Oct. 15, 1957 W. E. MILLER ET AL 2,809,592

ROTARY PUMP OR MOTOR

Filed Jan. 13, 1954 3 Sheets-Sheet 1

FIG. 1

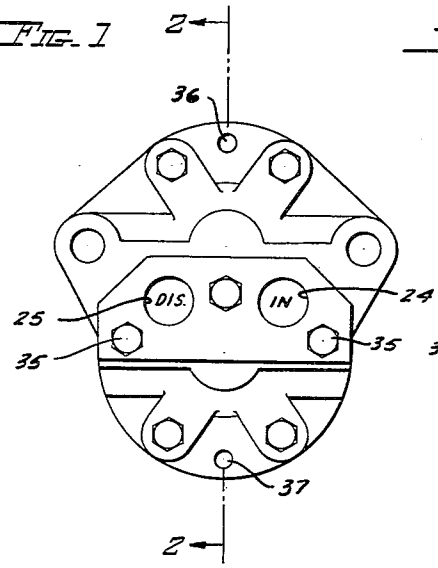


FIG. 2

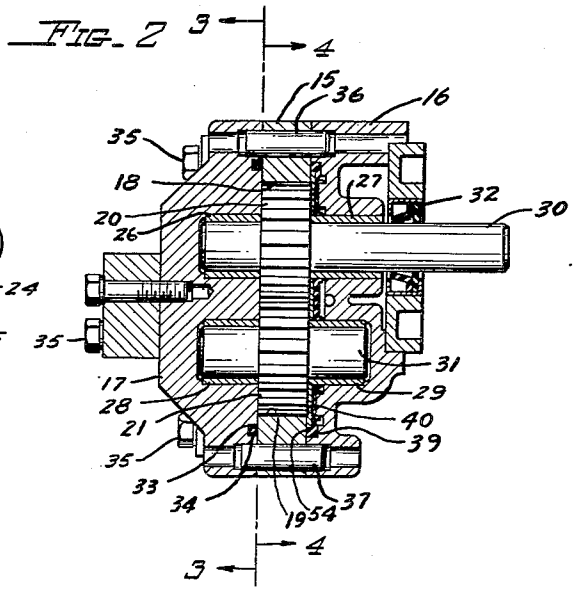


FIG. 3

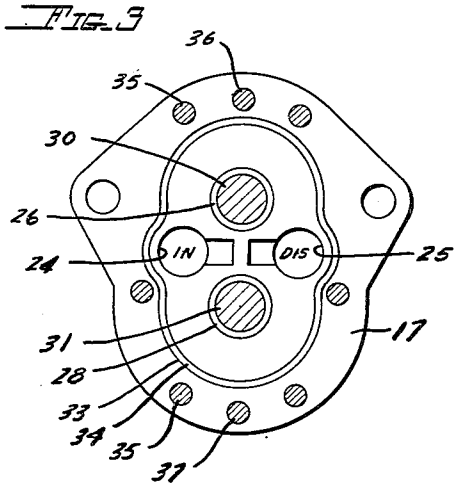
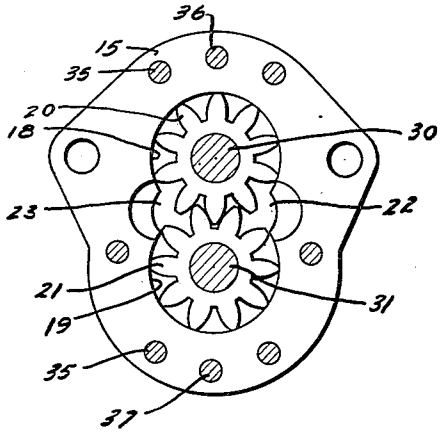


FIG. 4



WENDELL E. MILLER
LEONARD H. REIMER
INVENTORS

BY Hubert Miller

ATTORNEY

Oct. 15, 1957 W. E. MILLER ET AL 2,809,592

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Filed Jan. 13, 1954 3 Sheets-Sheet 2

