for example, gear pumps and motors of the herringbone and helical types, lobe-type pumps and motors, rotating-plunger pumps and motors, and pumps and motors of the pivoting-vane and sliding-vane types. In short, the invention will find application in virtually any positive-displacement fluid pump or motor which includes at least one rotary working element subject to a pressure differential or gradient during operation and having a peripheral working portion and nonworking side faces.

Gear pump **20** includes a two-piece housing consisting of a body **22** and an end cover **24** secured to the body by any suitable fastening means such as machine screws **26.** Locating pins **28** may also be provided to facilitate assembly. End cover **24** is formed with a low-pressure inlet port **30** and a high-pressure outlet port **32,** either of which may be threaded or otherwise adapted for connection, respectively, to a fluid source and to a fluid discharge outlet or receiver, none of which is shown. Ports **30** and **32** are enlarged at their inner ends, as shown in FIGS. **4** and **5.**

Housing body **22** is formed with an inner curved surface **34** which in general describes the contour of a pair of merged cylinders having parallel axes. An inner planar surface **36** of body **22** intersects curved surface **34.** End cover **12** is provided with a planar surface **38** which also intersects curved surface **34** and is opposed to surface **36** when end cover **24** is secured to body **22.** Surfaces **34, 36** and **38** define a pressure chamber or working cavity **40** of which surface **34** forms a peripheral surface and surfaces **36** and **38** end surfaces.

Mounted for rotation within working cavity **40** are a pair of working elements in the form of intermeshing gears **42** and **44,** each of which is provided with a peripheral working portion formed by gear teeth **46.** Pump **20** being illustrated and described as a simple gear pump, teeth **46** have longitudinal axes which are parallel with the axes of rotation of gears **42** and **44,** but numerous other wellknown gear configurations may be employed. In any case, however, the tips of gear teeth **46** are complementary to adjacent portions of peripheral surface **34.**

Gears **42** and **44** are provided at one side thereof with cylindrical journals **48** mounted for rotation in complementary cylindrical bores **50** formed in housing body **22** and intersecting end surface **36.** Surrounding the inner ends of journals **48** and normal to the axes of rotation of gears **42** and **44** are planar side faces **51** of the gears. Journal **48** of gear **44** carries an extension **52** adapted for connection to a power source by any suitable means such as a keyway **54** and a key **56** received therein. At the sides of gears **42** and **44** opposite the journals **48** and coaxial therewith are cylindrical journals **58** mounted for rotation in complementary, cylindrical blind bores **60** formed in end cover **24** and intersecting end surface **38.** If desired, bores **60** may be formed to extend through end cover **24** to the exterior as described and illustrated in the aforementioned patents. Planar side faces **61** of gears **42** and **44** surround the inner ends of journals **58** and are normal to the axes of rotation of the gears. Side faces **51** are identical with side faces **61** as the latter are viewed in FIG. **6.**

A pair of recesses **62** and **64** communicate with working cavity **40** and interrupt surface **34** thereof. The recesses are respectively aligned with ports **30** and **32** and cooperate with the enlarged inner ends thereof to facilitate unobstructed and continuous introduction of fluid to and egress of fluid from the peripheral working portions of gears **42** and **44.** Obviously, the fluid in recess **64** will exist at a higher pressure than that in recess **62** during operation of the pump, whereby recess **64** and adjacent portions of cavity **40** may be described as a source of fluid pressure.

Referring now particularly to FIGS. **7** to **9** and **9A,** there is shown a wear plate **66** which is formed with a curved outer peripheral surface **68** having a pair of opposed relieved portions **70** and **72.** Outer peripheral surface **68** is generally complementary to inner peripheral surface **34** of working cavity **40** but has a slightly smaller or undersized contour, as will be seen in exaggerated form in FIGS. **3** and **6,** for a purpose which will be made clear hereinafter. Peripheral surface **68** is intersected by a pair of parallel planar surfaces **74** and **76** normal thereto, surface **74** comprising a pressure surface of wear plate **66** and surface **76** comprising a wear face thereof, as will be explained hereinafter. Referring to FIG. **3,** wear face **76** is provided with a pair of shallow recessed portions **78** and **80** which, by relieving fluid trapped between intermeshing gear teeth, act to preclude the excessive and detrimental pressures which might otherwise be generated.

