Aug. 29, 1933. A. R. KUZELEWSKI 1,924,124

PUMP

Filed May 1, 1931 4 Sheets-Sheet 1

Fig. 1.

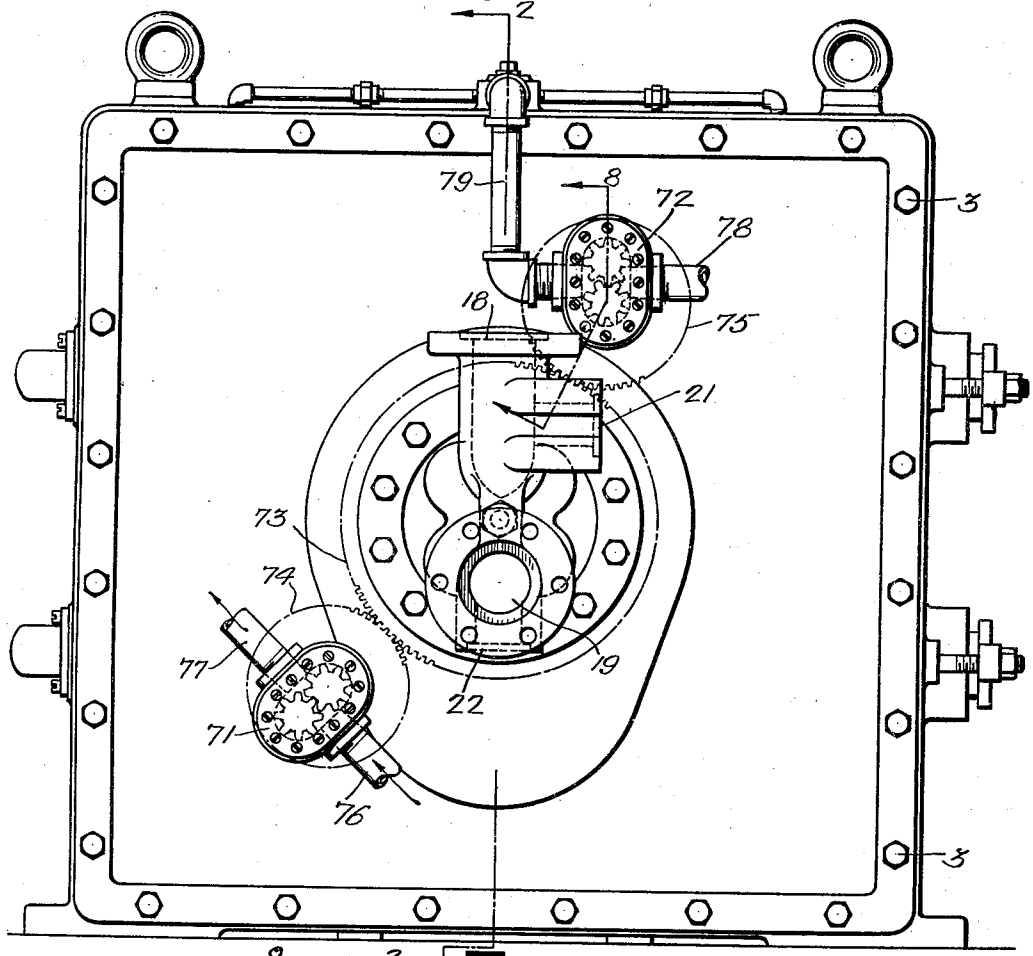


Fig. 8.

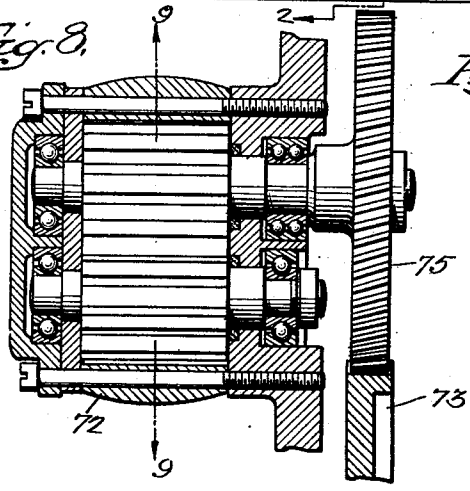
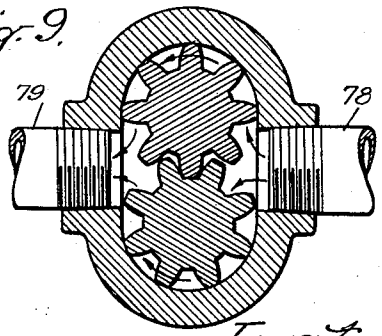


Fig. 9.