FIG. 5

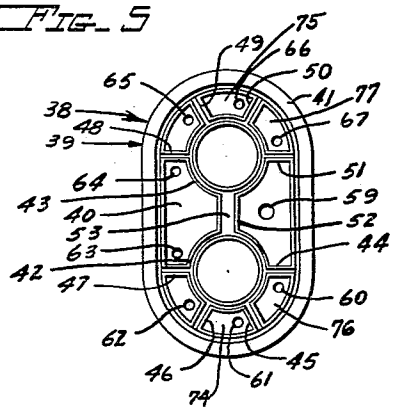


FIG. 6

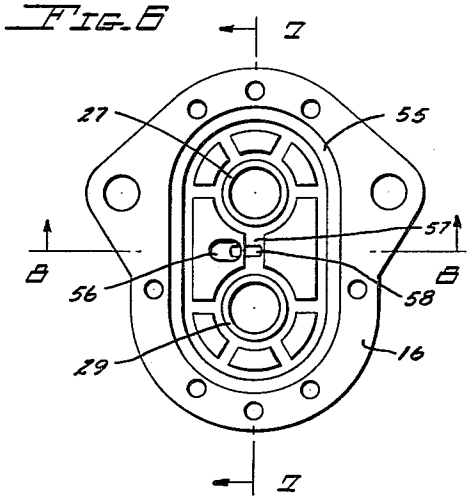


FIG. 8

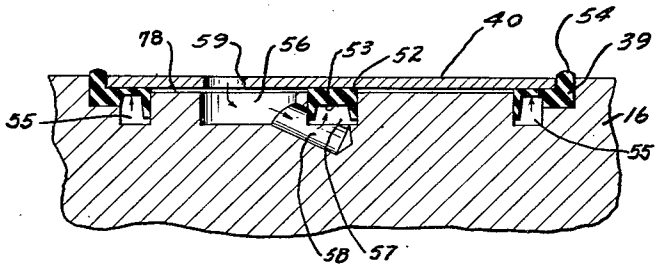
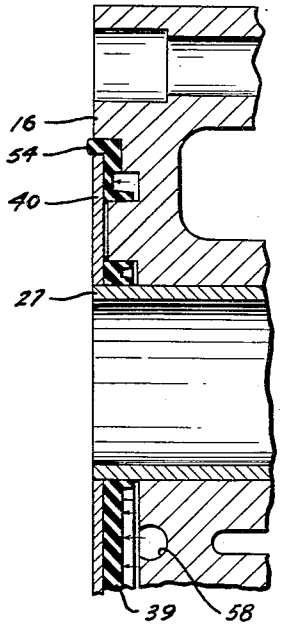


FIG. 7



WENDELL E. MILLER
LEONARD H. REIMER
INVENTORS

BY Hubert Miller

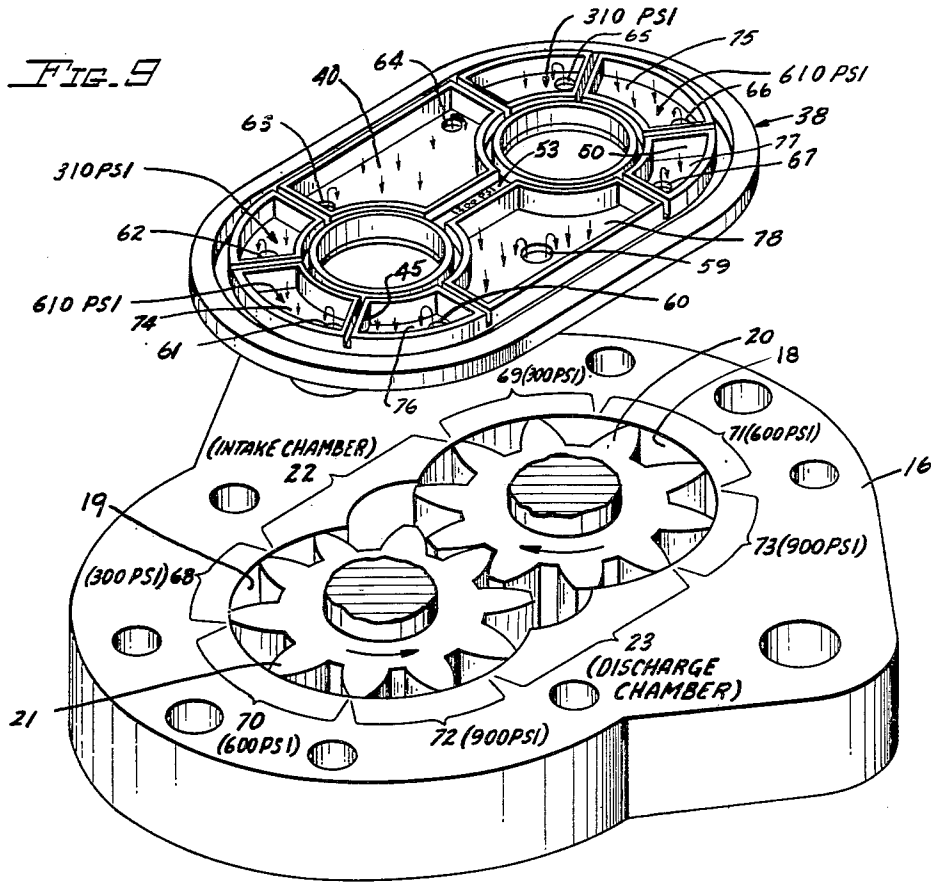
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Oct. 15, 1957 W. E. MILLER ET AL 2,809,592