Provided in pressure surface **74** of wear plate **66** is a groove **82** defined by a pair of side walls **84** and **86** and a bottom wall **88** intersecting the side walls. While side walls **84** are generally normal to the bottom wall in cross section, they preferably form angles therewith slightly greater than 90°; for example, approximately 95° in the preferred embodiment, so that the groove narrows or tapers somewhat from surface **74** to bottom wall **88.**

Also provided in pressure surface **74** are a pair of fluid access channels **90** which intersect relieved portion **70** of outer peripheral surface **68** and communicate with groove **82.** Access channels **90** are preferably located at those portions of pressure surface **74** which lie between relieved portion **70** and the closest points of approach of groove **82** thereto. Cylindrical bores or wells **92** are provided at the junctions of access channels **90** and groove **82** to ensure unrestricted communication therebetween.

A pair of cylindrical bores **94** are provided in wear plate **66** and intersect the surfaces **74** and **76** to surround journals **48** of gears **42** and **44,** but as shown in exaggerated form in FIG. **3,** they are oversized; that is, they are of slightly larger diameter than journals **48,** for a purpose to be explained hereinafter. It will be noted that portions of groove **48** partially surround the bores and pass closely to relieved portion **70.**

Turning now to FIGS. **10** to **17,** a seal means is illustrated in the form of a one-piece seal member **100.** The seal member may be formed of any one of a great number of resilient materials which exhibit suitable resistance to wear and extrusion. A variety of filled plastics will meet these requirements; for example, a filled nylon marketed by the Polymer Corporation under the name "Nylatron GS31." It will be apparent to persons of ordinary skill in the art, however, that even such materials as metals may be used satisfactorily.

The seal member **100** comprises fundamentally a first sealing wall **102** and a second sealing wall **104** each joined to the other at a common edge thereof. Sealing wall **102** provides a first outer sealing surface **106**, which lies in a single plane, and an inner pressure surface **108** opposed to the first sealing surface. Similarly, second sealing wall **104** provides a second outer sealing surface **110**, which is formed to engage side wall **84** of wear plate **66**, and an inner pressure surface **112** opposed to the second sealing surface. When seal member **100** is received in groove **82**, sealing wall **102** and its sealing surface **106** are disposed transversely of groove **82**, and sealing wall **104** and its sealing surface **110** extend inwardly relative to the groove from wall **102** and surface **106**, respectively, all as shown in FIG. **17.** It is important that sealing surfaces **106** and **110** be free of burrs, pits and other irregularities. While sealing surfaces **106** and **110** are generally normal to each other, they preferably form an angle supplementary to the angle defined by walls **84** and **88** of groove **82** so that seal member **100** will nest securely in the groove with second sealing surface **110** oriented to engage side wall **84** in continuous contact therewith. Thus, in the preferred embodiment, the angle formed by sealing surfaces **106** and **110** will be approximately 85°.

Referring particularly to FIG. **17**, a centroid **114** can be located in accordance with well-known mathematical principles for the plane figure representing a transverse section of sealing walls **102** and **104.** Disregarding the appurtenant structures of seal member **100** to be described hereinafter, if the centroids of all transverse sections of sealing walls **102** and **104** are joined, they will define an imaginary centroidal curve lying in a single plane represented by an interrupted line **116.** In the preferred embodiment, this curve has a serpentine, W-shaped form. The sealing walls being disposed about such a curve, sealing surface **106** will lie outwardly of sealing wall **102** relative to the curve and parallel with plane **116** thereof, and sealing surface **110** will be disposed outwardly of sealing wall **104** relative to the curve and intersecting plane **116** thereof at a locus of points equidistant from the curve. Thus, in the preferred embodiment, sealing walls **102** and **104** and their respective sealing surfaces **106** and **110** (and therefore seal member **100** in general) will follow the serpentine, W-shaped configuration of the imaginary curve, as best seen in FIGS. **9** and **10**, the walls of groove **82** defining a complementary form to receive the seal member. On the other hand, it will be recognized that the plan forms of groove **82** and seal member **100** may take any one of a number of patterns or configurations in accordance with the invention, including those illustrated and described in the aforementioned patents. The particular seal configuration selected will be suggested broadly by the type and function of the device in which the novel sealing arrangement is to be employed, and more particularly, by the magnitudes, directions and sources of the fluid forces to be encountered during operation.

