March 5, 1968 A. E. PETTYJOHN ET AL 3,371,615

PRESSURE LOADED PUMP

Original Filed Aug. 15, 1966 4 Sheets-Sheet 1

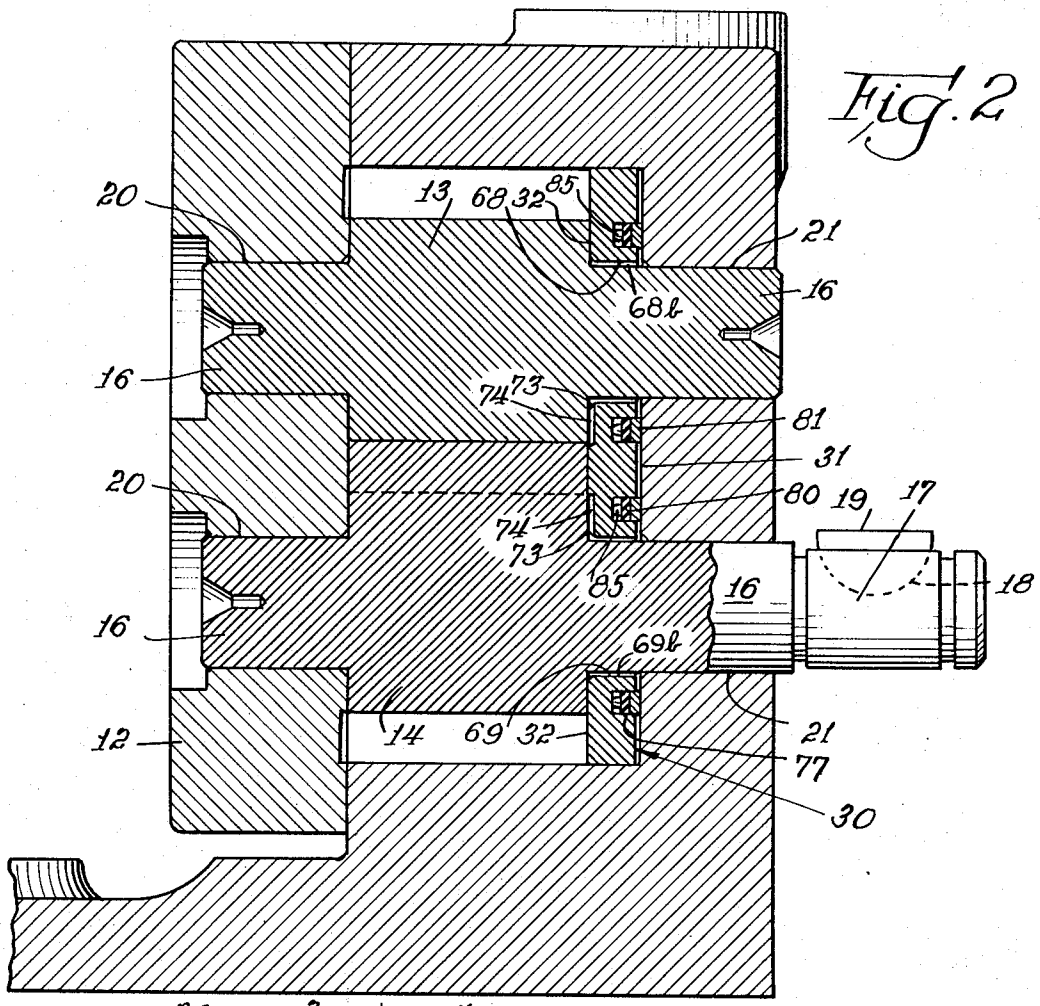


Fig. 2

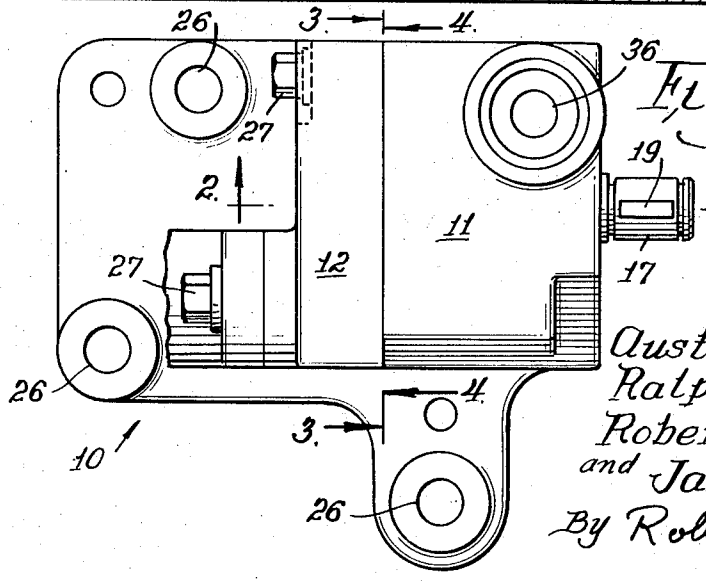


Fig. 1

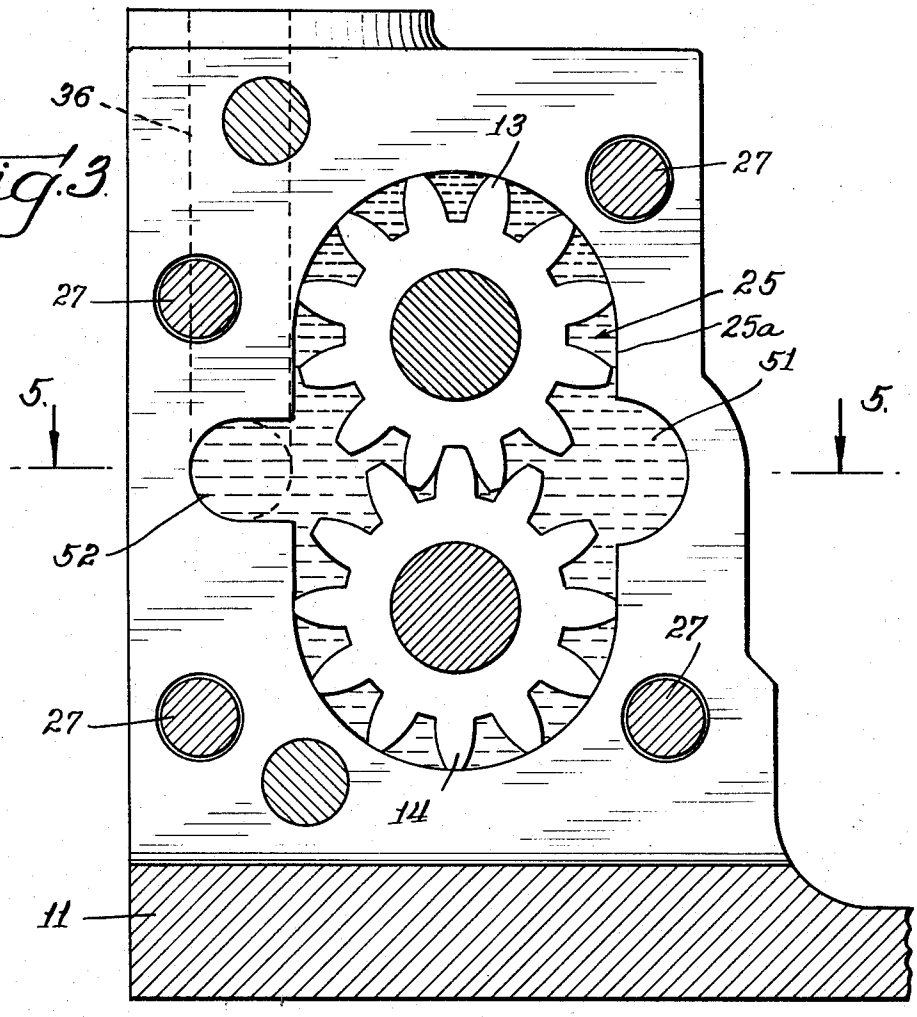
Inventors
Austin E. Pettyjohn,
Ralph J. Riblett,
Robert R. Davidson
and James R. Cox
By Robert L. Zieg
Atty.

March 5, 1968 A. E. PETTYJOHN ET AL 3,371,615

PRESSURE LOADED PUMP

Original Filed Aug. 15, 1966 4 Sheets-Sheet 2

Fig. 3



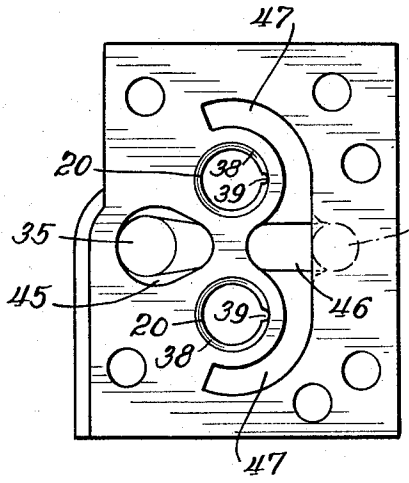


Fig. 4

Inventors
Austin E. Pettyjohn,
Ralph J. Riblett,
Robert R. Davidson
and James R. Cox
By Robert L. Zieg Atty.