ROTARY PUMP OR MOTOR

Filed Jan. 13, 1954 3 Sheets-Sheet 3

FIG. 9



WENDELL E. MILLER
LEONARD H. REIMER
INVENTORS

BY Huber Miller

ATTORNEY

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ROTARY PUMP OR MOTOR

Wendell E. Miller and Leonard H. Reimer, Hutchinson, Kans., assignors to The Cessna Aircraft Company, Wichita, Kans., a corporation of Kansas

Application January 13, 1954, Serial No. 403,766

12 Claims. (Cl. 103—126)

This invention relates generally to rotor type liquid displacement pumps and motors, and more particularly to such apparatus of the type employing a pressure loaded axially movable member to effect a seal against the rotor faces to prevent leakage of fluid from the internal high pressure toward the low pressure zones during operation.

Heretofore it has been common practice to provide flanged bushings for the rotor shafts of such pumps, to provide housing space in which at least one pair of the bushings could float axially with relation to the respective rotor shafts which they journal, and to utilize the bushing flanges to seal against the respective rotor faces by introducing discharge pressure between the housing wall and the adjacent outer surfaces of the flanges of the pair of "floating" bushings to force the inner surfaces of the flanges into sealing engagement with the respective adjacent faces of the rotors.

Such design does not take into consideration the fact that the rotor created internal pressure pressing outward in various localized areas on the inner surfaces of the respective sealing flanges is relatively low in areas adjacent the pump inlet and becomes progressively greater as each rotor pocket approaches the discharge chamber, while the sealing force exerted by discharge pressure on the outer surfaces of the respective floating bushings is the same at all points over the exposed flange surface. This means that the resultant sealing pressure on each bushing flange is relatively high in the area adjacent the pump inlet and is relatively low in the area immediately adjacent the pump outlet.

When it is considered that such pumps often operate at pressures of the order of 1000 to 5000 pounds per square inch, it will be readily understood that the sealing force against a rotor face in a selected area immediately adjacent the pump inlet may well be as much as 100 times or more greater than the sealing force against the same rotor face in substantially a diametrically opposite area adjacent the pump outlet, due entirely to the variance in internal-external pressure differential at different points or areas around the rotor face during pump operation.

Such unbalanced application of sealing force on the flanges of the floating bushings places a decided bending load on the respective rotor shafts, causes excessive bushing wear at opposite inner sides of each bushing, provides an uneven seal against the rotor faces with consequent fluid leakage from the high toward the low pressure side of the pump, and creates excessive friction against both faces of each rotor, all of which results in reduced pump efficiency and high maintenance costs.

It is the primary object of this invention to provide a pump in which the sealing force applied inward at any point on the outer surface of the rotor face sealing member is controlled to exceed the internal force exerted outward at each corresponding point on the inner face of such sealing member by a substantially identical predetermined differential, thus providing a positive sealing force which is substantially the same throughout the entire area of the rotor face.

Briefly, this is accomplished by dividing the outer or back face of the sealing member into series of separate pressure compartments surrounding the rotor shafts, and introducing into each compartment a selected pressure sufficiently great to exert a total sealing force in that compartment which exceeds by a precise selected amount the total force exerted outward against the sealing member in correspondingly located zones within the rotor chamber. An evenly distributed sealing force of the desired value is thus maintained over the entire area of the sealing member, and hence against the rotor faces.

It is an additional object to provide a pump construction which utilizes local internal pressures to provide the sealing force in corresponding localized areas on the outer surface of the sealing member to eliminate the ordinarily improperly distributed application of sealing force against the sealing member and the rotors, thus obviating all the previously mentioned defects of pressure loaded gear pumps presently available.