Opposite their common edge, sealing walls **102** and **104** are provided with free edges **118** and **120**, respectively. Preloading means in the form of spaced, elongated preloading elements **122** are provided on seal member **100** to exert a preloading force thereon in a direction tending to urge the seal member outwardly of groove **82** when the seal member and wear plate **66** are assembled in gear pump **20.** Each of a first series of preloading elements **122*a*** extends from surface **108**, and each preloading element **122*b*** of a second series extends from edge **120** of sealing wall **104.** The longitudinal axes of the preloading elements are parallel and extend in a direction generally normal to sealing surface **106**, with their free ends equidistant therefrom. The preloading elements establish the height of seal member **100** as it is viewed in FIG. **17**, the height being selected to be somewhat greater than the depth of groove **82** whereby, when the seal member is received in the groove with preloading elements **122** engaging bottom wall **88** thereof, sealing surface **106** will be raised slightly above surface **74** of wear plate **66** and parallel therewith. Preloading means similar to elements **122** are described and illustrated in the aforementioned patents.

In accordance with the invention, seal member **100** is further provided with additional preloading means which comprise a plurality of spaced transverse preloading elements **124** formed on edge **118** of sealing wall **102** and located adjacent side wall **86** when the seal member is received in groove **82.** As best viewed in FIGS. **9** and **10**, four of the transverse preloading elements form projections **124*a*** on edge **118** at intermediate locations thereof, while two of the transverse preloading elements form projections **124*b*** on edge **118** at the extreme ends thereof and of seal member **100**, each projection **124*b*** forming a part of an end enlargement **126** to be described with greater particularity hereinafter.

Each transverse preloading element has an outer surface **128*a*** or **128*b***, best seen in FIG. **9**, which is coplanar and contiguous with sealing surface **106** and therefore forms a continuation thereof. Each element **124** also has a preloading surface **130*a*** or **130*b*** generally normal to outer surface **128*a*** or **128*b***, respectively, but preferably forming an angle therewith which is supplementary to the angle defined by walls **86** and **88** of groove **82.** Thus, in the preferred embodiment, outer surface **128*a***, **128*b*** and preloading surface **130*a***, **130*b*** will form an angle of approximately 85°. In addition, each preloading surface **130*a***, **130*b*** is shaped to conform to the adjacent surface of side wall **86**, as best shown in FIG. **9**, whereby the preloading surface will engage side wall **86** in continuous contact therewith. Those portions of edge **118** located between adjacent ones of elements **124** relieved portions of sealing surface **106.**

End enlargements **126** each have an end sealing surface **132** which is generally rectangular and generally normal to sealing surface **106** and which forms an acute angle with sealing surface **108.** The end enlargements are dimensioned to close the ends of groove **32**, as best shown in FIG. **9A**, whereby they extend beyond edges **118** and **120.** The end surfaces are shaped to conform to and merge smoothly with peripheral surface **68** of wear plate **66**, as is shown in FIG. **9.** Each end enlargement **126** is also provided with an inner pressure surface **134** which is generally normal to inner pressure surface **108** and forms an acute angle with inner pressure surface **112.**

It will be readily apparent that end enlargements **126**, by virtue of the configuration just described, perform three functions, namely, to close the ends of the groove, to provide a preloading force in one direction in the manner of elements **122**, and to provide a preloading force in a second direction as explained immediately hereinafter.