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Aug. 29, 1933. A. R. KUZELEWSKI 1,924,124

PUMP

Filed May 1, 1931 4 Sheets-Sheet 2

Fig. 2.

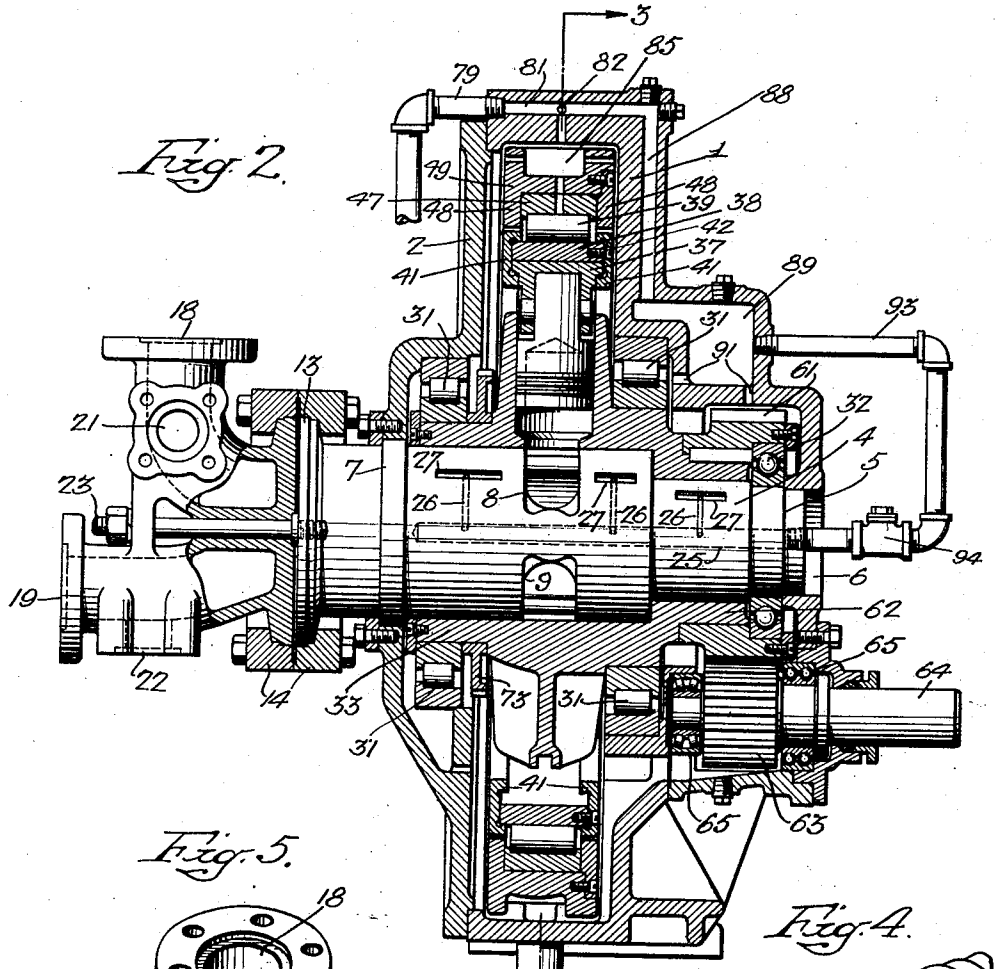


Fig. 5.

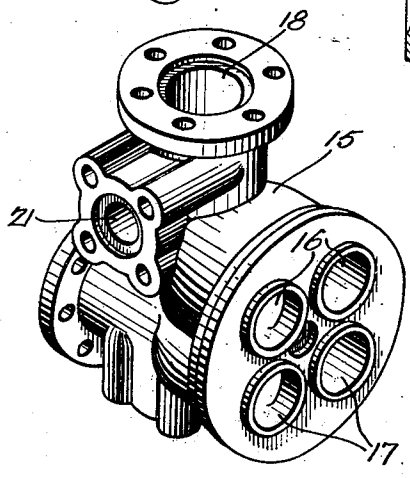
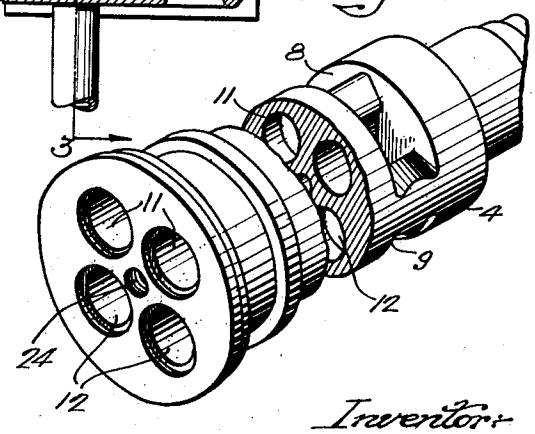


Fig. 4.