It is another object to provide a unitary diaphragm type sealing member for sealing against the rotor faces of a high pressure pump, as distinguished from the individual flanged bushing type floating sealing members of conventional rotor type pumps.

It is a further object to provide a diaphragm type sealing member having a plurality of individual pressure compartments on its outer face which make it possible to utilize different sealing pressures in different areas of the sealing member to obtain substantially identical sealing forces at all points on the sealing member.

It is another object to provide, in a high pressure liquid pump, a single deformable seal maintaining member having separated pressure areas, and an arrangement for respectively placing said areas in communication with pump created pressure of different values to create a precise evenly distributed sealing force applied over the entire sealing member surface and against the two side faces of each rotor with which the sealing member is associated.

It is a more general object to provide a high pressure liquid displacement unit of the rotor type capable of operating at extreme differences of output pressure while maintaining high volumetric efficiency.

It is a still further object to provide, in a liquid displacement rotor pump or motor, an arrangement for establishing and maintaining a plurality of liquid pressure zones each having a definite function in connection with the member which seals against the adjacent faces of the various rotors.

Another object is to provide a rotor unit of the type specified which is equally efficient whether operated as a pump or as a power transmitting unit.

Still another object is to provide a rotor pump which is considerably lighter in weight than pumps having similar output characteristics due to the incorporation of a thin flexible diaphragm as a rotor sealing member, instead of the thick heavy end plates or flanged bushing type sealing members employed in conventional pump designs.

Another object is to provide a pump construction which eliminates much of the perviously required precision machining of the internal surfaces of the pump housing and mating parts, thus greatly reducing cost of manufacture.

Still another object is to provide a pump construction in which wear on the rotor faces is compensated for by the use of a flexible deformable and floating member as the means for sealing against the rotor faces. Wear is compensated for even though it is greater at one point on the rotor face than at another point on the same face.

The invention, together with other objects attending its production, will be more clearly understood when the following description is read in connection with the accompanying drawings, in which:

Fig. 1 is a rear end view of a gear pump embodying our invention;

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

Figs. 3 and 4 are sectional views taken respectively along the lines 3—3 and 4—4 of Fig. 2;

Fig. 5 is a plan view of a flexible unitary sealing diaphragm which constitutes a part of the invention;

Fig. 6 is a plan view of the inner face of a front plate which constitutes a part of the pump housing;

Figs. 7 and 8 are fragmentary sectional views of said front plate and diaphragm, and show details of construction; and

Fig. 9 is a perspective view of the diaphragm and pump body with the associated gears.

The invention will be described as embodied in a gear pump.

Fig. 2 clearly shows that the pump housing comprises a central body **15** sandwiched between a front plate **16** and a rear plate **17**. Body **15** is provided with gear cavities **18** and **19** (Fig. 4), which house drive gear **20** and driven gear **21**, respectively. Additionally, body **15** is provided with an inlet chamber **22** (Fig. 4) and a discharge chamber **23**, both in open communication with both gear cavities, and also in open communication respectively with an inlet port **24** and with an outlet port **25** in rear plate **17** (Figs. 1 and 3).

Bushings **26**, **27**, **28** and **29** (Fig. 2) are press fitted into aligned complemental recesses in the front and rear plates, and serve to journal the opposite ends of gear shafts **30** and **31**, which are preferably made integral with the respective gears. Drive shaft **30** extends outward through plate **16**, and through a conventional replaceable shaft seal **32**.

The opposite faces of both gears **20** and **21** operate in planes which are common to the planes in which the opposite faces of the body **15** lie. The inner ends of all 4 shaft bushings preferably extend to the respective adjacent gear faces when the pump is assembled for operation. The ends of the gear teeth have an operating clearance with their respective cavity walls of approximately two one-thousandths of an inch. An even smaller clearance exists between the opposite gear side faces and the adjacent cooperating sealing surfaces, as will be later explained.

The inner surface of rear plate **17** is provided with an endless groove **33** (Figs. 2 and 3) which receives a synthetic rubber O-ring **34**, which prevents leakage of fluid from the gear chamber outward between the adjacent faces of plate **17** and body **15**. The entire housing assembly is secured together by a plurality of bolts **35** and press fitted dowel pins **36** and **37**.

