

Jan. 31, 1961

J. F. HOFFER
GEAR MOTOR OR PUMP

2,969,744

Filed March 10, 1959

3 Sheets-Sheet 1

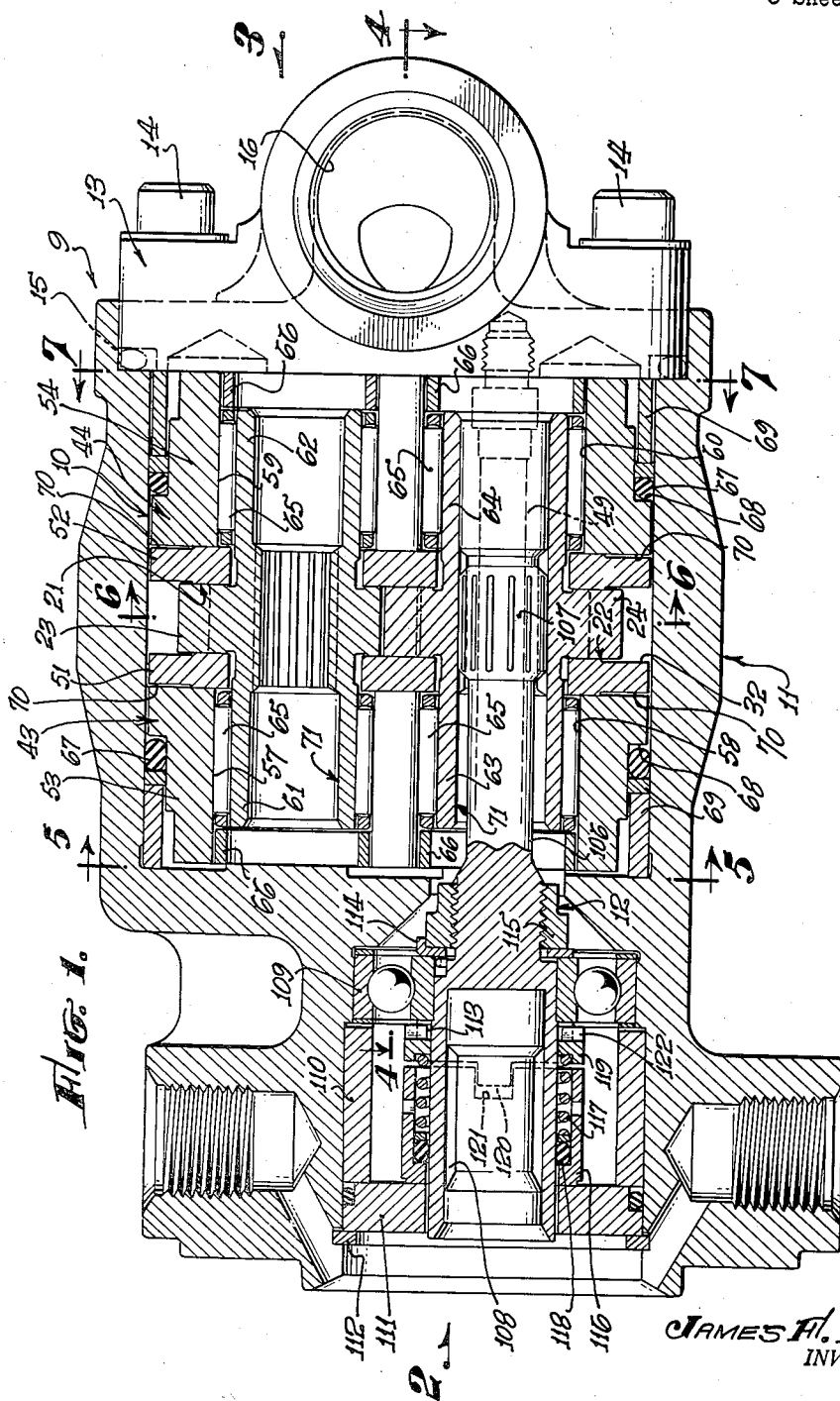


Fig. 1.

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HARRIS, KIECH, RUSSELL & KERN

