July 25, 1961 W. WEIGERT 2,993,450

GEAR PUMP

Filed Nov. 10, 1958 2 Sheets-Sheet 1

Fig. 2

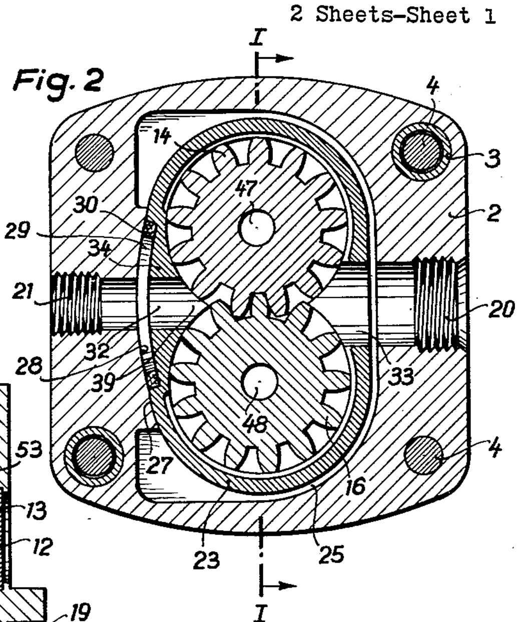

Fig. 1

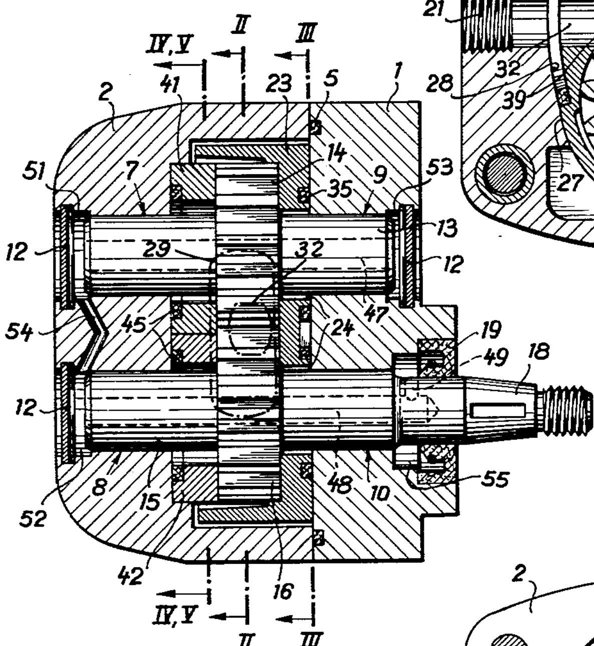

Fig. 3

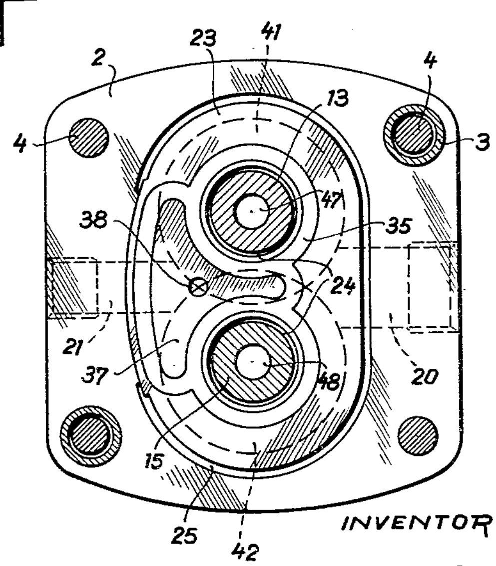

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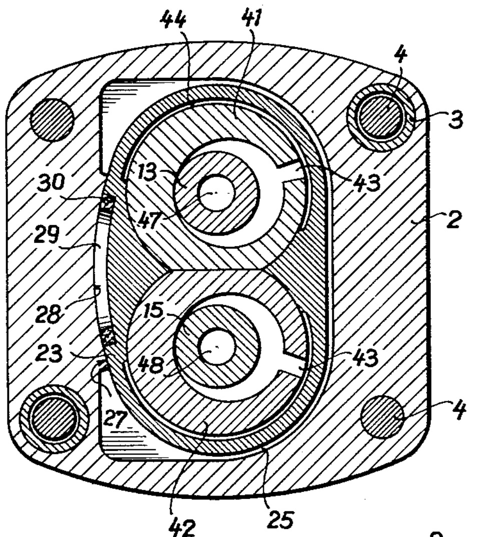
Fig. 4