Means is provided for substantially equalizing the sealing force applied at all points over the entire area of all four gear faces to prevent leakage of pressure fluid from internal high pressure zones along those faces toward internal low pressure zones. The same means serves also to substantially reduce total friction and consequent excessive wear on all gear faces, thus increasing overall operating efficiency. As clearly shown in Fig. 5, the invention includes a flexible deformable unitary diaphragm, designated as a whole by the numeral **38**. This diaphragm includes a one piece compartmented skeleton gasket **39** of suitable material, such as synthetic rubber, and a cooperating flexible sheet metal or plastic plate **40**.

The gasket proper includes a generally oval shaped grooved outer frame **41**, an integral web **43**, and a plurality of radially disposed grooved fences **44** to **52** inclusive. The grooves in the entire web and in the frame openly communicate with each other, and will herein be referred to as a single groove, **53**.

That surface of the gasket frame **41** opposite the grooved surface has a raised outer rim **54** (Figs. 7 and 8) around its marginal edge. Rim **54** complementally receives and seats the marginal edge of plate **40**, as shown.

Referring to Figs. 6 to 8, it will be seen that the inner surface of front plate **16** is complementally grooved to receive and seat the fenced or compartmented gasket of the diaphragm **38**, the plate groove being identified as a whole by the numeral **55**. The inner surface of plate **16** is also provided with an elongated blind recess **56** which lies in a position substantially normal to ring connecting fence groove **57** which receives and seats ring connecting fence **52** of the gasket **39**. A cross duct **58** (Fig. 8) connects the bottom of recess **56** with the bottom of fence groove **57**.

Plate **40** is provided with a plurality of through ports **59** to **67** inclusive (Fig. 5), each of which serves to conduct pressure fluid from a selected zone within the gear chamber to a respective one of the compartments formed by the gasket fences on the outer or remote face of the diaphragm **38**.

Assembly and operation

When the pump is assembled as shown in Fig. 2, the rim **54** of gasket **39** is compressed against the adjacent face of body **15**, and thus serves to prevent leakage outward from the gear chamber. The inner face of plate **40** lies flat against the adjacent faces of the gears **20** and **21**, and since the entire diaphragm **38** is flexible, pressure on the outer surface of the diaphragm (between it and the end plate **16**) causes the metal plate to deflect slightly and seal against the respective gear faces to prevent leakage of pressure fluid between the plate and gears during pump operation.

Fig. 9 illustrates the pressure loaded sealing principle of the invention. The designated pressure zones in the gear cavities **18** and **19** have been arbitrarily selected, and are exemplary only. The zones indicated by the numbered brackets around the respective gear cavities in the body **15** correspond in number, circumferential extent and location to the compartments formed by the gasket fences on the outer surface of the diaphragm **38**. If it was desired to utilize a greater or lesser number of pressure zones, the gasket would be modified to provide a like number of corresponding pressure compartments.

At any rate, the characteristics of any gear pump are such that as gears **20** and **21** are rotated during pump operation, internal pressure progressively increases from little or no pressure in the intake chamber zone **22** to the maximum output pressure, in this case approximately 1200 p. s. i., in the discharge chamber zone **23**. Between these two extremes, around the respective gear cavities, an average pressure of 300 p. s. i. may exist, for instance, in zones **68** and **69**, an average pressure of approximately 600 p. s. i. in zones **70** and **71**, and an average pressure of approximately 900 p. s. i. in zones **72** and **73**. Within each of these individual zones, however, the actual pressure measured at a point nearer the intake chamber **22** is less than the actual pressure measured at a point nearer the discharge chamber **23**. Thus pressure fluid can be bled from each individual internal zone at a selected point nearer the discharge chamber to provide an external sealing force within a corresponding gasket compartment which exceeds the force exerted by the average internal pressure within the corresponding zone by a precise predetermined amount. In the pump industry such a provision is called a "precise unbalance" or a precise "differential sealing pressure."

As previously stated, this invention is characterized by providing just such a precise unbalance or sealing force. The desired force may be obtained not only by varying the location of the ports in plate **40** through which sealing pressure fluid passes to the individual gasket compartments, but may also be obtained by varying the plate area which is exposed to pressure within the individual gasket compartments, or by a combination of both.

In the pump illustrated, the desired precise sealing force is obtained by locating ports **60** to **67** inclusive nearer the discharge chamber within their respective zones, as

clearly illustrated in Fig. 5, it being assumed that the respective corresponding inner and outer plate areas subjected to fluid pressure are substantially equal.