March 5, 1968 A. E. PETTYJOHN ET AL 3,371,615

PRESSURE LOADED PUMP

Original Filed Aug. 15, 1966 4 Sheets-Sheet 3

Fig. 5

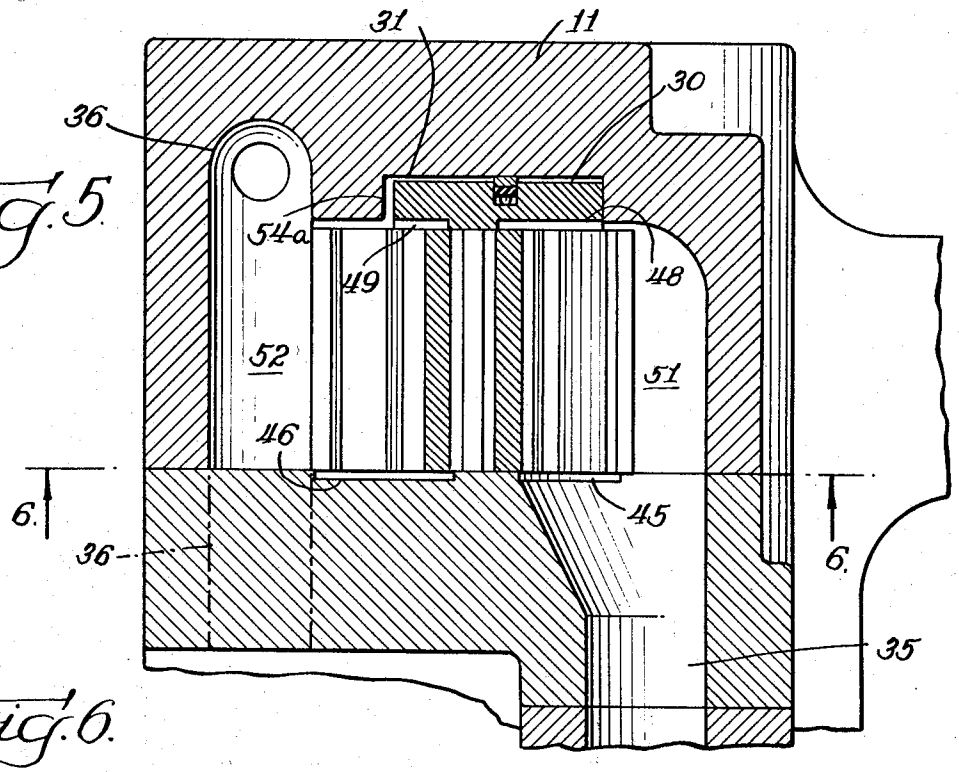


Fig. 6

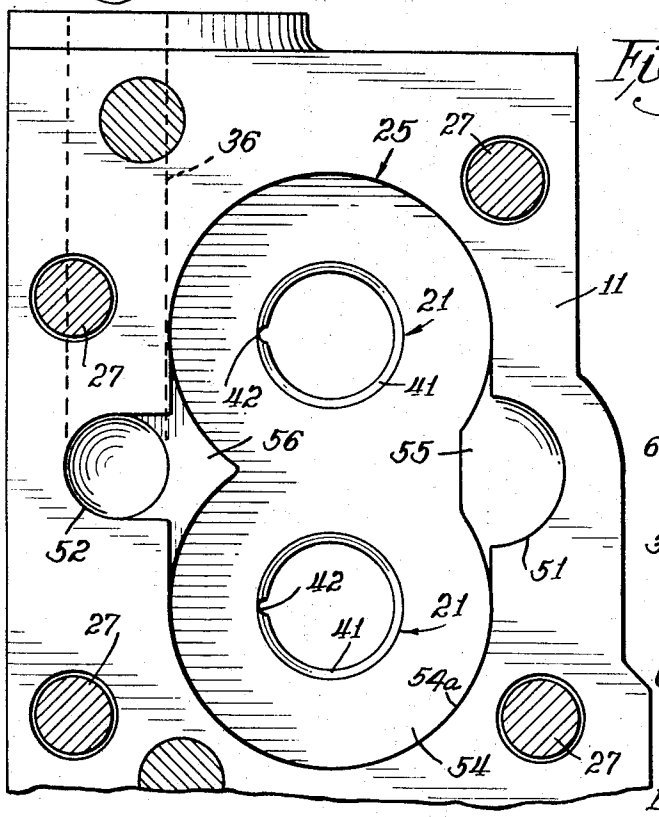
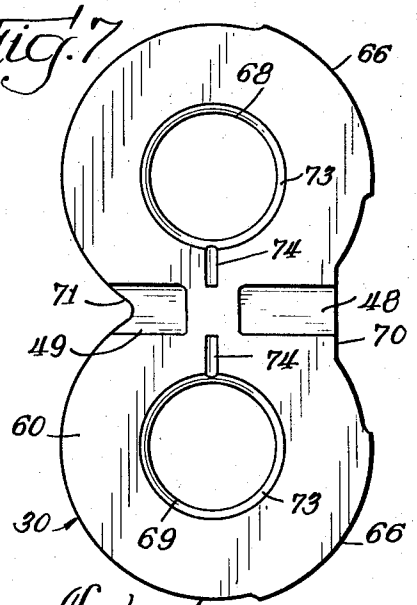


Fig. 7



Inventors
Austin E. Pettyjohn,
Ralph J. Riblett,
Robert R. Davidson
and James R. Cox
By Robert L. Zieg Atty

March 5, 1968 A. E. PETTYJOHN ET AL 3,371,615

PRESSURE LOADED PUMP

Original Filed Aug. 15, 1966 4 Sheets-Sheet 4

Fig. 8.

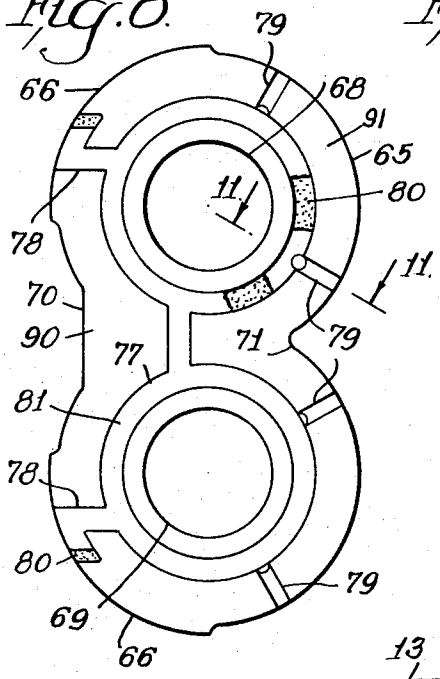


Fig. 9.