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Aug. 29, 1933. A. R. KUZELEWSKI 1,924,124

PUMP

Filed May 1, 1931 4 Sheets-Sheet 3

Fig. 3.

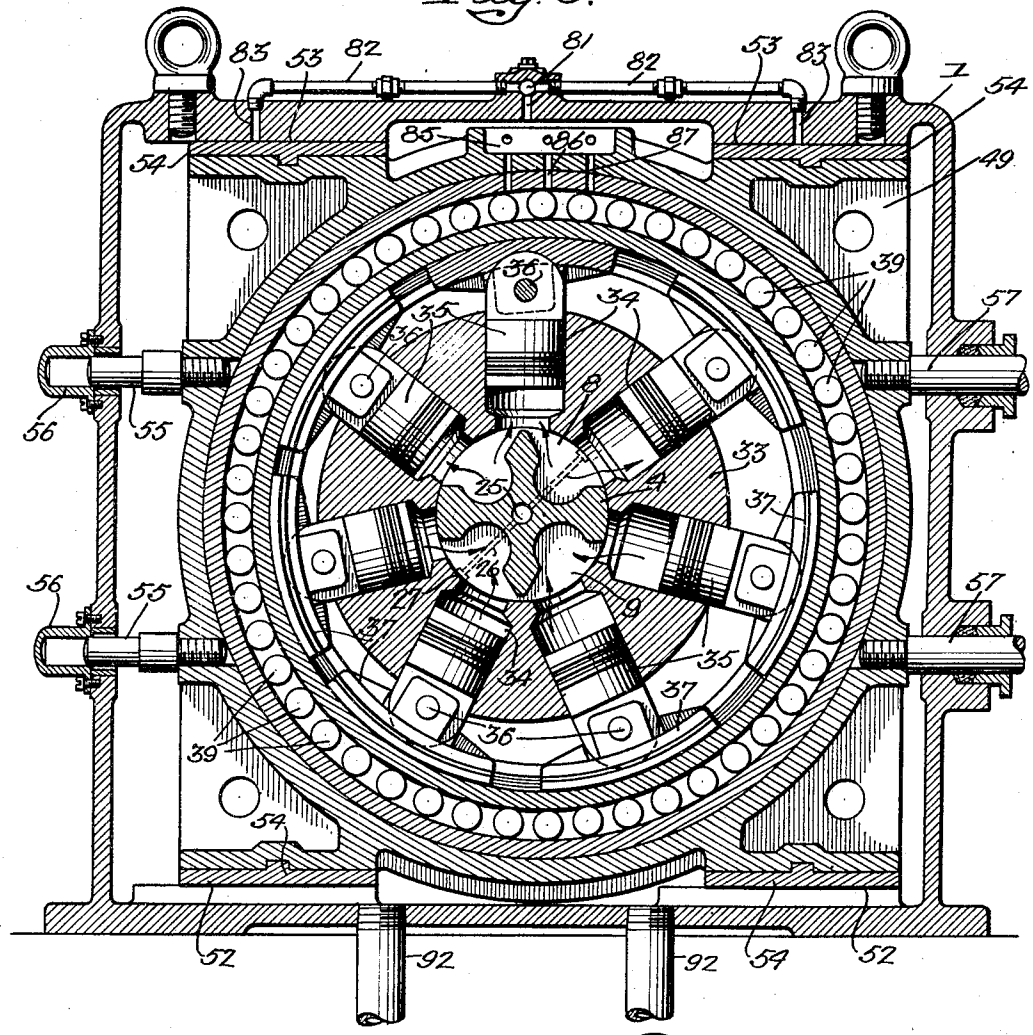


Fig. 6

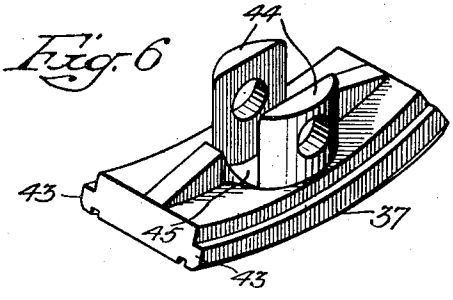
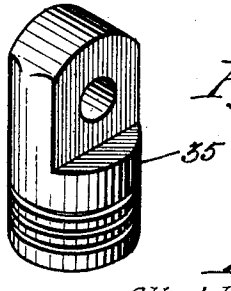