The transverse dimension of sealing wall **102** at, and including, transverse preloading elements **124** is selected so that the transverse preloading elements and side wall 86 will cooperate to provide a transverse preloading force acting on sealing wall 102 in a direction normal to the preloading force provided by preloading elements 122, whereby to effect a mechanical seal between second sealing surface 110 and side wall 84. This transverse preloading force will be present whenever the resilient seal member 100 is received snugly in the groove.

Referring to FIGS. 2, 9 and 17, it will be noted that portions of edge 118 are spaced from side wall 86 by virtue of the transverse preloading elements 124, and that therefore intervals 135 communicating with groove 82 are defined by adjacent ones of transverse preloading elements 124, edge 118 (or the relieved portions of sealing surface 106 formed thereby), and the adjacent side wall 86, the intervals providing fluid access to the groove and to inner pressure surfaces 108 and 112.

In assembling gear pump 20, seal member 100 is disposed in groove 82 as shown in FIGS. 9, 9A and 17, and wear plate 66 is mounted in the pump with its pressure surface 74 adjacent surface 36 of cavity 40 and its wear face 76 adjacent side faces 51 of gears 42 and 44. Relieved portions 70 and 72 of peripheral surface 68 of the wear plate will be exposed to fluid pressures in recesses 64 and 62, respectively, and journals 48 will be somewhat loosely received in bores 94 of the wear plate.

The dimensions of cavity 40, gears 42 and 44, wear plate 66 and seal member 100 are selected so that a preloading force will be exerted by preloading elements 122 in a direction to maintain first sealing surface 106 of the seal member in engagement with end surface 36 of the working cavity and urge the wear plate toward side faces 51 of the gears. In this manner a space 138 is defined between the adjacent surfaces 36 and 74, which space provides communication between recess 64 on the one hand, and intervals 136 and thus groove 82, on the other hand. At the same time, the preloading force provided by transverse preloading elements 124 will maintain second sealing surface 110 in engagement with side wall 84 of groove 82.

OPERATION

The general principles of operation of gear pumps are well-known and need only be outlined briefly. Inlet port 30 is connected to a suitable source of fluid, and outlet port 32 is connected to a suitable fluid discharge outlet or receiver. Power from any suitable source thereof is applied to extension 52 of journal 48 by way of key 56 to drive gear 44 which acts through intermeshing gear teeth 46 to drive gear 42. The directions of rotation of the gears are indicated by arrows in FIG. 6. Fluid is entrapped by the rotating gear teeth in elongated rotating chambers or spaces continuously formed by adjacent gear teeth in cooperation with surfaces 34, 36 and 38 as the gear teeth travel out of mesh, the fluid being delivered to recess 64 before the gear teeth again intermesh. The fluid is thereby continuously drawn into recess 62 at a relatively low pressure by way of inlet port 30, and continuously discharged at a relatively high pressure by way of recess 64 and outlet port 32.

As soon as a fluid pressure differential exists across the gears 42 and 44; that is, between recesses 62 and 64, wear plate 66 will be urged to the left as viewed in FIG. 3. This movement is permitted by its previously mentioned undersized peripheral surface 68 and oversized bores 94, both exaggerated in FIG. 3 in the interests of clarity. Again referring to FIG. 3, the left-hand side of peripheral surface 68 will thereby form a seal with the adjacent portion of surface 34 of cavity 40. End surfaces 132 of seal member 100 will also engage surface 34 to seal the ends of groove 82. At the same time, high-pressure fluid from recess 64 and the vicinity thereof will be admitted to groove 82 by way of access channels 90 and a passage comprising space 138 and intervals 136 communicating therewith. The high-pressure fluid so admitted provides a pressure-loaded sealing force by acting on pressure surfaces 108 and 112 to urge sealing surface 106 in a direction toward the adjacent surface of cavity 40 and to urge sealing surface 110 in a direction toward side wall 84 of groove 82. The preloading characteristics of seal member 100, by providing a mechanical seal when the pump is at rest, facilitate the pressure-loading of the seal member from the very outset of operation of the pump.