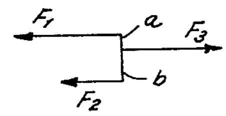


Fig. 7

Fig. 6

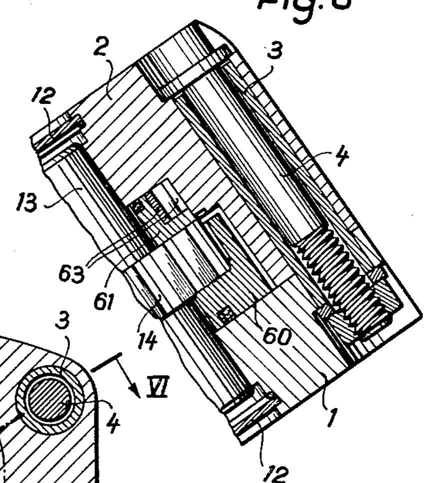
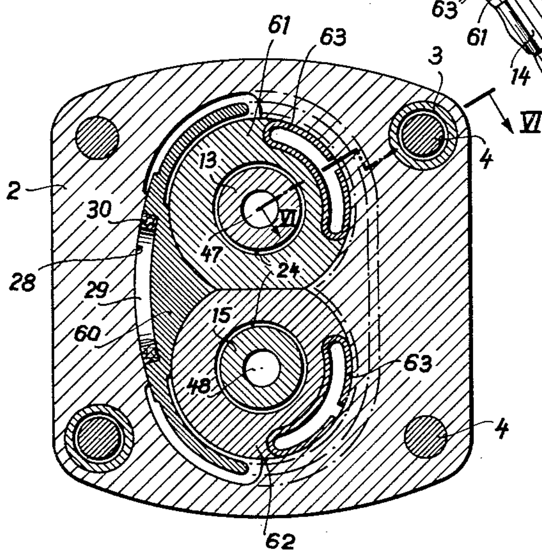


Fig. 5



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GEAR PUMP

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Claims priority, application Germany Nov. 9, 1957

7 Claims. (Cl. 103—126)

The present invention relates to pumps.

More particularly, the present invention relates to gear pumps.

In order for gear pumps to operate with the desired efficiency it is necessary to provide very small spaces around the gears of the gear pump so that there will be a minimum loss of pressure. It is therefore required that the gears of the gear pump slide along stationary surfaces, and inserts may be located in the pump housing next to the gears to cooperate with the latter to maintain the pressure in the pump. These inserts form a bearing surface against which the gears slide during rotation of the latter, and the inserts are of a softer metal than the relatively expensive gears so that after a certain period of use the inserts become worn and at such time it is possible to remove the worn inserts and replace them with new inserts, the expensive gears of the pump being still useful and undamaged.

Various problems arrive during the wearing away of such inserts. As they become worn the play of the inserts in the pump housing increases, and when this play becomes undesirably large the inserts are changed.

One of the objects of the present invention is to provide a gear pump with an insert arrangement which will automatically compensate for wear of the inserts so as to maintain the gaps around the gears at a minimum as the inserts become worn.

Another object of the present invention is to provide an insert arrangement of the above type which is capable of automatically compensating for both axial and radial wearing away of the inserts so that the inserts are maintained very close to the gears of the pump both axially and radially with respect to the latter even though the inserts become worn during use.

Another object of the present invention is to provide a gear pump with an insert arrangement which will automatically follow the movements of the gears in their bearings during operation so as to maintain or to diminish the gaps around the gears during operation.

A further object of the present invention is to provide a gear pump composed of simply constructed elements and including a relatively small number of parts which must be manufactured with a high degree of accuracy.

With the above objects in view, the present invention includes in a gear pump a hollow pump housing having an inlet and an outlet and supporting for rotation a pair of parallel shafts which extend through the hollow interior of the housing. A pair of pump gears are carried by these shafts in the interior of the housing. In accordance with the present invention an insert is located in the pump housing between the latter and the gears at one side of these gears, and this insert is formed with a pair of openings through which the shafts respectively extend and has a peripheral portion extending around the periphery of the pump gears. The peripheral portion of the insert is spaced from the pump housing and the insert is also spaced from the shafts by a certain relatively small distance providing a limited play of the insert which permits the insert to move in a plane which is normal to the axes of the shafts. Adjacent to the outlet of the housing the insert is formed with a recess which has a surface spaced from and directed toward a surface of the housing at the interior thereof, and these surfaces define between themselves a pressure chamber in which fluid under pressure is located for urging the periphery of the insert which is adjacent to the outlet of the housing radially toward the gears.