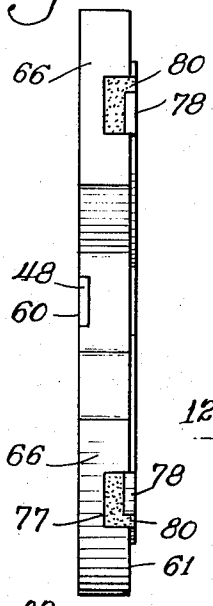


Fig. 10.

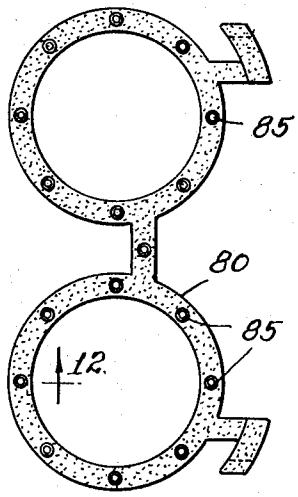


Fig. 11.

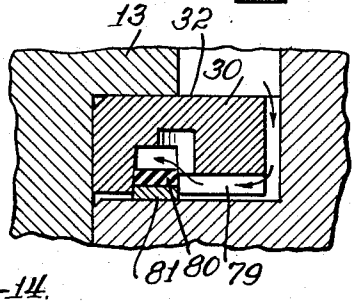


Fig. 12.

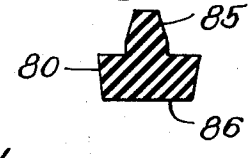


Fig. 13.

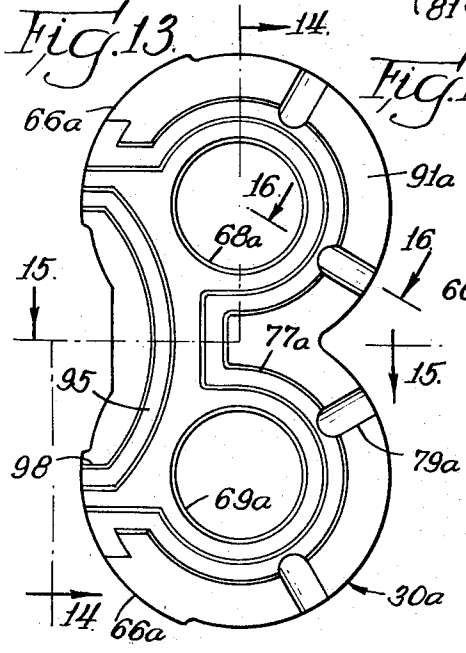


Fig. 14.

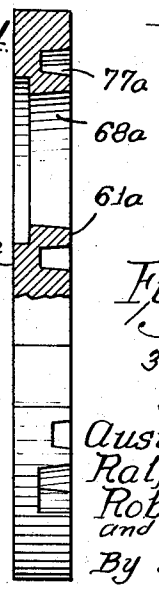


Fig. 16.

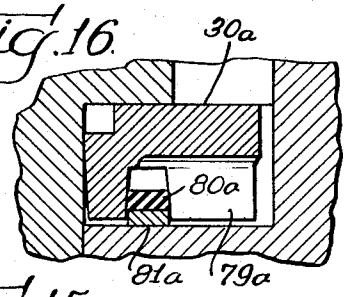
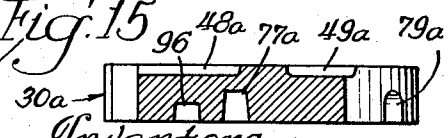


Fig. 15.



Inventors
Austin E. Pettyjohn,
Ralph J. Riblett,
Robert R. Davidson
and James R. Cox
By Robert L. Zieg atty.

United States Patent Office 3,371,615 Patented Mar. 5, 1968

3,371,615

PRESSURE LOADED PUMP

Austin E. Pettyjohn, Auburn, Ind., Ralph J. Riblett, Wooster, and Robert R. Davidson, Elyria, Ohio, and James R. Cox, Fort Wayne, Ind., assignors to Borg-Warner Corporation, Chicago, Ill., a corporation of Illinois

Continuation of application Ser. No. 572,494, Aug. 15, 1966. This application Jan. 16, 1967, Ser. No. 609,686
12 Claims. (Cl. 103—126)

ABSTRACT OF THE DISCLOSURE

An improved pressure loaded pump having a one-piece wear plate mounted between the pump gears and the housing. The wear plate has a groove on the face adjacent the pump end wall which is of a "spectacle" shape and in which is assembled a sealing member and a resilient member. Fluid pressure in the groove urges the sealing member into contact with the end wall to define pressure loading zones on the wear plate.

This application is a continuation of my earlier-filed patent application, Ser. No. 572,494, filed Aug. 15, 1966, entitled, "Pressure Loaded Pump."

It is an object of the present invention to provide an improved pressure loaded pump utilizing a wear plate having an improved sealing means therein to accomplish the necessary sealing for pressure loading.

It is a more particular object to provide an improved pump mechanism including a wear plate having a relatively thin cross section with grooves formed in the wear plate having sealing means within the groove. The invention may be used for example in gear type pumps with the wear plate mounted between the side faces of the gears and an end wall of the pump body. The grooves in the wear plate are preferably formed on the face of the wear plate adjacent the pump end wall and the grooves have a seal therein in sealing engagement with the end wall of the pump to define pressure loading zones around the wear plate.

The improved sealing structure comprises a sealing member which may be composed of a synthetic non-metallic material within the grooves in the wear plate. Below the sealing member is mounted a resilient member which forms a pressure channel in the grooves in which fluid pressure will be supplied when the pump is operating to compress the resilient member and force the sealing means outwardly from the wear plate into engagement with the pump end wall to seal the pressure loading zones and further to aid in the pressure loading by providing additional force moving the wear plate toward the pump gears.