The seal so formed between seal member 100, wear plate 66 and surface 36 of cavity 40 will establish clearly defined pressure-loading zones on pressure surface 74 of the wear plate. Specifically, referring to FIG. 9, the high-pressure zone will comprise that area of surface 74 which lies above, below and to the left of seal member 100, and the low-pressure zone will comprise the area to the right of the seal member.

It will be apparent that the forces which result from the pressures acting on the respective loading zones will effectively oppose the fluid forces generated within the cavity 40 to urge wear plate 66 to the left as viewed in FIG. 2 in engagement with side faces 51 of gears 42 and 44, thereby to load the gears at the interface between side faces 51 and wear face 76 and at the interface between side faces 61 and end surface 38. obviously, this force-balancing effect will be realized regardless of the speed of rotation of the gears.

ALTERNATIVE EMBODIMENTS AND MODIFICATIONS

It is not essential that the wear plate be located at the right-hand end of cavity 40 as viewed in FIG. 2. The seal arrangement will perform equally well if the wear plate is inverted, reversed and positioned at the left-hand end of the cavity with pressure surface 74 adjacent end surface 38 and wear face 76 adjacent side faces 61 of the gears. In such an event the gears will, of course, be displaced to the right, as viewed in FIG. 2, with their side faces 51 immediately adjacent end surface 36. Similarly, two wear plates may be provided, one at either end of cavity 40.

While the member 66 has been consistently referred to as a wear plate, it will be apparent that it may perform the function of a thrust plate by acting to oppose unbalanced axial forces acting on the gears, as might be generated, for example, in a helical gear pump or motor.

It will also be apparent to the person of ordinary skill in the art that, while the fluid pressure device 20 has been described as a gear pump, it is capable of use as a fluid motor by connecting port 32 to an external source of fluid pressure. The pressure fluid thereby introduced to recess 64 will act to drive gears 42 and 44 in directions opposite to those shown in FIG. 6, and relatively low-pressure fluid will be discharged by way of recess 62 and port 30. Journal extension 52 will thus become a drive or power-output member. It is important to note, however, that the novel sealing arrangement of the present invention will continue to function in precisely the manner heretofore described.

Alternatively, the wear plate can be made to be reversible by adopting appropriate groove and seal member patterns or configurations such as those described and illustrated in the aforementioned U.S. Pat. No. 3,348,492. With a reversible wear plate, the high and low-pressure sides of working cavity **40** can be reversed when the device is used as a fluid motor. In such a case, the gears will continue to rotate in the same directions and ports **30** and **32** will remain an inlet and an outlet, respectively. On the other hand, the same mode of operation can be realized using the wear plate and seal member disclosed herein by simply removing the wear plate, inverting it and replacing it with the seal member again adjacent end surface **36**.

It is important to note that groove **82** may be provided in end surface **36** instead of pressure surface **74** of the wear plate. If this modification is adopted, pressure surface **74** will be uninterrupted and access channels **90**, if provided, will be formed in surface **36** and connect the groove directly with recess **64**. The manner of operation of the seal arrangement will remain essentially the same. Briefly, the preloading characteristics will effect a mechanical seal between the seal member and a side wall of the groove and between the seal member and pressure surface **74** of the wear plate, whereby to define the pressure-loading zones on the wear plate. Admission of high-pressure fluid to the groove, effected in the same manner as heretofore described, will pressure-load the seal, and the forces resulting from the pressures to which the loading zones are exposed will act to urge the wear plate in a direction to load the gears.

While the invention has been described in connection with specific embodiments thereof, it is to be understood that this is by way of illustration and not by way of limitation; and the scope of the appended claims should be construed as broadly as the prior art will permit.

I claim:

1. A pressure-loaded seal member for a rotary fluid-pressure energy-translating device of the positive displacement type, formed of resilient material and comprising first and second sealing walls generally normal to each other and disposed about a centroidal curve lying in a single plane, the first sealing wall having a planar first sealing surface disposed outwardly relative to the curve and parallel with the plane thereof, the second sealing wall having a second sealing surface disposed outwardly relative to the curve and intersecting the plane thereof at a locus of points equidistant therefrom, the sealing walls being joined to each other at a common edge thereof and each having a free edge opposite the common edge, and a plurality of preloading elements projecting from the free edge of the first sealing wall in transverse directions relative thereto and in spaced relation to each other, each of the preloading elements having an outer surface coplanar and contiguous with the first sealing surface, and a preloading surface generally normal to the outer surface and extending therefrom toward the plane of the curve.