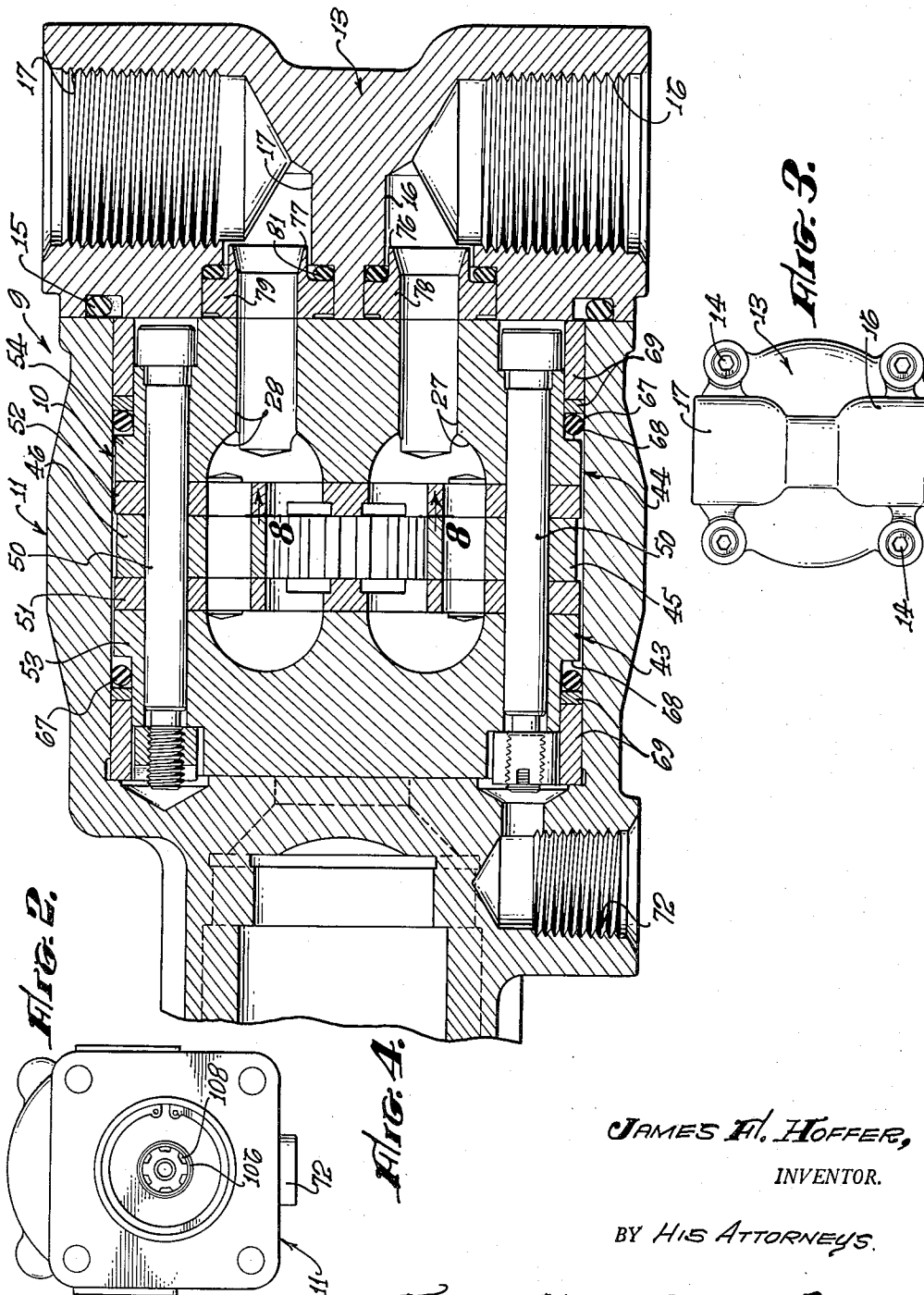
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Fig. 5.

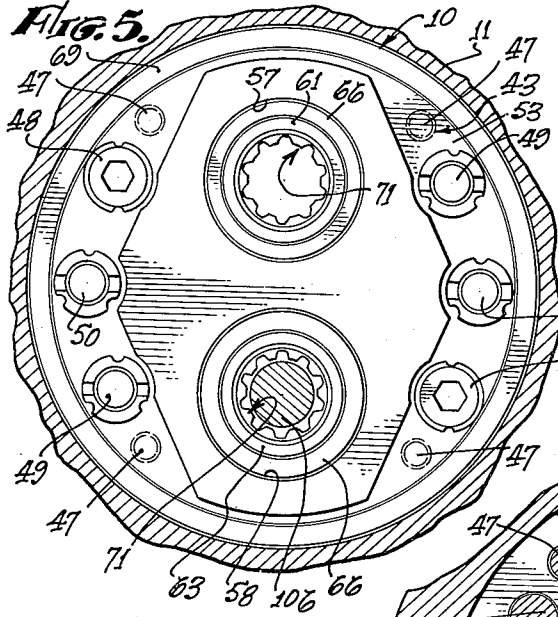


Fig. 8.

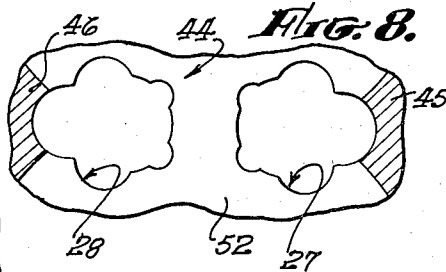


Fig. 6.