Further, the present invention includes a resilient means in the groove in the pump wear plate having projections thereon which are compressed when the pump is assembled so that after assembly the wear plate is preloaded into engagement with the pump gears to provide necessary pump efficiency when the operation of the pump is initiated.

Other objects and advantages of novel features of the invention will become apparent upon consideration of the detailed description in connection with the accompanying drawings wherein:

FIGURE 1 is a top view of a pump embodying the principles of the present invention;

FIGURE 2 is a cross sectional view taken along the line 2—2 of FIGURE 1;

FIGURE 3 is a sectional view taken along the line 3—3 of FIGURE 1;

FIGURE 4 is a sectional view taken along the line 4—4 of FIGURE 1;

FIGURE 5 is a cross sectional view taken along the line 5—5 of FIGURE 3;

FIGURE 6 is a sectional view taken along the line 6—6 of FIGURE 5;

FIGURE 7 is an end view of the wear plate for the pump;

FIGURE 8 is an end view of the opposite side of the wear plate and the pump;

FIGURE 9 is an end view of the wear plate of FIGURE 8;

FIGURE 10 is a view of the resilient means for the wear plate grooves;

FIGURE 11 is a cross sectional view taken along the lines 11—11 of FIGURE 8;

FIGURE 12 is a cross sectional view taken along the lines 12—12 of FIGURE 10;

FIGURE 13 is a view of a modified form of wear plate design;

FIGURE 14 is an end view of the wear plate of FIGURE 13 partially in cross section;

FIGURE 15 is a cross sectional view taken along the line 15—15 of FIGURE 13; and

FIGURE 16 is a cross sectional view taken along the line 16—16 of FIGURE 13.

Referring to FIGURES 1 and 2 a pump is illustrated which may employ the present invention therein. The pump **10** includes a pump body or housing **11** and a pump end cover **12**. The pump body **11** includes a cavity **25** defined by an inner peripheral surface **25***a*. Mounted within the pump cavity are gears **13** and **14** which intermesh and when rotated are operative to pump fluid. Journals **16** are provided for the gears **13** and **14**. One of the journals **16** for the gearing includes an extension **17** having a keyway **18** therein engageable by a key **19** to provide the driving connection to turn the pump gears when connected to a power source. The journals **16** for the gears **13** and **14** are mounted in a pair of bores **20** within the cover **12** and in a pair of bores **21** provided in the pump body **11**. Holes **26** are provided in the pump body **11** for mounting the pump in a desired position. The cover member **12** may be secured to the pump body **11** by any known means as for example by bolts **27**. An improved wear plate **30** is provided which is mounted in the pump cavity between the gears **13** and **14** and an inner face or wall **31** of pump body **11**. The gears **13** and **14** have side faces **32** which are engaged by the wear plate **30**.

Referring to FIGURES 4 and 5 an inlet port **35** is shown in the cover **12** which communicates fluid into the cavity **25** of the pump body.

Referring to FIGURES 1 and 3 an outlet port **36** for pressure developed by the pump **10** is illustrated which is formed in the pump body **11**. The outlet port **36** could also be located in the cover member **12** as indicated in phantom lines in FIGURES 4 and 5.

Referring to FIGURE 4 the bores **20** in the cover **12** which receive journals **16** of the pump gears are provided with counter bores **38**. Counter bores **38** comprise a chamfered recess in communication with grooves **39** which extend axially the length of the bores **20**. The grooves **39** serve to supply lubricant to the journals within bores **20**. Likewise referring to FIGURE 6 the bores **21** on pump body **11** which accommodate journals **16** of the pump gear may be counter bored to form recesses **41**. The recesses **41** communicate with grooves **42** which extend axially along the bores **21** to carry lubricating fluid to the journals **16**.

Referring to FIGURE 4 the cover **12** is provided with a generally pear-shaped recess **45** and a generally rectangular outlet recess **46**. The outlet recess **46** is provided with connecting arcuate recesses **47**.

Referring to FIGURE 7 the wear plate **30** is also provided with a rectangular shaped inlet recess **48** and a partially rectangular outlet recess **49**. The relationship between the recesses is best illustrated in the cross section of FIGURE 5. The inlet recesses **45** and **48** combine to provide adequate and smooth flow of fluid to the pump gears. The outlet recesses **46** (with arcuate recesses **47**) and **49** prevent the fluid from being trapped between the teeth of the gears and thus prevent undue high pressure from being developed in excess of the pressure normally obtained from the pump.

As illustrated in FIGURES 3, 5 and 6 the cavity **25** for the gears **13** and **14** includes an axially extending recess **51** connected to the inlet **35** of the pump and an axially extending outlet recess **52** connected to the outlet of the pump **36**. The recesses **51** and **52** extend axially parallel to the axis of rotation of the gears **13** and **14** and insure adequate fluid flow to and from the pump gears.

A pocket **54** defined by an inner peripheral surface **54***a* is formed within the pump body **11** on the side opposite cover **12** which contains the inner face **31**. The wear plate **30** of the pump is mounted within pocket **54**. The pocket **54** includes projecting areas **55** and **56** which project into the pocket **54** on opposite sides thereof. The projecting areas **55** and **56** have different shapes, the area **55** being rather blunt and the area **56** more pointed. The purpose of the shape of areas **55** and **56** will be described later.