Since it is known that the average internal pressure in zones 70 and 71 is 600 p. s. i., ports 61 and 66 (Figs. 5 and 9) in plate 40 may be located sufficiently near the respective gasket fences 45 and 50 (in other words spaced sufficiently upstream from the point in the respective zones at which an actual pressure of 600 p. s. i. exists) to bleed off an actual pressure of 610 p. s. i., for instance, into the respective gasket compartments 74 and 75. This precisely determined excess pressure in these two compartments thus serves to force the inner surface of plate 40 tightly against the gear faces within the two zones 70 and 71 to prevent pressure fluid from leaking from high pressure points toward low pressure points along the gear faces.

Similarly, ports 62 and 65 are so located in zones 68 and 69 to bleed off a sealing pressure of 310 p. s. i. into the corresponding gasket compartments, and ports 60 and 67 are located to bleed off a sealing pressure of 910 p. s. i. and so on completely around both gear cavities. The actual sealing pressure at all points around the gear cavities thus exceeds the internal pressure against plate 40 at all points by approximately 10 p. s. i., in this particular example. It will be understood that a larger or smaller sealing pressure differential and total sealing force can be obtained by properly locating the respective bleed-off ports 59 to 67 inclusive, and this is true even though the plate areas exposed to sealing pressure in the various gasket compartments are greater or smaller than the respective corresponding plate areas exposed to internal pressure from correspondingly located zones in the gear cavities.

Conversely, by increasing or decreasing the width of the gasket fences which define the various compartments, the plate area exposed to sealing pressure within the respective compartments may be varied to obtain the precise unbalanced sealing force desired.

It will be recognized, and should be taken into consideration when locating the bleed off ports, that maximum output pressure exists in the composite groove 53 of the various gasket fences, and will in itself create an added sealing force on plate 40. Maximum output fluid pressure reaches the composite fence groove 53 through port 59 (Fig. 8), compartment 78, blind recess 56, and duct 53.

Since all the gasket fences are firmly supported along both sides by the complemental composite groove 57 in front plate 16, this discharge or outlet fluid pressure in the groove 53 in all the fences forces them tightly against the surface of plate 40, and prevents leakage of fluid from a diaphragm compartment having higher pressure into an adjacent compartment having lower pressure. This internal pressure in the fence grooves also prevents possible shearing of the gasket material by a pressure differential between two adjacent compartments. If the bleed off ports are properly located, considering the plate area exposed to pressure in each compartment, the sealing force applied by the plate 40 at any one point or localized area on either gear face will vary little from the sealing force applied at any other point or localized area. Naturally, the sealing force exerted against the outer surface of plate 40 also forces the opposite faces of the gears against the cooperating inner surface of rear plate 17, maintaining a similar seal therebetween.

By providing an evenly distributed sealing force against both faces of both gears or rotors, pump efficiency is greatly increased. This is true because leakage of pressure fluid from internal high pressure zones toward low pressure zones is practically eliminated, because there is much less total friction exerted on the rotor faces due to the evenly distributed sealing force, because such an evenly distributed sealing force does not place a bending load on the rotor shafts, and because the elimination of bending loads on the rotor shafts makes for much longer journal or bushing life. Furthermore, the provision of a flexible rotor face sealing diaphragm automatically compensates for frictional wear on the rotor faces by deflection of plate 40, and volumetric efficiency of the pump is thus maintained.

While the invention has been shown embodied in a gear pump, it will be understood by those familiar with this art that the pressure sealing principle disclosed may be embodied equally well in fluid motors, fluid dividers, in vane type pumps and motors, in internal gear type pumps and motors, in rotary compressors, and in other rotary type positive liquid displacement apparatus. In all such devices the invention is capable of providing a precise unbalance between external sealing force and internal rotor created force, and a consequent evenly distributed sealing force around the entire rotor cavity, producing maximum volumetric and mechanical efficiency with minimum friction and wear. The invention makes for unusually compact construction, low weight, and reduced costs.