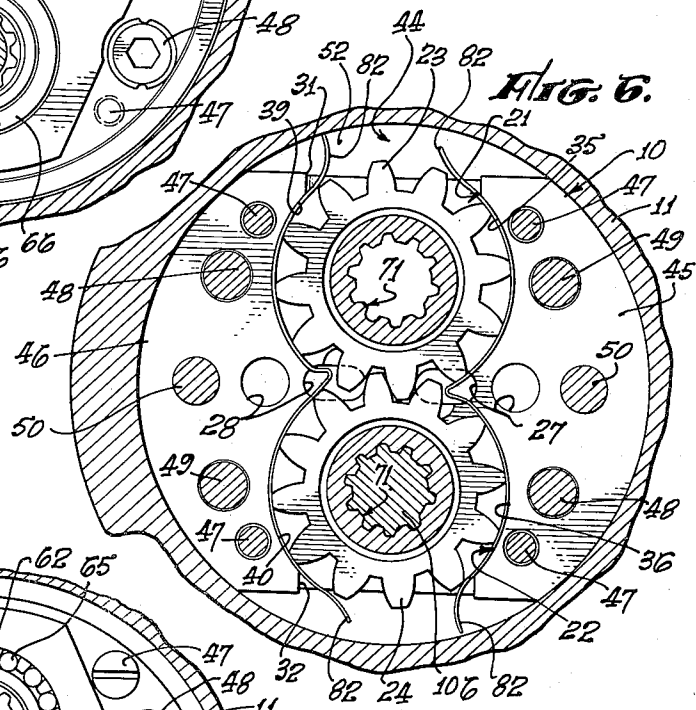
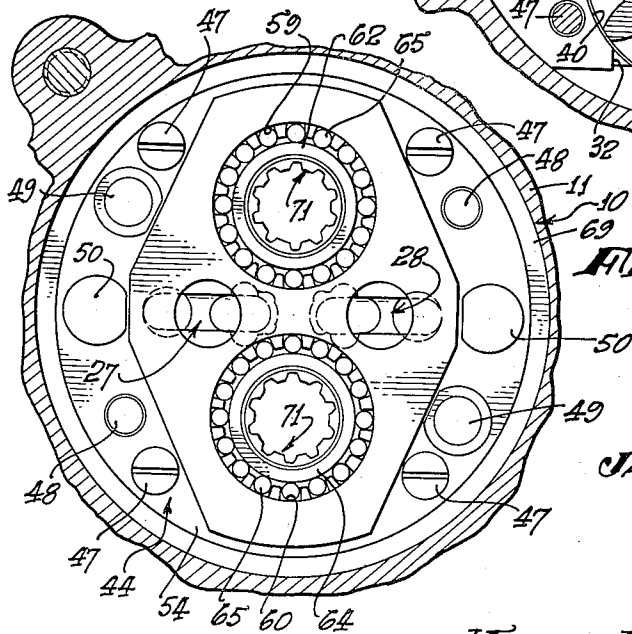


Fig. 7.



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2,969,744

GEAR MOTOR OR PUMP

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Filed Mar. 10, 1959, Ser. No. 798,513

7 Claims. (Cl. 103—126)

The present invention relates in general to the gear motor or pump art and, more particularly, to a gear pump or motor which is an improvement on the device disclosed in my co-pending patent application Serial No. 426,421, filed April 29, 1954, now Patent No. 2,880,678, granted April 7, 1959.

As background, the device of my aforementioned prior patent comprises a case subassembly which includes a drive means for transmitting power to the device when it is used as a pump and from the device when it is used as a motor, a cartridge subassembly disposed within the case subassembly, and a port head subassembly secured to the case subassembly, each of these subassemblies being susceptible of modification independently of the others to meet various requirements. The cartridge subassembly, or cartridge, is a self sufficient unit comprising a housing having therein intersecting gear chambers respectively occupied by gears in mesh at the intersection of the chambers, the cartridge housing having two main ports spaced apart laterally thereof and respectively located on opposite sides of the intersection of the chambers adjacent such intersection. The main ports communicate with both gear chambers and respectively communicate with main passages extending through one end wall of the cartridge housing into communication with main ports in the port head subassembly. Each main port of the cartridge may be either an inlet port, or an outlet port, depending upon the directions of rotation of the gears and depending on whether the device is utilized as a pump, or as a motor.

Considering the cartridge more specifically, the housing thereof includes end plates which define the end walls of the gear chambers and includes spacer means between the end plates which define the circumferential walls of the gear chambers, the spacer means including two spacer plates respectively disposed on opposite sides of the intersection of the gear chambers and being spaced apart laterally of the cartridge to provide therebetween and in the periphery of the cartridge two auxiliary ports located on opposite sides of the cartridge and between the two main ports. The two spacer plates are clamped between the two end plates by screws and dowel bolts which form part of the cartridge, the entire bolting configuration being a part of the cartridge so that the cartridge may be installed in and removed from any complementary case as an independent unit.

Since the aforementioned auxiliary ports in the cartridge are located in the periphery thereof, they communicate with the interior of the case when the cartridge is disposed therein.

An important object of the invention is to isolate the portion of the case with which these auxiliary ports in the cartridge communicate by providing the cartridge with two peripheral seals spaced apart axially of the cartridge with the auxiliary ports disposed therebetween, such seals being engageable with the peripheral wall of the case. This trapping of fluid in the circumferential portion of the case which communicates with the auxil-

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iary ports has the effect of reducing the loads on the bearings for the gears and of increasing volumetric efficiency.

Another object is to locate the peripheral seals mentioned between shoulders on the cartridge and floating backing elements respectively engageable with the end wall of the case and the port head. This construction has the effect of decreasing the pressure loading within the cartridge, which is an important feature.

Another object of the invention is to apply the pressures in the main passages of the cartridge to the outer surface of the end plate through which such passages extend in axially inward directions and in alignment with the main ports within the cartridge. Thus, the pressure within each main port acting outwardly on the end plate in question is balanced by the same pressure acting inwardly on such end plate in alignment with the main port in question, the effect being to minimize deflection of the end plate through which the main passages extend. Since this end plate is balanced with respect to the pressures in both main ports, deflection of such end plate is minimized irrespective of whether the device is used as a motor, or as a pump, and irrespective of the directions of rotation of the gears.