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The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a sectional elevational view of a pump according to the present invention taken along line I—I of FIG. 2 in the direction of arrows in a plane which includes the axis of the gears;

FIG. 2 is a transverse sectional view of the structure of FIG. 1 taken along line II—II of FIG. 1 in the direction of arrows;

FIG. 3 is a partly sectional transverse view taken along line III—III of FIG. 1 in the direction of arrows;

FIG. 4 is a transverse sectional view of the structure of FIG. 1 taken along line IV—IV of FIG. 1 in the direction of arrows;

FIG. 5 is a transverse sectional view similar to FIG. 4 of a different embodiment of a pump according to the present invention;

FIG. 6 is a fragmentary sectional view of the structure of FIG. 5 taken along line VI—VI of FIG. 5 in the direction of arrows; and

FIG. 7 is a force diagram illustrating the operation of the pump of the invention.

Referring now to FIG. 1, it will be seen that the pump of the invention includes a housing **1, 2** made up of a hollow member **2** which is closed at its left end and open at its right end, as viewed in FIG. 1, and the open right end of the member **2** is closed by the housing wall **1**. The housing parts **1** and **2** are held together by screw members **4** (FIG. 6), and a pair of diagonally opposed screw members **4** respectively pass through sleeves **3**, as is particularly evident from FIG. 6. An elliptical sealing ring **5** is located between the housing parts **1** and **2** so that they are fluid-tightly connected together. The housing part **2** is formed with a pair of parallel bores **7** and **8**, and the cover **1** is formed with a pair of parallel bores **9** and **10** which are respectively coaxial with the bores **7** and **8**. A pair of springy closure plates **12** are snapped into the housing **2** at the ends of the bores **7** and **8**, respectively, for closing off these bores from the outer atmosphere, and a similar springy plate is snapped into the cover **1** at the outer end of the bore **9** for the same purpose. A shaft **13** is turnably supported by the housing **1, 2** in the bores **9** and **7** thereof. This shaft **13** is integral with a pump gear **14** which meshes with a second pump gear **16** which is integral with a shaft **15** which is turnably supported by the bores **8** and **10**. The right end of the shaft **15**, as viewed in FIG. 1, extends outwardly beyond the cover **1** and has a frusto-conical portion **18** adapted to receive a coupling member forming part of a clutch, for example, so that the pump is driven through the transmission member which is carried by the portion **18** of the shaft **15**. In this way the gears **14** and **16** are rotatable in the housing **1, 2** without being influenced by any outside forces such as the one-sided pull exerted by belt on a pulley, for example, which may be carried by the portion **18** of the shaft **15**. Moreover, with this arrangement the pump has a very compact construction. A sealing ring **19** is carried by the cover **1** around the shaft **15**. The pump housing part **2** is formed, as shown in FIG. 2, with an inlet **20** and with an outlet **21** of a smaller diameter than the inlet **20**.

In accordance with the present invention an insert 23 is located in the housing between the latter and the right faces of the gears 14 and 16, as viewed in FIG. 1. This insert 23 is of substantially dish-shaped configuration and has a periphery extending around the periphery of the gears, as is particularly evident from FIG. 2. The insert 23 is formed with a pair of openings through which the shafts 13 and 15 respectively pass, and at these openings the insert 23 is spaced from the shafts by a radial distance 24. The periphery of the insert 23 is spaced from the inner surface of the housing by the gap 25 shown in FIG. 2, with the exception of the portion of the periphery of the insert which is adjacent to the outlet 21. The gaps 24 and 25 provide a certain limited play of the insert 23 in a plane normal to the axes of the shafts 13 and 15, and the extent of this play is limited by the radial dimension of the gap 24. Thus, in accordance with the radial dimension of the gap 24 surrounding each shaft 13 and 15 the insert 23 will be capable of moving transversely of these shafts.

Adjacent to the outlet 21 of the pump housing, the insert 23 has a portion 27 which engages an inner surface 28 of the housing. This portion 27 of the insert is formed with a recess 29 which has a surface spaced from and directed toward the surface 28 so as to form a pressure chamber with the latter, and a sealing means in the form of a sealing ring 30 extends along the outer periphery of the recess 29 to seal off this pressure chamber from the rest of the interior of the housing 1, 2. The insert 23 is formed with a bore 32 passing through a wall portion thereof coaxially with the outlet 21, and this bore 32 communicates directly with the recess 29 which forms the pressure chamber. The periphery of the insert 23 is also formed with a bore 33 which is aligned coaxially with the inlet 20. The periphery of the insert 23 extends with a relatively small radial clearance from the bore 33 around the gears 14 and 16 up to the portion 34 of the insert which forms approximately one quarter of the periphery thereof. This portion 34 of the insert is located as close as possible to the teeth of the gears, the distance between the portion 34 of the insert and the gear teeth being only great enough to permit the gears to turn. Therefore, the gaps between those teeth of the gears which at any given instant are located next to the portion 34 of the insert 23 are substantially closed by the insert portion 34.