Referring to FIGURES 7, 8 and 9 the wear plate **30** for the pump containing the novel pressure loading and sealing structure of the present invention is illustrated. The wear plate **30** has a face **60** which is adapted to engage the gear side faces **32**. Also, the wear plate has a face **61** on the opposite side thereof adapted to be in close association with the inner face **31** of the pump body. The wear plate **30** is generally of a figure **8** shape having two generally circular sections.

The outer circumference of the wear plate **30** is relieved to define circumferential outer peripheral portions **65** of reduced radius as compared with body engaging portions **66**.

The wear plate **30** includes central bores **68** and **69** adapted to receive the journals **16** of the gears **13** and **14**. The bores are somewhat larger than the journals of the gears forming clearances **68***b* and **69***b* so that the wear plate **30** may move transversely with respect to the axis of the gears to a limited extent.

The shape of the wear plate in the central area thereof differs as illustrated in FIGURES 7 and 8. These areas have a different shape so as to correspond to the areas **55** and **56** provided in the pump cavity **25**. Thus the wear plate can be assembled into the cavity **25** in one relationship only to the cavity thereby insuring the wear plate will be assembled with the face **61** toward the inner face **31** of pocket **54** and the face **60** toward gears **13** and **14**. Therefore a generally straight line area **70** is provided on wear plate **30** which generally matches projecting area **55** of pump cavity **25** and a generally circular indented area **71** is provided on the opposite side of wear plate **30** which generally matches the shape of projecting area **56**.

Provided on the face **60** of wear plate **30** surrounding the bores **68** and **69** are recesses **73**. Connected to recesses **73** are vertically extending recesses **74** which serve to conduct fluid from near the intermeshing area of the pump gears to the recesses **73** which will thus insure that the internal bores **68** and **69** have adequate fluid for lubrication and cooling during operation of the pump.

Provided in the face **61** of the wear plate **30** is a continuous groove **77** which generally is of a "spectacle" shape surrounding each of the journals for the gears and including generally straight sections **78** and **79** which extend from the circular portions of the groove surrounding bores **68** and **69** out to the circumferential portions **66**. Extending radially from the groove **77** are grooves

79 which in a preferred embodiment of the pump are four in number adapted to convey fluid to the groove **77**. The grooves **79** extend from the groove **77** to the circumferential portions **65** of the wear plate **30**.

Assembled within groove **77** are two components having generally the same "spectacle" shape as groove **77**. A resilient member or elastomer **80** is assembled within groove **77** and on top of the resilient member **80** is a sealing member **81** also assembled within groove **77**.

Referring to FIGURES 10 and 12 the elastomer or resilient member **80** is illustrated. The resilient member **80** has a plurality of generally conical projections **85** on one side thereof. On the opposite side of projections **85** is a face **86**. Conical projections **85** are distributed over the entire extent of resilient member **80** in equidistance locations. The conical projections **85** function as a preloading means for the wear plate **30** as will be later described. The resilient member **80** may be composed of rubber or similar types of elastomers.

The "spectacle" shaped sealing member **81** is of a generally rectangular cross section which will closely match the width of the groove **77** as it is assembled in groove **77**. As illustrated in FIGURE 11 the sealing member **81** is adapted to engage the inner face **31** of the pocket **54** in the cavity **25** of the pump.

With the seal member **81** engaging the face **31** pressure zones are defined on the wear plate **30** and within the pocket **54** in which the wear plate **30** is disposed. A low pressure area **90** is defined which is generally in the area of inlet recess **51** and on the inlet side of the pump. A high pressure area **91** is defined which extends around the major portion of the wear plate **30**. The defined high pressure area **91** is in communication with the outlet or high pressure recess **52** of the pump. The area **91** is so shaped and defined so as to properly pressure load the pump to counterbalance the forces developed in the high pressure outlet zone of the intermeshing gears **13** or **14** adjacent the wear plate. Due to the clearance between the projecting area **56** within pump cavity **25** and the wear plate **30** the high pressure in the outlet recess **52** is communicated around the circumferential portions **65** of the wear plate to the face **61** and to the high pressure defined zone **91**.

High pressure in the area **91** of the wear plate is conducted by grooves **79** into the groove **77**. High pressure in groove **77** applies force to the elastomer **80** thereby deforming same and forcing face **86** of the elastomer or resilient member **80** into engagement with sealing member **81** to urge same outwardly of the wear plate **30** into engagement with inner face **31**. A pressurized fluid seal is thus provided to insure that the pressure zones on the wear plate and within the pocket **54** will be maintained. Thus as the pressure within the pump increases the force of the resilient member **80** on the sealing member **81** also increases. The pressurized fluid seal which surrounds the journals **16** of the pump also prevents air from being sucked along journals **16** into the inlet by inlet vacuum and thereby prevents the poor efficiency which can result when this type of seal is not provided.

When the pump is assembled the height of conical projections **85** is such that the projections engage the lower or bottom surface of the groove **77** and are compressed slightly in assembly. Thus the conical projections **85** provide a preload for the sealing member **81** urging the sealing member **81** into engagement with inner face **31** prior to any pressure being developed by the pump. Since the groove **77** is continuous the high pressure communicated through grooves **79** will be communicated around the entire extent of the groove **77** so that sealing member **81** is urged into engagement with inner face **31** with a relatively constant force over its entire extent.