Another object of the invention is to make the two spacer plates laterally adjustable relative to the end plates during assembly so as to permit establishing predetermined running clearances between the spacer plates and the gears, such running clearances preferably being established by inserting between the spacer plates and the gears shims which are withdrawn through the auxiliary ports after the screws and dowel bolts which hold the end plates and the spacer plates together have been tightened. The spacer plates are rendered laterally adjustable during assembly by making certain of the dowel bolt holes therethrough larger than the corresponding dowel bolts so that the spacer plates may be shifted laterally as required to provide the proper running clearances, subsequent tightening of such dowel bolts and installation of other dowel bolts permanently locking the spacer plates in the selected positions relative to the gears. Proper running clearances between the end plates and the ends of the gears are maintained by properly relating the thickness of the spacer plates and the axial dimension of the gears. The foregoing construction permits very accurate control of all running clearances for the gears without requiring extreme tolerance control during manufacture of the parts, which makes for economical manufacture.

Another object of the invention is to mount the gears for rotation in the cartridge with roller bearings to minimize friction and to permit high speed operation, the latter permitting higher outputs than would otherwise be possible. In this connection, an object is to provide each gear with shafts which extend through inner plate members of the respective end plates into bearing bores in outer plate members of the respective end plates, roller bearings surrounding the shafts being disposed in such bearing bores and being retained therein by the inner plate members and by annular retainers inserted into the outer ends of the bearing bores.

The foregoing objects, advantages, features and results of the present invention, together with various other objects, advantages, features and results thereof which will be evident to those skilled in the gear motor or pump art in the light of this disclosure, may be attained with the exemplary embodiment of the invention described in detail hereinafter and illustrated in the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view of the gear pump or motor of the invention which is taken in a plane containing the axes of the gears thereof;

Figs. 2 and 3 are end views on a reduced scale respectively taken in the directions indicated by the arrowed lines 2 and 3 of Fig. 1;

Fig. 4 is a fragmentary longitudinal sectional view taken along the arrowed line 4—4 of Fig. 1;

Figs. 5, 6 and 7 are transverse sectional views respectively taken along the arrowed lines 5—5, 6—6 and 7—7 of Fig. 1; and

Fig. 8 is an enlarged, fragmentary, transverse sectional view taken along the arrowed line 8—8 of Fig. 4 of the drawings.

The gear motor or pump of the invention which is illustrated in Figs. 1 to 8 of the drawings is similar in many respects to that disclosed in my aforementioned patent, and many of the techniques utilized in manufacturing and assembling the various components thereof are also similar. Consequently, the gear motor or pump presently under consideration will not be described in as much detail as in my prior patent with respect to features which are similar to features disclosed therein, and the primary emphasis herein will be placed on features which distinguish the device of Figs. 1 to 8 of the drawings.

The gear pump or motor of the invention is designated generally by the numeral 9 and includes a cartridge or cartridge subassembly 10 in a case subassembly 11 which includes drive means 12, the case having an open end closed by a port head or port head subassembly 13. The latter is secured to the case 11 by screws 14 and a fluid-tight seal between the port head and the case is provided by a sealing element, such as an O-ring 15, disposed therebetween. The port head 13 is provided with main ports or passages respectively designated by the numerals 16 and 17, each of these ports being either the inlet port or the outlet port of the device 9, depending on whether it is used as a motor, or as a pump, and depending on its direction of operation.

Considering the cartridge 10 in more detail, it includes a housing having therein intersecting gear chambers 21 and 22 respectively occupied by gears 23 and 24 in mesh at the intersection of the chambers, as best shown in Fig. 6 of the drawings. Communicating with the gear chambers 21 and 22 are main ports 27 and 28 respectively located on opposite sides of and adjacent the intersection of the gear chambers, the main ports 27 and 28 respectively communicating with the main ports 16 and 17 in the port head 13. Providing communication between the interior of the case 11 and the gear chambers 21 and 22 intermediate the main ports 27 and 28 are auxiliary ports 31 and 32 respectively communicating with the gear chambers 21 and 22. The auxiliary ports 31 and 32 are spaced from the main port 27 by circumferential walls 35 and 36, respectively, of the gear chambers 21 and 22, and the auxiliary ports 31 and 32 are spaced from the main port 28 by circumferential walls 39 and 40, respectively, of the gear chambers 21 and 22.

Considering the structure of the housing of the cartridge 10, it includes two end plates 43 and 44 having therebetween a spacer means comprising two spacer plates 45 and 46 respectively disposed on opposite sides of the gear chambers 21 and 22 adjacent the main ports 27 and 28, the spacer plates being spaced apart laterally of the cartridge to provide the auxiliary ports 31 and 32 therebetween. Each of the spacer plates 45 and 46 is clamped between the end plates 43 and 44 by screws 47 and 48 and by dowel bolts 49 and 50 extending through these plates.