The right end face of the insert 23, as viewed in FIG. 1, is formed with a recess 37 which communicates with a pair of arcuate grooves which respectively extend around the shafts 13 and 15, and as may be seen from FIG. 3, a sealing member 35 is located in these arcuate grooves and along the periphery of the recess 37 so as to provide a fluid-tight closed pressure recess 37 which is defined by the left surface of the cover 1, as viewed in FIG. 1, by the right surface of the insert 23, as viewed in FIG. 1, and by the sealing ring 35. As may be seen from FIG. 3, this recess or chamber 37 is a substantially T-shaped configuration with the cross bar of the T extending perpendicularly to the shafts 15 and 13 and located at the part of the recess 37 which is nearest to the outlet 21, the leg of the T extending from the cross bar portion thereof toward the inlet 20. The insert 23 is formed with a bore 38 passing from the chamber 37 through the insert to the gears 14 and 16 at the pressure side thereof located at the pressure chamber 39 of the pump which communicates with the bore 32, as indicated in FIG. 2.

The dish-shaped insert 23 is open at its left end, as viewed in FIG. 1, and in accordance with the present invention a springy closure plate means is provided for closing this open end of the insert 23. In the embodiment of FIGS. 1–4, this closure plate means takes the form of a pair of springy split rings 41 and 42 shown most clearly in FIG. 4. These rings 41 and 42 have opposite flat side faces, and they respectively extend around the shafts 13 and 15. The inner surfaces of the rings 41 and 42 are cylindrical and eccentrically positioned with respect to the shafts 13 and 15, as indicated in FIG. 4. The smallest radial distance between the outer surfaces of the shafts 13 and 15 and the inner surfaces of the rings 41 and 42, respectively, is equal to the largest permissible shifting movement of the insert 23. In other words, these radial distances are equal to the radial distances 24. Thus, the rings 41 and 42 serve to limit the movement of the insert 23 to the right, as viewed in Fig. 4. At their portions of smallest cross section the rings 41 and 42 are formed with the slits 43, respectively, so that these rings operate as springs. The rings 41 and 42 have flattened surface portions engaging each other as indicated in FIG. 4 so that in this way the positions of the rings 41 and 42 with respect to each other are determined. Along not quite half of its periphery the insert 23 is spaced by the gap 44 (FIG. 4) from the rings 41 and 42 particularly in the region of the slits 43 thereof, this gap 44 having a radial dimension corresponding to the radial distance between the gears 14 and 16, on the one hand, and the periphery of the shell or insert 23. As is evident from FIG. 1, the rings 41 and 42 extend to the left, as viewed in FIG. 1, beyond the insert 23 into recesses of the housing part 2. These recesses are in fact a single common recess, and only the right portions of the rings 41 and 42, as viewed in FIG. 4, press against the housing part 2. The left portions of the rings 41 and 42, as viewed in FIG. 4, press only against the insert 23, so that the latter is in this way urged to the left, as viewed in FIG. 4, by the springy closure plate means 41 and 42. It is evident that the rings 41 and 42 serve to substantially close the dish-shaped insert 23 at the left side thereof, as viewed in FIG. 1. Thus, the springy rings 41 and 42 urge the insert 23 against the inner surface 28 of the housing 1, 2. Each of the rings 41 and 42 carries a sealing ring 45 located between each ring and the housing 2, as indicated in FIG. 1.

The shaft 13 is formed with an axial bore 47 extending all the way through the shaft 13 from one end thereof to the other, and the shaft 15 is formed with an axial bore 48 extending from the left end thereof, as viewed in FIG. 1, up to the region of the sealing ring 19, where this bore 48 terminates and communicates with a radial bore 49 leading to the chamber 55. The plates 12 form with the ends of the shaft 13 and the left end of the shaft 15 the chambers 51, 52 and 53. The chamber 53 communicates through the bore 47 with the chamber 51, and this chamber 51 communicates through a passage 54 formed in the housing part 2 with the chamber 52 which communicates through the bore 48 and the radial passage 49 with the chamber 55. This chamber 55 communicates through an unillustrated passage formed in the housing 1, 2 with the suction side of the pump.