Due to the relieved portions **65**, the fluid pressure acting on the wear plate **30** in the high pressure zone is generally constant over most of its extent. This type of relieving helps alleviate the pressure gradient changes due

to speed variation. At high speeds the seal point between the gear teeth and body bore tend to move towards the outlet port whereas at low speeds it tends to move towards the inlet. Only in the area of portions **66** of relatively small arcuate extent is a pressure gradient involved thereby improving the pressure loading characteristics of the pump.

When the pump is delivering high pressure, the wear plate **30** will be urged into engagement with the face **60** of the wear plate engaging face **32** of gears **13** and **14**. The high pressure is not only utilized to pressure load the pump but will act on the circumferential portions **65** of the wear plate due to the clearance involved between these areas and the pocket **54** and move the wear plate transversely so that areas **66** engage the cavity **25** and provide a fluid seal between areas **66** and cavity **25**. This seal being necessary to prevent fluid pressure from being communicated between the high pressure area **91** on wear plate **30** and low pressure area **90**. Since only area **66** engages the bore **25** the improved wear plate **30** is economical to manufacture in that only the area **66** on the outer circumference thereof need to be finish machined.

The sealing members **81** are constructed to relatively closely engage either side of groove **77** to prevent the possibility of the elastomer **80** from being extruded out of groove **77** under high pressure between the wear plate **30** and the inner face **31** which would destroy the effectiveness of the fluid seal.

Referring to FIGURES 13, 14, 15 and 16 a modified form of wear plate is illustrated. The wear plate **30***a* is generally similar in construction to wear plate **30**. The identical portions of wear plate **30***a* are numbered the same as wear plate **30** with the suffix small *a* added. The difference being that in the modified wear plate **30***a* a groove **77***a* is utilized which is of a generally W configuration although the groove **77***a* of wear plate **30***a* may also be referred to as of a generally "spectacle" shaped configuration. As compared to the groove **77** of wear plate **30** an area of the seal which would complete the incircling of the bores **68** and **69** has been eliminated since this area is not necessary to define the high pressure loading zone of the wear plate. The groove **77***a*, elastomer **80***a* and seal **81***a* of FIGURES 13 and 16 substantially surround the bores **68***a* and **69***a* which accommodate the journals of the gears and, as illustrated in FIGURE 13, may extend approximately 270° around the bores **68***a* and **69***a* and the gear journals. However, when the W shaped construction is utilized, an additional seal **95** may be used. The seal **95** comprising an elastomeric or resilient sealing member assembled within a groove **96**. The additional seal **95** is necessary in this construction to prevent any high pressure fluid around the journals **16** of the gears **13** and **14** from leaking to the inlet side of the pump across the face of the wear plate **30***a* in the area of the seal **95** as will be clear from the drawings. The W shaped seal of wear plate **30***a* defines generally an identical high pressure zone **91** on the wear plate as does the construction of FIGURE 30. Thus the modified wear plate **30***a* will function in a like manner to the wear plate **30** as described above.

From the above it will be apparent that the present invention provides a novel and improved pressure loaded pump structure which has numerous advantages and unexpected results in the pressure loaded pump field due to the use of the grooves **77** and the structure therewithin. Fluid pressure is utilized to define a high pressure loading zone by providing a loading force on the seal of the wear plate defining the zone. Further, the pressure utilized to provide a sealing force within the area of grooves **77** also aids in the pressure loading function in that additional force will also be applied to the wear plate to move same into contact with the side faces of the gears.

Also, a resilient member or elastomer has been utilized which in pump assembly is slightly compressed and inherently provides a preloading function on the wear plate **30** to initially move the wear plate into engagement with the gears and provide a sealing engagement between the gears and the wear plate to improve pump efficiency during initial pumping stage.

Further, the shape of the improved wear plate of the present invention has been designed so as to provide a fool-proof assembly feature in that the wear plate must be assembled within the cavity in the proper orientation or assembly is not possible.

Further, the improved wear plate has a relieved outer surface over a great extent thereof in the high pressure zone to eliminate the pressure gradient problem normally involved in pressure loaded pumps and minimize same.

In the construction of the present invention the pressure loading seal structure is a part of and carried with the wear plate of the pump. Thus complicated machining within the pump body is eliminated since the wear plate may be machined and the pressure loading and sealing structures carried therewith assembled to the wear plate before the wear plate is assembled to the pump.

Further, the improved pump design of the present invention includes inlet recesses in both the pump cover and the wear plate to provide a smooth and continuous flow of fluid to the pump gears and outlet recesses are provided in both the wear plate **30** and the pump cover to serve as anti-trapping grooves or recesses to prevent high pressure fluid from being trapped between the gears and thereby improve pump efficiency. Arcuate recesses **47** in the pump cover which connect to the outlet recess **46** further improve pump efficiency in reducing the torque required to operate the pump since the recesses **47** extend approximately 107° around the circumference of the pumping gears in the area of the gear teeth. The recesses **47** extend in a radial sense from the root of the teeth of the pumping gears to the outer diameter of the gear teeth and thus a substantial area of the pump cover which normally has frictional engagement with the pump gears has been relieved to substantially reduce the frictional losses within the pump.

The present invention comprising the improved wear plate **30** can be used in pumps having a wear plate on each side of the gears. The principle of operation of the wear plate in providing pressure loading when two are used is similar to that described above for a single wear plate pump. However in the two wear plate construction advantages are apparent in that less accuracy of machining is required when the sealing and pressure loading described above is provided on each side of the pump gears.