The end plates 43 and 44 define the end walls of the gear chambers 21 and 22, the spacer plate 45 defines the circumferential walls 35 and 36 thereof, and the spacer plate 46 defines the circumferential walls 39 and 40 thereof. The end plates 43 and 44 respectively include inner plate members 51 and 52 engaging the gears 23 and 24 and outer plate members 53 and 54 respectively engageable with the end wall of the case 11 and the

port head 13. The outer plate member 53 is provided with bearing bores 57 and 58 therethrough which are concentric with the gear chambers 21 and 22, respectively, and the outer plate member 54 is provided with bearing bores 59 and 60 which are concentric with the gear chambers 21 and 22, respectively. The gear 23 is provided with integral shafts 61 and 62 respectively extending through smaller bores in the inner plate members 51 and 52 into the bearing bores 57 and 59, respectively, in the outer plate members 53 and 54, and the gear 24 is provided with integral shafts 63 and 64 respectively extending through smaller bores in the inner plate members 51 and 52 into the bearing bores 58 and 60 in the outer plate members 53 and 54.

Disposed in the bearing bores 57, 59, 58 and 60 and encircling the corresponding shafts 61, 62, 63 and 64 therein are caged roller bearings 65 the rollers of which utilize the shafts as their inner races and the peripheral walls of the bearing bores as their outer races. The roller bearings 65 are held in the bearing bores 57, 58, 59 and 60 by engagement of the inner ends of the cages thereof with the corresponding inner plate members 51 and 52 and by engagement of the outer ends thereof with annular retainers 66 in the bearing bores, these annular retainers being held in the bearing bores by the end wall of the case 11 and by the port head 13. This structure provides a simple and effective means of retaining the roller bearings 65 in place while permitting ready removal thereof for repair or replacement.

The gear motor or pump 9 of the invention is characterized by a low starting torque and the ability to be operated at high speeds, high speed operation resulting in high power output when the device is used as a motor and in high fluid output when it is employed as a pump. Such characteristics are primarily the result of utilizing the roller bearings 65 for the gears 23 and 24, but are also attributable to the manner in which the loading of the roller bearings has been minimized, as will now be described. As previously stated, the auxiliary ports 31 and 32 formed by the gaps between the spacer plates 45 and 46 communicate with the interior of the base 11. The housing of the cartridge 10 carries axially spaced, peripheral seals, preferably O-rings 67, between which the auxiliary ports 31 and 32 are disposed and which are in sealing engagement with the peripheral wall of the case 11 when the cartridge 10 is installed therein. Thus, the auxiliary ports 31 and 32 communicate with an isolated annular zone of the case. The auxiliary ports 31 and 32 are relatively large and are located substantially diametrically opposite the gear chambers 21 and 22 from the main ports 27 and 28. Considering the situation which obtains when the device operates as a motor for convenience of explanation, there are pressure differentials around the gears 23 and 24 between the main ports 27 and 28, the directions of such pressure differentials depending upon which of the main ports 27 and 28 is utilized as the inlet port. The pressure in the annular zone isolated by the O-rings 67, and in the auxiliary ports 31 and 32, is approximately the average of the pressures in the main ports 27 and 28. This pressure in the auxiliary ports 31 and 32 acts on relatively large areas of the gears 23 and 24 in directions to oppose the action of the high inlet pressure in one or the other of the main ports 27 or 28, which high inlet pressure acts on relatively small areas of the gears since the main ports 27 and 28 are considerably smaller than the auxiliary ports 31 and 32. Consequently, the loads on the bearings 65 are minimized, which is an important feature. The annular zone isolated by the O-rings 67 also tends to improve volumetric efficiency, particularly when the device is utilized as a pump, as more fully discussed in my aforesaid prior patent.

The O-rings 67 are disposed in grooves in the cartridge 10 having inner side walls formed by annular shoulders 68 on the cartridge housing. The opposite side walls of

the grooves for the O-rings 67 are formed by floating backing elements 69 which encompass reduced-diameter ends of the cartridge 10 and which seat against the end wall of the case 11 and the port head 13, respectively. With this construction, the pressure forces within the cartridge 10 extend only to the inner peripheries of the O-rings 67, instead of to the outer peripheries thereof, as would have been the case had the O-rings 67 been disposed in integral grooves in the cartridge 10, instead of in grooves formed partially by the floating backing elements 69. Consequently, the net effect of the floating backing elements 69 is to reduce the internal pressure loading of the cartridge 10, which is an important feature.

Any tendency to deflect the inner plate members 51 and 52 of the end plates 43 and 44 axially outwardly in the vicinities of the auxiliary ports 31 and 32 is prevented by providing clearances 70 between each inner plate member and the corresponding outer plate member opposite the auxiliary ports, such clearances being shown as formed by relieving the outer surfaces of the inner plate members. Consequently, the inner plate members are hydraulically balanced in the axial direction in the vicinities of the auxiliary ports 31 and 32.

Radially inward leakage of fluid between the end plates 43 and 44 and the gears 23 and 24 flows through the roller bearings 65 to lubricate and cool them, which is an important feature. Referring to Fig. 1, the radially inward leakage flows toward the left end of the interior of the case 11 directly through the bearings 65 which are located at the left of the gears 23 and 24, and flows to the left end of the interior of the case through the bearings 65 which are located at the right of the gears by way of axial passages 71 through the gears and the shafts carrying them. After lubricating and cooling the bearings 65 in the foregoing manner, the radially inward leakage may be returned to a reservoir, or other point of disposal, the case 11 being provided with a leakage discharge port 72 for this purpose. As shown in Fig. 4, the leakage discharge port communicates with the left end of the interior of the case.