When the pump is operated so as to pump a fluid such as oil, for example, the oil is sucked into the pump through the inlet 20 and the bore 33 of the insert 23, and the pump transfers this oil in the gaps between the teeth of the gears 14 and 16 to the pressure side of the pump where the oil is discharged under pressure through the outlet passages 32 and 21. The axial play of the gears 14 and 16 with respect to the insert 23, on the one hand, and the closure plate means 41, 42, on the other hand, is maintained at a minimum, first as a result of the inherent elasticity of the sealing ring 35 which urges the insert 23 to the left, as viewed in FIG. 1, and second as a result of the oil under pressure in the chamber 37 which also acts to urge the insert 23 to the left, as viewed in FIG. 1, so that the insert is maintained next to the right side faces of the gears 14 and 16, as viewed in FIG. 1, and so that the left side faces of these gears, as viewed in FIG. 1, is maintained against the rings 41 and 42. The suction space in the pump extends from the bore 33 around the peripheries of the gears 14 and

16 up to the portion 34 of the insert 23. While the teeth of the gear move along the portion 34 of the insert 23 they build up the pressure in the oil which exists at the outlet of the pump. The smaller the axial and radial gaps at the portion 34 of the insert the greater is the volumetric efficiency of the pump. As the pressure of the fluid in the pump increases at the pressure chamber 39 the pressure of the fluid in the gaps between the teeth next to the portion 34 of the insert 23 also increases and tends to shift the gears 14 and 16 to the right, as viewed in FIG. 2. However, this pressure at the outlet side of the pump also prevails in the fluid within the pressure chamber 29, and thus the pressure acts on the insert 23 to urge the latter toward the inlet of the pump. In this way the radial gap between the portion 34 of the insert 23 and the gears 14 and 16 remains at all times the same and there is no decrease in efficiency resulting from an increase in this radial gap.

The shiftability of the insert 23 is dependent upon the yieldability of the springy rings 41 and 42, and the latter are so constructed that the insert 23 and the gears 14 and 16 shift to the same extent, so that the radial play between the gears 14 and 16 and the portion 34 of the insert 23 remain the same under all operating conditions of the pump. It is also possible to provide a reduction in the size of the radial gap between portion 34 and the insert 23 and the gears 14 and 16 with increasing pressure at the outlet of the pump. It is only necessary to limit the shifting of the insert 23 within the housing 2 to such an extent that the sealing ring 30 can reliably maintain the pressure chamber 29 sealed off from the gap 25 in the interior of the pump housing even if the insert 23 has shifted slightly to the right, as viewed in FIG. 2.

As was pointed out above, the shifting movement of the insert 23 is limited by the radial distance between the shafts 13 and 15 and the insert 23, on the one hand, and by the radial distance between these shafts and the rings 41 and 42. Thus, when the rings 41 and 42 and the insert 23 bear against the shafts 13 and 15, the insert 23 has moved through the maximum permissible distance, and it is necessary at this time to replace the worn insert 23 with a new insert.

It will be noted that the forces in the chamber 29 acting to the right on the insert 23 at the portion 34 thereof, as viewed in FIG. 2, are directed oppositely to the forces which act on the portion 34 of the insert 23 to urge the latter toward the left, as viewed in FIG. 2, and as a result these forces have no tendency to distort the insert 23. Therefore, there is no change in the radial gap between the gears 14 and 16 and the portion 34 of the shell 23 as a result of the forces acting on the portion 34 of the shell 23.

It will also be noted that the fluid which is under pressure at the outlet of the pump acts only on the relatively small inner surface 28 of the pump housing. The oil does not exert any larger forces on the housing. Thus, with the pump of the invention the pump housing need only have a sufficient mass and stiffness to withstand the normal stresses exclusive of the maximum pressure of the fluid acting against the surface 28. If this latter surface should change its shape slightly as a result of the pressure of the fluid, there will be no decrease in the efficiency of the pump and therefore when designing the pump the mass of the housing thereof need not be made so great as to entirely resist the pressure of the fluid at the discharge side of the pump.

All of the forces and moments acting on the insert 23 compensate each other and balance each other under all operating conditions. The axial pressure on the insert 23 exerted by the oil in the gaps between the teeth of the gears which are next to the portion 34 of the insert 23 are directly opposed by the pressure in the T-shaped recess 37. These opposed forces have no tendency to tilt the insert 23 in the housing, since these opposed forces are directly in line with each other.