Having described the invention with sufficient clarity to enable those familiar with this art to construct and use it, we claim:

1. In a rotary pump or motor of the class wherein a fluid pressure sealed housing defines a cavity having two end walls and the pump includes a fluid moving rotor journaled to rotate in a pressure chamber which constitutes a major portion of said cavity, one end of the pressure chamber being sealed by one of said end walls, said pressure chamber having an inlet and an outlet spaced angularly from each other around the rotor axis, an inherent characteristic of such class pump during rotor operation being the establishment of a rising pressure gradient between the inlet and outlet around the rotor axis in the direction of rotor rotation, an improved pressure chamber sealing means for sealing against a side face of the rotor and for sealing the other end of the pressure chamber from the remainder of the cavity, said sealing means comprising: a generally planar sealing plate having its inner face in flat sealing engagement with said side face of the rotor and sealing said other end of the pressure chamber; means including fences of resilient compressible material disposed betweeen and in sealing engagement with the other end wall and with the outer face of the sealing plate and circumscribing a plurality of closed zones and defining, in cooperation with the respective circumscribed areas of the outer surface of the sealing plate and of the adjacent surface of said other end wall, a plurality of angularly spaced individual sealed pressure compartments substantially surrounding the rotor axis; duct means in said other end wall including as movable walls thereof those surfaces of the fences remote from said plate; means affording communication between said ducts and the pressure chamber near a point of maximum pressure therein whereby fluid is bled into the ducts under relatively high pressure and exerts a force against said fences to urge them against the sealing plate; and additional means affording separate fluid communication between the respective pressure compartments and the pressure chamber at points therein with respect to the pressure gradient which provide within the respective compartments selected different pressures which exert inwardly directed sealing forces against the respective fence circumscribed areas of the plate, and due to the relative locations of the points at which communication is established with the respective pressure compartments the fluid pressure per square inch exerted against the fences exceeds the pressure per square inch exerted against the circumscribed plate areas of the pressure compartments, whereby the fences are stiffened against lateral deformation.

2. The sealing means described in claim 1 in which the means establishing separate communication between the respective compartments and the pressure chamber are ports through the plate, at least one within the

confines of each pressure compartment, due to the said pressure gradient within the pressure chamber and to the selected location of each port with respect thereto, the inwardly directed force exerted by the fluid pressure in each compartment against the fence circumscribed plate area in that compartment plus the inwardly directed force exerted by the fluid pressure in the duct means against the fence which circumscribes that compartment together exceed by a substantially equal differential the respective outwardly directed forces exerted against respective corresponding plate areas by the fluid pressure within the pressure chamber.

3. In a rotary pump or motor of the class wherein a fluid pressure sealed housing defines a cavity having two end walls and the pump includes a fluid moving rotor journaled to rotate in a pressure chamber which constitutes a major portion of said cavity, one end of the pressure chamber being sealed by one of said end walls, said pressure chamber having an inlet and an outlet spaced angularly from each other around the rotor axis, an inherent characteristic of such class pump during rotor operation being the establishment of a rising pressure gradient between the inlet and outlet around the rotor axis in the direction of rotor rotation, an improved pressure chamber sealing means for sealing against a side face of the rotor and for sealing the other end of the pressure chamber from the remainder of the cavity, said sealing means comprising: a generally planar sealing plate having its inner face in flat sealing engagement with said side face of the rotor and sealing said other end of the pressure chamber; means including fences of resilient compressible material disposed between and in sealing engagement with the other end wall and with the outer face of the sealing plate and circumscribing a plurality of closed zones and defining, in cooperation with the respective circumscribed areas of the outer surface of the sealing plate and of the adjacent surface of said other end wall, a plurality of angularly spaced individual sealed pressure compartments substantially surrounding the rotor axis; means establishing separate fluid communication between the respective pressure compartments and the pressure chamber at points with respect to the pressure gradient therein which provide within the respective compartments pressures which exert respective inwardly directed forces against the respective circumscribed plate areas which substantially equally exceed the respective outwardly directed forces exerted over respective corresponding plate areas by pressure fluid within the pressure chamber.

4. The pressure chamber sealing means described in claim 3 in which the means establishing separate communication between the respective compartments and the pressure chamber are ports through the plate, at least one within the confines of each pressure compartment.

5. The pressure chamber sealing means described in claim 3 in which the sealing plate is thin and flexible, and a major portion of its margin extends outward beyond and bridges the said other end of the pressure chamber, and due to its flexibility it is capable of being deflected by the mentioned sealing forces to maintain sealing engagement with the rotor side face as it wears.