Considering the fluid flow through the cartridge 10 now, the main ports 27 and 28 in the cartridge 10 respectively communicate with the main ports 16 and 17 in the port head 13, the main ports 27 and 28 extending through the end plate 44. To facilitate filling and emptying of the intertooth spaces of the gears 23 and 24, the main ports 27 and 28 in the cartridge 10 communicate with the intertooth spaces both radially, as will be apparent from Fig. 6, and axially from both ends, as will be apparent from Fig. 4, the end plates 43 and 44, or, more particularly, the outer plate members 53 and 54 of the end plates, being recessed, as clearly shown in Fig. 2, to provide axial filling of the intertooth spaces from both ends. These recesses in the outer plate members 53 and 54 are interconnected by suitable passages through the inner plate members 51 and 52 and the spacer plates 45 and 56, this being clearly shown in Fig. 4 so that it is thought unnecessary to specifically apply reference numerals thereto, it being understood that the various recesses and passages mentioned form parts of the main ports 27 and 28.

It will be noted that the circumferential walls 35, 36, 39 and 40 of the gear chambers 21 and 22 cover only small fractions, e.g., one-sixth, of the intertooth spaces of the gears. Consequently, as more fully discussed in my aforementioned prior patent, there are high pressure gradients in directions away from that one of the main ports 27 and 28 which is the high pressure port, which one of these ports is the high pressure port depending on whether the device is being used as a motor, or as a pump, and depending on the directions of rotation of the gears 23 and 24. The net result of the foregoing is that the high pressure in one or the other of the main ports

27 and 28 is severely localized and thus acts to spread the end plates 43 and 44 in the axial direction over only a small area. This tendency exists even though the end plates are of substantial thickness, as shown, and are clamped together by a substantial number of screws and dowel bolts. An important feature of the present invention is to balance out the pressure tending to spread the end plates 43 and 44 irrespective of whether the high pressure exists in the main port 27, or the main port 28. To achieve this, annular shoulders 76 and 77 are provided around portions of the ports 16 and 17 in the port head 13 in axial alignment with the main ports 27 and 28, respectively, in the cartridge 10. As will be apparent from Fig. 4 of the drawings, the annular shoulders 76 and 77 are exposed to the pressures in the ports 16 and 17, respectively, and thus in the ports 27 and 28, respectively, and face away from the end plate 44. The annular shoulders 76 and 77 are provided by the outer ends of pressure balancing buttons 78 and 79 which are disposed in complementary recesses in the port head 13 and which are sealed with respect thereto by O-rings 80 and 81, the inner ends of these buttons being seated against the outer surface of the end plate 44. Thus, high fluid pressures in the main ports 27 and 28 tending to spread the end plates 43 and 44 act on the outer ends of the pressure balancing buttons 78 and 79 to balance or cancel out the concentrated or localized high pressures within the cartridge 10, the desired pressure balance being attained by applying the high pressures to only relatively small areas because of the fact that the high pressures within the cartridge are severely localized or concentrated as hereinbefore mentioned. It will be understood, of course, that only one of the main ports 27 and 28 will contain fluid under high pressure at a given time, depending on whether the device is used as a motor, or as a pump, and depending upon the direction of rotation of the gears 23 and 24. The main port 27 or 28 which contains fluid under high pressure will be the inlet port when the device is operating as a motor, and will be the outlet port when the device is operating as a pump, either of the main ports 27 and 28 being capable of serving as the inlet port for motor operation and the outlet port for pump operation. The two pressure balancing buttons 78 and 79 provide axial pressure balancing tending to prevent spreading of the end plates 43 and 44 under any of these conditions of operation.

One of the features of the present invention is to provide extremely close control of the clearances for the gears 23 and 24 without necessitating the maintenance of extremely close tolerances in manufacturing operations. This is accomplished for the most part in the manner discussed in my aforesaid prior patent so that a detailed discussion herein is unnecessary. However, there are some differences in the present invention which will now be considered.

Initially, holes are bored in the end plates 43 and 44 and the spacer plates 45 and 46 for the screws 47 and 48 and the dowel bolts 49, the holes for these fastening elements being bored slightly oversize in the spacer plates 45 and 46 so that these plates can be moved toward and away from the gears 23 and 24 during assembly. Holes are provided also in the end plates 43 and 44, but not in the spacer plates 45 and 46, for the dowel bolts 50. Initially, the various elements of the cartridge 10 are loosely assembled by means of the screws 48 and the dowel bolts 49. As shown in Fig. 6, shims 82 are inserted between the spacer plates 45 and 46 and the gears 23 and 24, the thickness of these shims, which has been exaggerated in Fig. 6, representing the running clearances desired for the gears 23 and 24. With the shims 82 in place, the spacer plates 45 and 46 are biased toward the gears 23 and 24 with predetermined forces. With the shims 82 thus clamped between the gears 23 and 24 and the spacer plates 45 and 46 with predetermined forces, the screws 48 and dowel bolts 49 are then tightened to hold the

spacer plates 45 and 46 in place. Then, holes for the dowel bolts 50 are bored through the spacer plates 45 and 46, using the previously formed holes for these dowel bolts in one or the other of the end plates 43 and 44 as guides. The holes thus bored through the spacer plates 45 and 46 for the dowel bolts 50 have the same diameter as the dowel bolts 50 so that these dowel bolts, when installed, firmly hold the spacer plates 45 and 46 in place. As a final step, the dowel bolts 50 and the screws 47 are installed, and the various screws 47 and 48 and dowel bolts 49 and 50 are finally tightened to secure the spacer plates in the properly adjusted positions. The shims 82 may be removed at any time after the spacer plates 45 and 46 are initially locked in place by initial tightening of the screws 48 and dowel bolts 49. As will be apparent, the shims may readily be withdrawn through the auxiliary ports 31 and 32 by rotating the gears 23 and 24 in the proper directions.