In the radial direction the force of the oil under pressure in the chamber 29 tends to move the insert 23 to the right, as viewed in FIG. 2. This force is opposed by a pair of forces. Thus, there is the force of the oil at the right side of the portion 34 of the insert 23, as viewed in FIG. 2, and also there is the force of the springs 41 and 42. The resultants of all of these forces will act in a horizontal plane normal to the plane of FIG. 2 and located midway between the axes of the gears 14 and 16, respectively. The shape and location of the surface of the recess 29 which is directed toward the surface 28 is such that the resultant of the forces of the oil under pressure in the pressure chamber 29 will be spaced from the pair of opposed forces inversely to the size of these forces so as to eliminate any tendency of the insert 23 to tilt as a result of the radial forces. Thus, referring to FIG. 7 which may be considered as taken in a horizontal plane normal to the plane of FIG. 2 and midway between the axes of the gears 14 and 16, it can be assumed that the force F_1 represents the force of the oil under pressure in the gap between the teeth of the gears 14 and 16 located just to the right of the portion 34 of the insert 23 and urging the latter to the left. The force F_2 represents the force of the springs 41 and 42, these forces F_1 and F_2 being the resultant forces of the oil under pressure and the springs which urge the insert 23 to the left, as viewed in FIG. 2. It will be noted that these two forces F_1 and F_2 are spaced from each other, and this space will be somewhat greater than one half the thickness of each gear 14 and 16. The resultant of the forces of the oil under pressure in the chamber 29 is shown at F_3, and it will be noted that the distance a of the force F_3 from the larger resultant force F_1 is smaller than the distance b of the force F_3 from the smaller resultant force F_2. As a result, the force F_2 multiplied by the distance b will equal the force F_1 multiplied by the distance a, and therefore there will be no tendency for the insert 23 to tilt as a result of the radial forces shown in FIG. 7. Thus, it can be seen that the distance of the force F_3 from the forces F_1 and F_2 is inversely proportional to the size of the forces F_1 and F_2.

As is indicated in dot-dash lines in FIG. 1, the opening 32 is offset with respect to the recess 29 so as to provide the action of the forces indicated in FIG. 7.

Some of the oil under pressure in the gaps between the teeth of the gears 14 and 16 will reach the shafts 13 and 15 and flow axially along the outer surface thereof through the openings 7—10 of the housing 1, 2 so that in this way the rotary movement of the shafts is lubricated. This very small amount of oil will reach the chambers 51—53 and 55. The oil which collects in the chamber 53 will flow along the bore 47 of the shaft 13 to the chamber 51 and will flow together with the oil which has already collected in the chamber 51 through the passage 54 to the chamber 52 to be joined therewith with the oil already collected therein. All of the oil in the chamber 52 flows along the bore 48 to the radial bore 49 and from the latter into the chamber 55, and the oil which collects in the chamber 55 flows back to the suction side of the pump through the unillustrated passage which provides communication between the chamber 55 and the suction side of the pump.

The embodiment of the invention which is illustrated in FIGS. 5 and 6 differs from that of FIGS. 1–4 only with respect to the construction of the insert 60, which corresponds to the insert 23, and the closure plate means 61, 62 which corresponds to the closure plate means 41, 42. The remaining parts of the structure of FIGS. 5 and 6 are identical with those of FIGS. 1–4 and are indicated with the same reference characters. The plane in which the section of FIG. 5 is taken is located to the left of the plane of FIG. 4 in FIG. 1, so that FIG. 5 shows the configuration of the housing part 2 at the portion thereof which cooperates with the rings 41 and 42, and it will be noted from FIG. 5 that the rings 41 and 42 will only press at their right sides, as viewed in FIG.

4, against the housing part **2** and their left sides will only press against the insert **23**.

Referring now to FIGS. 5 and 6, the insert **60** has a peripheral portion which extends beyond the gears **14** and **16** only along the outlet side of the pump. In this way the closure plate members **61** and **62** are capable of pressing against the left peripheral portion of the insert **60**, as viewed in FIG. 5. Spring members **63** serve to urge the rings **61** and **62** against the insert **60**. Each of the spring members **63** is in the form of a steel band and is composed of a pair of arcuate portions interconnected at their ends, and the outer arcuate portion is split approximately at its center, as shown in FIG. 5, so that each springy member **63** has a pair of free springy ends located adjacent to but spaced from and directed toward each other. These springy members **63** are smaller than the plates **61** and **62** and are respectively located in recesses of these plates. As is apparent from FIG. 6, the recesses which receive the springs **63** do not extend all the way up to the gears **14** and **16**, so that the springs **63** are in this way maintained spaced from the gears **14** and **16**. These springs **63** provide the action that the members **41** and **42** provide, and with the embodiment of FIG. 5 the rings **61** and **62** need not be provided with eccentrically located bores.