6. In a rotary pump or motor of the class wherein a fluid pressure sealed housing defines a cavity having two end walls and the pump includes a fluid moving rotor journaled to rotate in a pressure chamber which constitutes a major portion of said cavity, one end of the pressure chamber being sealed by one of said end walls, said pressure chamber having an inlet and an outlet spaced angularly from each other around the rotor axis, an inherent characteristic of such class pump during rotor operation being the establishment of a rising pressure gradient between the inlet and outlet around the rotor axis in the direction of rotor rotation, an improved pressure chamber sealing means for sealing against a side face of the rotor and for sealing the other end of the pressure chamber from the reminder of the cavity, said sealing means comprising: a substantially planar pressure chamber sealing plate disposed between said side face of the rotor and the other end wall of the housing and having its inner face in flat sealing engagement with said side face of the rotor and closing the other end of the pressure chamber; a unitary open skeleton type generally planar gasket which includes a ring-like peripheral frame and integral interconnected fences all of resilient compressible material, said fences dividing the space surrounded by the frame into individual zones or compartments, the fences and the frame of said gasket being disposed in sealing engagement with said other end wall and with the outer face of the sealing plate and circumscribing sealed individual pressure compartments between the two; means establishing separate fluid communication between the respective pressure compartments and the pressure chamber at points with respect to the pressure gradient therein which provide within the respective compartments selected different pressures which exert inwardly directed sealing forces against the respective circumscribed areas of the plate, which inwardly directed sealing forces are respectively greater than are the outwardly directed forces on corresponding areas of the opposite side of the plate.

7. The pressure chamber sealing means described in claim 6 in which the sealing plate is thin and flexible, and a major portion of its margin extends outward beyond and bridges the said other end of the pressure chamber, and due to its flexibility it is capable of being deflected by the mentioned sealing forces to maintain sealing engagement with the rotor side face as it wears.

8. The sealing means described in claim 6 in which the means establishing separate communication between the respective compartments and the pressure chamber are ports through the plate, at least one within the confines of each pressure compartment, said ports being located to bleed pressure fluid from the pressure chamber at points which provide within the respective compartments pressures which exert respective inwardly directed forces against the respective fence circumscribed plate areas which substantially equally exceed the respective outwardly directed forces exerted over respective corresponding plate areas by pressure fluid within the pressure chamber.

9. The pressure chamber sealing means described in claim 6, and intercommunicating grooves in the adjacent surface of said other end wall opening toward the plate, portions of the gasket frame and its integral fences remote from said plate being in sealing engagement with the groove openings to cooperate with the side walls and bottoms of the grooves to convert them into sealed intercommunicating ducts, one wall of which is gasket material; and means affording communication between said ducts and the pressure chamber near a point of maximum pressure therein whereby fluid pressure is bled from the pressure chamber into said ducts, and exerts a force against said fences and gasket frame to urge them against the sealing plate.

10. A rotary pump of the class described comprising: a rotary impeller; a plate having its inner surface in sealing engagement with an axial face of the impeller; a sealed housing enclosing the plate and defining therewith a fluid pressure chamber which encloses the impeller, and having an end wall disposed adjacent and substantially parallel to the plate; a unitary skeleton type generally planar gasket of resilient compressible material which includes an endless peripheral frame and integral interconnected fences dividing the space surrounded by the frame into individual zones or compartments, one side of said gasket being in sealed engagement with the end wall and the other side of the gasket being in engagement with the adjacent outer surface of the plate; the end wall, the outer surface of the plate, and the frame and fences of the

gasket cooperating to provide individual closed pressure compartments; duct means for conducting fluid from a single high pressure zone in the pressure chamber and for confining and directing it against those surfaces of the fences and of the frame remote from said plate to urge them into sealing engagement with the axial face of the impeller; and ports through the plate establishing communication between the interiors of each of the respective individual compartments and zones of different pressure in the pressure chamber.

11. Means for sealing one end of the pressure chamber of a rotary pump and for sealing against the adjacent initially co-planar face of a rotor in the chamber comprising: a unitary diaphragm which includes a thin flexible plate larger in corresponding cross dimensions than the pressure chamber and capable of being deflected by fluid pressure into sealing engagement with the rotor face as it wears; a skeleton gasket having an integral upstanding peripheral continuous rim which receives the plate and which rim seals against the entire peripheral edge of the plate; a plurality of spaced fences integral with said rim and extending generally radially inwardly therefrom along and in engagement with the back surface of the plate; additional fences connected the inner ends of adjacent ones of the first mentioned fences together and integral

with the first mentioned fences and also in engagement with the back surface of the plate, said rim and fences dividing the back surface of the plate into a plurality of individual fence separated compartments.

12. The sealing member described in claim 11 in which those surfaces of the rim and the fences remote from the back surface of the plate are grooved, and all the grooves intercommunicate.

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