It will be understood that while the running clearances for the gears 23 and 24 have been shown as established through the use of the shims 82, the spacer plates 45 and 46 may be so adjusted during assembly as to provide zero running clearances for the gear teeth, whereupon the gear teeth generate their own running clearances when the device is put into operation. This procedure is particularly suitable when the device is to be used as a pump.

Considering the drive means 12, it includes a shaft 106 which extends into the case 11 and which is provided at its inner end 107 with means for driving connection to either of the gears 23 and 24, depending upon the position of the cartridge 10 within the case, the cartridge being positionable in the case in either of two positions spaced 180° apart. In the particular construction illustrated, the inner end 107 of the shaft 106 is externally splined for engagement with internal splines formed in either of the gear-shaft assemblies 23—61—62 and 24—63—64.

The drive shaft 106 is internally splined, at 108, for connection to an external driving means, or an external driven means, depending upon whether the device 9 is used as a pump, or as a motor. The shaft 106 is carried by a bearing 109 mounted in a counterbore in the case 11. The outer race of the bearing 109 is retained by a sleeve 110, a seal plate 111 and a snap ring 112. The inner race of the bearing is retained on the shaft 106 between an annular flange 113 on the shaft and a washer 114 held by a nut 115 threaded on the shaft.

Leakage from the interior of the case 11 along the shaft 106 is prevented by a cup-shaped seal 116 which encircles the shaft and which is biased into sealing engagement with the plate 111 by a compression spring 117, a fluid-tight seal between the seal 116 and the shaft being provided by an O-ring 118. The seal 116 is driven by an element 119 having diametrically opposed lugs 120 fitting into complementary notches 121 in the seal 116. The driving element 119 is connected to the shaft 106 by being provided thereon with lugs 122 fitting into notches in the flange 113. The lugs 122 are diametrically opposed and are spaced 90° from the lugs 120. This drive for the seal 116 insures that a pure couple is applied to the seal so that accurate alignment of the seal with the plate 111 is maintained.

Although an exemplary embodiment of the invention has been disclosed herein for purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated in such embodiment and that various features of such embodiment may be incorporated in other embodiments all without departing from the spirit of the invention and defined by the claims which follow.

I claim:

1. In a gear motor or pump, the combination of: a cartridge having therein two intersecting gear chambers respectively occupied by two gears which mesh at the

intersection of said chambers, said cartridge providing said chambers with end walls respectively engaged by the ends of said gears and with circumferential walls respectively engaged by the circumferences of said gears, said cartridge having two main ports spaced apart laterally thereof and respectively located on opposite sides of said intersection of said chambers, each of said main ports being located adjacent said intersection and communicating with both of said chambers, said cartridge having in its periphery two auxiliary ports spaced apart laterally thereof and respectively extending through said circumferential walls into communication with said chambers between said main ports; a case enclosing said cartridge and having axially spaced end walls and a peripheral wall, said case having main passages respectively communicating with said main ports, and the interior of said case communicating with said auxiliary ports; and two axially spaced, peripheral seals carried on the periphery of said cartridge and engaging said peripheral wall of said case and cooperating with said periphery of said cartridge and said peripheral wall of said case to define a peripheral space around said cartridge which is spaced from said main ports, said auxiliary ports being between said seals and in communication with said peripheral space.

2. In a gear motor or pump, the combination of: a cartridge having therein two intersecting gear chambers respectively occupied by two gears which mesh at the intersection of said chambers, said cartridge having two main ports spaced apart laterally thereof and respectively located on opposite sides of said intersection of said chambers, each of said main ports being located adjacent said intersection and communicating with both of said chambers, said cartridge having in its periphery two auxiliary ports spaced apart laterally thereof and respectively communicating with said chambers between said main ports, said cartridge including two axially spaced end plates respectively defining end walls of said gear chambers and including two spacer plates between said end plates, said spacer plates respectively being disposed on opposite sides of said intersection and respectively forming circumferential walls of said gear chambers, said spacer plates being spaced apart laterally of said cartridge and providing said auxiliary ports therebetween; a case enclosing said cartridge and having axially spaced end walls and a peripheral wall, said case having main passages respectively communicating with said main ports, and the interior of said case communicating with said auxiliary ports; and two axially spaced, peripheral seals carried on the periphery of said cartridge and engaging said peripheral wall of said case and cooperating with said periphery of said cartridge and said peripheral wall of said case to define a peripheral space around said cartridge which is spaced from said main ports, said auxiliary ports being between said seals and in communication with said peripheral space.