Of course, the structure of the invention also can be used to function as a motor rather than a pump, and in this case the only difference would be that the oil would flow through the motor in the reverse direction and the gears would rotate in a reverse direction as compared to the operation of the structure as a pump.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of pumps differing from the types described above.

While the invention has been illustrated and described as embodied in gear pumps, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characeristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a gear pump, in combination, a hollow pump housing having an inlet and an outlet; a pair of parallel shafts turnably carried by said housing and extending across the hollow interior thereof; a pair of pump gears respectively carried by said shafts and located in the hollow interior of said housing; a substantially dish-shaped insert located between said housing and gears and having a base portion extending at one side of the latter normal to the axes thereof and formed with a pair of openings through which said shafts respectively extend, said base portion covering the entire side faces of said gears at said one side thereof, said insert having a peripheral portion integral with said base portion and extending completely around the periphery of said gears and spaced from said housing and said insert also being spaced from said shafts so that said insert has a limited play in said housing in a plane normal to the axes of said shafts, said insert having a pressure surface spaced from and directed toward a surface of said housing at the outlet of the latter and defining with the latter housing surface a pressure chamber in which fluid under pressure is located, said insert having opposite said pressure surface a sealing surface directed toward the periphery of said gears and urged by said fluid pressure in said pressure chamber against the periphery of said gears with a pressure depending exclusively on the pressure of the fluid in said pressure chamber, said pressure chamber communicating with the outlet of said housing and with said gears on the pressure side thereof; and closure plate means located next to the opposite side of said gears and substantially closing said dish-shaped insert.

2. In a gear pump, in combination, a hollow pump housing having an inlet and an outlet; a pair of parallel shafts turnably supported by said housing and extending through the hollow interior thereof; a pair of pump gears carried by said shafts and located in the hollow interior of said housing; a substantially dish-shaped insert located in said housing between the latter and said gears and having a base portion extending at one side of said gears normal to the axes thereof, said base portion covering the entire side faces of said gears at said one side thereof, said insert having a peripheral portion integral with said base portion and extending completely around the periphery of said gears and spaced from said housing and said insert having a pressure surface directed toward and spaced from a surface of said housing in the interior thereof adjacent said outlet thereof and defining with the latter housing surface a pressure chamber in which fluid under pressure is located, said insert having opposite said pressure surface a sealing surface directed toward the periphery of said gears and urged by said fluid pressure in said pressure chamber against the periphery of said gears with a pressure depending exclusively on the pressure of the fluid in said pressure chamber, said pressure chamber communciating with the outlet of said housing and with said gears on the pressure side thereof; and closure plate means engaging said gears at the opposite side thereof and closing substantially the space surrounded by the periphery of said insert, said shafts being spaced at the sides thereof which are directed toward the outlet of said housing from said insert and said closure plate means by a distance which limits the movement of said insert in said housing in a direction normal to the axis of each shaft.

3. In a gear pump, in combination, a hollow pump housing having an inlet and an outlet; a pair of parallel shafts turnably carried by said housing and extending through the hollow interior thereof; a pair of pump gears carried by said shafts and located in the interior of said housing; a substantially dish-shaped insert located in said housing between the latter and said gears and having a base portion extending at one side thereof normal to the axes thereof and formed with openings through which said shafts pass, said base portion covering the entire side faces of said gears at said one side thereof, said insert having a peripheral portion integral with said base portion and extending completely around the periphery of said gears and also spaced from said housing, said insert having a portion directed toward the outlet of said housing and formed with a recess having a pressure surface directed toward and spaced from a surface of the housing in the interior thereof and defining with the latter housing surface a pressure chamber in which fluid under pressure is located, said insert having opposite said pressure surface a sealing surface directed toward the periphery of said gears and urged by said fluid pressure in said pressure chamber against the periphery of said gears with a pressure depending exclusively on the pressure of the fluid in said pressure chamber, said pressure chamber communicating with the outlet of said housing and with said gears on the pressure side thereof; and springy closure plate means located in said housing against the other side of said gears and cooperating with said insert for resiliently urging said portion thereof toward said surface of said housing, said closure plate means yielding to permit movement of said insert in a direction away from the outlet of said housing.

4. In a gear pump as recited in claim 3, said springy

closure plate means being in the form of a pair of split rings respectively extending around said shafts.