2. The seal member according to claim **1**, wherein the curve has a serpentine, generally W-shaped configuration, and the seal member includes a generally rectangular end sealing surface at either end thereof, the end sealing surface intersecting the first and second sealing surfaces, the end surface being generally normal to the first sealing surface and forming an acute angle with the second sealing surface, the end surface extending outwardly relative to the curve beyond the free edges of the first and second sealing surfaces.

3. A seal assembly for a rotary hydraulic pump or motor of the positive displacement type, comprising, in combination, a plate member having opposed planar surfaces, means including a pair of spaced side walls defining a groove in one of the planar surfaces, a resilient seal member received in the groove and comprising a sealing wall having a first sealing surface and defining first and second edges, said seal member further comprising a second sealing surface, the first sealing surface being disposed transversely of the groove and facing outwardly of the groove with the second sealing surface in engagement with one of the side walls and extending inwardly relative to the groove from the first sealing surface, the seal member further comprising preloading means engaging the other side wall to exert a preloading force on the seal member in a transverse direction relative to the groove to urge the second sealing surface into engagement with said one side wall, and means for admitting fluid pressure to the groove to urge the seal member toward said one side wall and outwardly relative to the groove, the second sealing surface extending from the first edge of the first sealing surface, and the pressure-admitting means including an interval between said other side wall and the second edge of the first sealing surface, the preloading means comprising a plurality of preloading elements disposed in spaced relation to each other on said second edge of the first sealing surface, each of the preloading elements comprising a projection formed on said second edge of the first sealing surface, the projection having an outer surface coplanar and contiguous with the first sealing surface, and a preloading surface generally normal to the outer surface and extending inwardly of the groove therefrom, the preloading surface being formed to engage said other side wall.

4. A seal assembly for a rotary hydraulic pump or motor of the positive displacement type, comprising, in combination, a plate member having opposed planar surfaces, means including a pair of spaced side walls defining a groove in one of the planar surfaces, a resilient seal member received in the groove and comprising a sealing wall having a first sealing surface and defining first and second edges, said seal member further comprising a second sealing surface, the first sealing surface being disposed transversely of the groove and facing outwardly of the groove with the second sealing surface in engagement with one of the side walls and extending inwardly relative to the groove from the first sealing surface, the seal member further comprising preloading means engaging the other side wall to exert a preloading force on the seal member in a transverse direction relative to the groove to urge the second sealing surface into engagement with said one side wall, and means for admitting fluid pressure to the groove to urge the seal member toward said one side wall and outwardly relative to the groove, the second sealing surface extending from the first edge of the first sealing surface, and the pressure-admitting means including an interval between said other side wall and the second edge of the first sealing surface, the preloading means comprising a plurality of preloading elements disposed in spaced relation to each other on said second edge of the first sealing surface, the plate member has a generally curved peripheral surface intersecting the planar surfaces, the peripheral surface intersecting the groove at at least one end thereof, the seal member having an enlargement at at least one end thereof formed to close said one end of the groove, the enlargement having an end surface extending inwardly of the groove from the first sealing surface and between the side walls of the groove from the second sealing surface, the end surface being shaped to conform to adjacent portions of the peripheral surface of the plate member, one of the preloading elements comprising a portion of the enlargement projecting beyond said second edge of the first

sealing surface, the enlargement having an outer surface coplanar and contiguous with the first sealing surface, the projecting portion having a preloading surface generally normal to the outer surface and extending inwardly of the groove therefrom, the preloading surface being formed to engage said other side wall.

5. The seal assembly according to claim **4,** wherein the groove-defining means includes a bottom wall intersecting each of the side walls, the enlargement being dimensioned to engage the bottom wall of the groove to exert a further preloading force on the seal member in a direction to move the seal member outwardly of the groove.

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