3. In a gear motor or pump, the combination of: a cartridge having therein two intersecting gear chambers respectively occupied by two gears which mesh at the intersection of said chambers, said cartridge providing said chambers with end walls respectively engaged by the ends of said gears and with circumferential walls respectively engaged by the circumferences of said gears, said cartridge having two main ports spaced apart laterally thereof and respectively located on opposite sides of said intersection of said chambers, each of said main ports being located adjacent said intersection and communicating with both of said chambers, said cartridge having in its periphery two auxiliary ports spaced apart laterally thereof and respectively extending through said circumferential walls into communication with said chambers between said main ports; a case enclosing said cartridge and having axially spaced end walls and a peripheral wall, said case having in one of said end walls thereof main passages respectively communicating

with said main ports, the interior of said case communicating with said auxiliary ports; and two axially spaced, peripheral seals carried on the periphery of said cartridge and engaging said peripheral wall of said case and cooperating with said periphery of said cartridge and said peripheral wall of said case to define a peripheral space around said cartridge which is spaced from said main ports, said auxiliary ports being between said seals and in communication with said peripheral space.

4. In a gear motor or pump, the combination of: a cartridge having therein two intersecting gear chambers respectively occupied by two gears which mesh at the intersection of said chambers, said cartridge providing said chambers with end walls respectively engaged by the ends of said gears and with circumferential walls respectively engaged by the circumferences of said gears, said cartridge having two main ports spaced apart laterally thereof and respectively located on opposite sides of said intersection of said chambers, each of said main ports being located adjacent said intersection and communicating with both of said chambers, said cartridge having in its periphery two auxiliary ports spaced apart laterally thereof and respectively extending through said circumferential walls into communication with said chambers between said main ports; a case enclosing said cartridge and having axially spaced end walls and a peripheral wall, said case having main passages respectively communicating with said main ports, and the interior of said case communicating with said auxiliary ports; two axially spaced, peripheral seals carried on the periphery of said cartridge and engaging said peripheral wall of said case and cooperating with said periphery of said cartridge and said peripheral wall of said case to define a peripheral space around said cartridge which is spaced from said main ports, said cartridge having two axially spaced, peripheral shoulders respectively facing said end walls of said case, said auxiliary ports being between said shoulders and in communication with said peripheral space, and said seals being disposed adjacent said shoulders, respectively; and backing elements carried on the periphery of said cartridge and respectively engageable with said end walls of said case, said seals being disposed between said backing elements and said shoulders, respectively, and said backing elements being movable toward and away from said shoulders, respectively.

5. A gear motor or pump including two meshed gears respectively disposed in intersecting gear chambers in a housing having two main ports respectively located on opposite sides of the intersection of said chambers, each of said main ports being located adjacent said intersection and communicating with both of said chambers, said housing including end plates respectively defining end walls of said gear chambers and including spacer means between said end plates and defining circumferential walls of said gear chambers, said end plates and said spacer means being rigidly secured together, said gear pump or motor including two means respectively communicating with said main ports for applying the pressures therein to one of said end plates in axial alignment with said main ports, respectively, and in a direction axially inwardly toward said main ports, respectively.

6. A gear motor or pump including two meshed gears respectively disposed in intersecting gear chambers in a housing having two main ports respectively located on opposite sides of the intersection of said chambers, each

of said main ports being located adjacent said intersection and communicating with both of said chambers, said housing including end plates respectively defining end walls of said gear chambers and including spacer means between said end plates and defining circumferential walls of said gear chambers, said end plates and said spacer means being rigidly secured together, one of said end plates having said main ports therein, said gear motor or pump including two means respectively communicating with said main ports for applying the pressures in said main ports to said one end plate in axial alignment with said main ports, respectively, and in a direction axially inwardly toward said main ports, respectively, the two means last mentioned respectively including annuli respectively encircling said main ports and exposed to the pressures therein.

7. A gear motor or pump including a housing having therein two intersecting gear chambers respectively occupied by two gears which mesh at the intersection of said chambers, said housing having two main ports spaced apart laterally thereof and respectively located on opposite sides of said intersection of said chambers, each of said main ports being located adjacent said intersection and communicating with both of said chambers, said housing having in its periphery two auxiliary ports spaced apart laterally thereof and respectively communicating with said chambers between said main ports, said housing including two axially spaced end plates respectively defining end walls of said gear chambers and including two spacer plates between said end plates, said spacer plates respectively being disposed on opposite sides of said intersection and respectively forming circumferential walls of said gear chambers, said spacer plates being spaced apart laterally of said cartridge and providing said auxiliary ports therebetween, said end plates respectively including inner plate members adjacent said gears and outer plate members respectively located axially outwardly of said inner plate members, said inner plate members having inner surfaces adjacent and exposed to fluid pressure in said auxiliary ports, there being clearances between said inner plate members and said outer plate members adjacent and in fluid communication with said auxiliary ports and providing said inner plate members with outer surfaces axially opposite and of substantially the same areas as said inner surfaces thereof and exposed to the fluid pressure in said auxiliary ports, whereby the fluid pressure in said auxiliary ports acting on said inner surfaces is balanced in the axial direction by the fluid pressure in said auxiliary ports acting on said outer surfaces, said housing having sealing means thereon for separating said auxiliary ports from said main ports.

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