5. In a gear pump as recited in claim 3, said springy closure plate means including a pair of rings through which said shafts respectively pass, said rings respectively being formed with recesses extending from peripheral portions thereof which are nearest to said inlet of said housing into said rings, and springs located in said recesses and engaging said rings and housing for urging said rings away from said inlet toward said outlet so as to urge said insert at said portion thereof toward said surface of said housing.

6. In a gear pump, in combination, a hollow pump housing having an inlet and an outlet; a pair of parallel shafts turnably carried by said housing and extending through the hollow interior thereof; a pair of pump gears carried by said shafts and located in said housing; a substantially dish-shaped insert located in said housing between the latter and the gears and having a base portion extending at one side of said gears normal to the axes thereof, said base portion covering the entire side faces of said gears at said one side thereof, said insert having a periphery extending around said gears and spaced from said housing, said insert also being spaced from said shafts so that said insert has a limited play in said housing in a plane normal to the axis of said shafts, said insert having adjacent the outlet of said housing a pressure surface directed toward an inner surface of said housing and defining with the latter inner surface a pressure chamber in which fluid under pressure is located, said insert having opposite said pressure surface a sealing surface directed toward the periphery of said gears and urged by said fluid pressure in said pressure chamber against the periphery of said gears with a pressure depending exclusively on the pressure of the fluid in said pressure chamber, said pressure chamber communicating with the outlet of said housing and with said gears on the pressure side thereof, and the fluid under pressure in said pressure chamber acting on said insert with a resultant force directed from said outlet toward said inlet substantially midway between the axis of said shafts; and closure plate means located against said gears at the other side thereof and cooperating with said insert for urging the latter in a direciton opposite to said resultant force, the fluid under pressure in the gaps between the teeth of said gears and said closure plate means acting on said insert with a pair of resultant forces which are spaced from each other and located in the same plane as said first-mentioned resultant force substantially midway between the axis of said shafts, the distance between said first-mentioned resultant force and said pair of resultant forces being inversely proportional to the size of said pair of resultant forces.

7. In a gear pump, in combination, a pump housing having an inlet and an outlet; a pair of parallel shafts turnably supported by said housing and extending through the interior thereof; a pair of meshing pump gears fixed to said shafts, respectively, and located in the interior of said housing; a cup-shaped insert located in said housing and having a base portion extending substantially normal to the axes of said shafts, being located in said housing at one side of said gears and covering the entire side faces of said gears at said one side thereof and a peripheral portion integral with said base portion and extending completely around the periphery of said gears, said base portion being formed with openings through which said shafts respectively extend, said base portion being spaced from said shafts and said peripheral portion being spaced from the periphery of said gears and said pump housing by a distance providing limited movement of said insert with respect to said housing and shafts in a plane normal to the axes of said shafts, said peripheral portion of said insert having a pressure surface spaced from and directed toward a surface of said housing at said outlet thereof and defining with the latter housing surface a pressure chamber in which fluid under pressure is located, said peripheral portion having opposite said pressure surface a sealing surface directed toward the periphery of said gears and urged by said fluid pressure in said pressure chamber substantially into sealing contact against the periphery of said gears in the region of said pump outlet with a pressure depending exclusively on the pressure of the fluid in said pressure chamber, said base portion having an outer side thereof directed away from said gears and toward the surface of said housing in the interior thereof; and an endless sealing member located between said surfaces of said base portion of said insert and said housing and defining with the latter an additional pressure chamber in the region of said outlet, said insert being formed with a passage providing communication between said additional pressure chamber and the pressure side of said gears for introducing fluid under pressure into said additional pressure chamber to urge said base portion of said insert substantially into sealing contact with said side faces of said gears.

References Cited in the file of this patent

UNITED STATES PATENTS

164,147	Conver	June 8, 1875
1,880,108	Ross	Sept. 27, 1932
2,742,862	Banker	Apr. 24, 1956
2,816,510	Jarvis	Dec. 17, 1957
2,817,297	Mosbacher	Dec. 24, 1957
2,824,522	Compton	Feb. 25, 1958
2,824,524	Banker	Feb. 25, 1958
2,837,031	Ilune	June 3, 1958
2,842,066	Hilton	July 8, 1958
2,855,854	Aspelin	Oct. 14, 1958
2,936,717	Kalle	May 17, 1960

FOREIGN PATENTS

625,405	Germany	Feb. 8, 1936
771,050	Great Britain	Mar. 27, 1957
782,701	Great Britain	Sept. 11, 1957
1,165,631	France	June 2, 1958