Various of the features of the invention have been particularly shown and described; however, it should be obvious to one skilled in the art that various modifications may be made therein without departing from the scope of the invention.

We claim:

1. An hydraulic apparatus comprising: a housing having a cavity and a pair of end walls; a pair of rotatable means having sides thereon disposed in said cavity; means defining an inlet and an outlet in said housing leading to and from said rotatable means whereby said rotatable means receives fluid from said inlet and delivers a certain fluid pressure out said outlet; a one-piece plate disposed in said cavity between one of said end walls and said pair of rotatable means, said plate having opposed faces; said plate being movable toward said pair of rotatable means to provide a sealing engagement between one of said faces and said pair of rotatable means, a groove in the other face of said plate having a resilient means therein, a sealing member in said groove engageable by said resilient means, said sealing member being engageable with said one end wall to define a pressure chamber, said chamber being in communication with the pressure in said outlet whereby said pressure in said chamber maintains said plate in engagement with said rotatable means, and means in said plate communicating pressure in said chamber with said groove whereby said pressure will act in

said groove to deform said resilient means and thereby urge said sealing member outwardly with respect to said plate to maintain a sealing engagement between said sealing member and said end wall, and wherein said pair of rotatable means comprises a pair of gears each having a journal extending through said plate, said sealing means, resilient member and groove each having a generally "spectacle" like shape and thereby substantially surrounding each of said journals.

2. An hydraulic apparatus as claimed in claim 1 wherein said resilient means includes preloading means integral therewith and adapted to initially move said sealing member into engagement with said end wall before said hydraulic apparatus is in operation and delivering fluid pressure.

3. An hydraulic apparatus as claimed in claim 2 wherein said preloading means comprises: a plurality of projections on one side of said resilient means adapted to engage said plate within said groove to provide an initial separating force between said plate and said sealing member.

4. An apparatus as claimed in claim 2 wherein said resilient means has a generally rectangular cross-section.

5. An apparatus as claimed in claim 4 wherein said preload means comprises a plurality of conically shaped projections extending from said resilient means and contacting said plate within said groove.

6. An apparatus as claimed in claim 1 wherein said resilient member has a channel therein cooperating with said groove to form a passage to conduct fluid pressure along the length of said resilient member.

7. An apparatus as claimed in claim 1 wherein said resilient member comprises an elastomer.

8. An apparatus as claimed in claim 1 wherein said sealing member is flexible.

9. An hydraulic apparatus as claimed in claim 1 wherein said plate has a generally arcuate circumferate surface generally complimentary to said cavity, said surface being relieved except for two arcuate locating portions thereof to allow for relatively free axial movement of said plate within said cavity.

10. An assembled structure including a fluid seal comprising a surface and a member adjacent said surface, means cooperating with said surface comprising a source of fluid pressure, a groove in said member, a resilient member mounted in said groove, a sealing member within said groove and in engagement with said resilient member, means communicating said pressure to said groove whereby said resilient member will be deformed and urge said sealing member into sealing engagement with said surface, preload means integral with said resilient means comprising a plurality of deformable conical projections on said resilient means, said projections being deformed when said structure is assembled whereby said sealing member will be initially urged into engagement with said surface prior to supply of fluid pressure from said source.

11. An hydraulic apparatus as claimed in claim 1 wherein said housing cavity is defined by an inner peripheral surface and said pair of end walls; said plate having bores therein, said journals passing through said bores, means defining a clearance between said bores and said journals, said plate being movable transversely toward said inner peripheral surface to provide a sealing engagement between said plate and said surface and axially toward said rotatable means.

12. An hydraulic apparatus comprising: a housing having a cavity and a pair of end walls; a pair of rotatable means having sides thereon disposed in said cavity; means defining an inlet and an outlet in said housing leading to and from said rotatable means whereby said rotatable means receives fluid from said inlet and delivers a certain fluid pressure out said outlet; a one-piece plate disposed in said cavity between one of said end walls and said pair of rotatable means, said plate having opposed faces; said plate being movable toward said pair of rotatable means to provide a sealing engagement between one of said faces and said pair of rotatable means, a groove in the other face of said plate having a sealing member therein, said sealing member being engageable with said one end wall to define a pressure chamber, said chamber being in communication with the pressure in said outlet whereby said pressure in said chamber maintains said plate in engagement with said rotatable means, and means in said plate communicating pressure in said chamber with said groove whereby said pressure will act in said groove to urge said sealing member outwardly with respect to said plate to maintain a sealing engagement between said sealing member and said end wall and wherein said pair of rotatable means comprises a pair of gears each having a journal extending through said plate, said sealing member and groove each having a generally "spectacle" like shape and thereby substantially surrounding each of the said journals.

References Cited

UNITED STATES PATENTS

2,714,856	8/1955	Kane	103—126
2,809,592	10/1957	Miller et al.	103—126
2,816,512	12/1957	Murray	103—126
2,853,952	5/1958	Aspelin	103—126
2,933,047	4/1960	Judkins	103—126
3,068,804	12/1962	Thrap et al.	103—126
3,104,616	9/1963	Peet	103—126
3,137,238	6/1964	Gordon	103—126
3,142,260	7/1964	Oliver	103—126
3,213,799	10/1965	Trick	103—126
3,294,029	12/1966	Clark et al.	103—126

DONLEY J. STOCKING, *Primary Examiner.*

WILBUR J. GOODLIN, *Examiner.*