Fig. 7



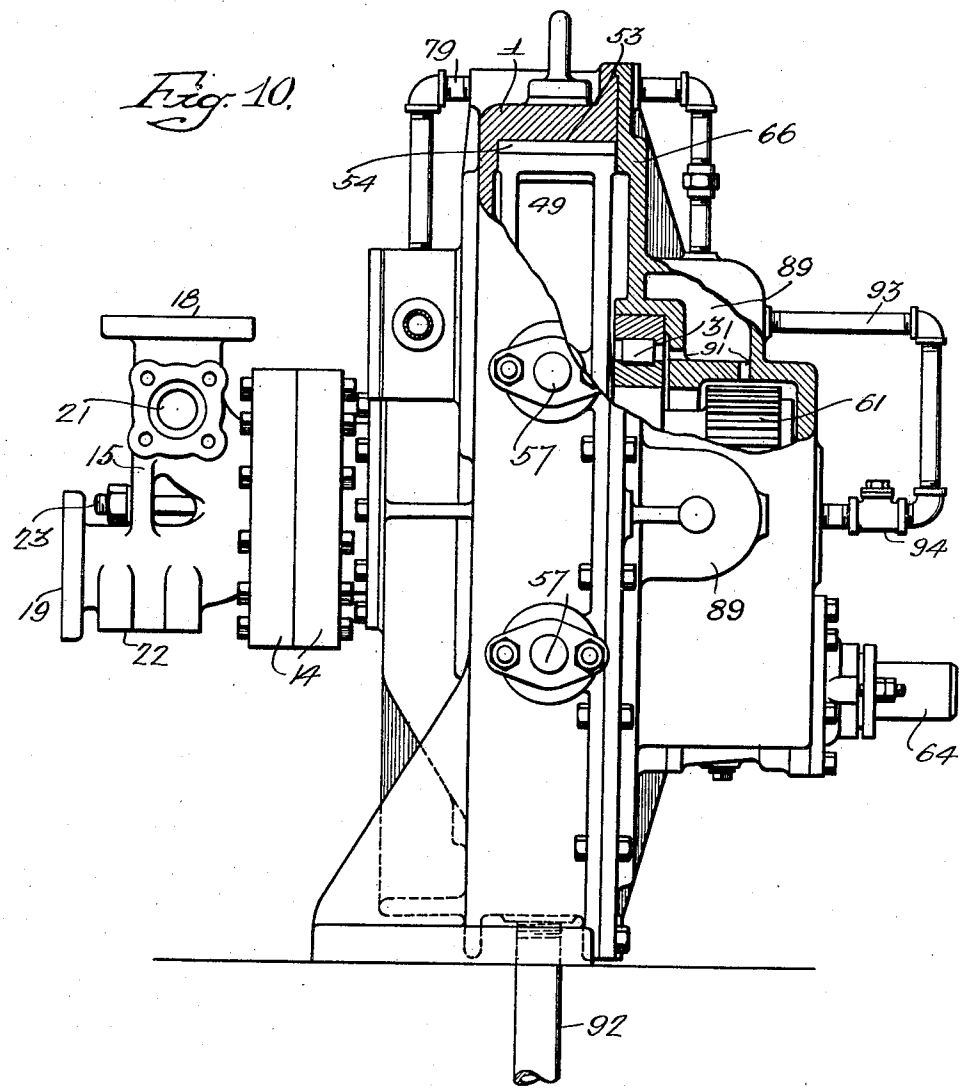
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Fig. 10.



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Patented Aug. 29, 1933 1,924,124

UNITED STATES PATENT OFFICE

1,924,124

PUMP

Albert R. Kuzelewski, Philadelphia, Pa., assignor to American Engineering Company, Philadelphia, Pa., a Corporation of Pennsylvania

Application May 1, 1931. Serial No. 534,356

4 Claims. (Cl. 103—161)

This invention relates to improvements in reversible and variable discharge pumps, of the type disclosed in United States Letters Patent No. 1,077,979, and known in the trade as Hele-Shaw.

One object of my invention is to provide a generally improved assembly conferring improved characteristics, higher operating efficiency, and greater durability, all as hereinafter specifically set forth.

Another and more specific object of the invention is to provide an improved construction in pumps of the stated type, providing rigid support for the stationary valve element in the housing.

Still another object of the invention is to provide a novel pump construction incorporating as a unitary part of the pump structure a gear reduction, said reduction being positioned within the main housing and providing for direct connection of the pump unit to a high speed motor.

A further object of the invention is to provide a pump of the stated character affording a desirable adjustability of the position of the driven shaft with respect to the housing.

A still further object of the invention is to provide a novel pump construction eliminating pump pressure from the main housing, thereby effecting a material economy in the production of said housing, and improving structural characteristics of the pump as a whole.

Another object of the invention is to provide in a pump of the stated character a housing of improved form, affording increased radiating surface, aiding elimination of the heat generated in the pump, and effecting a sturdier and better balanced discharge control mechanism.

The invention further contemplates the provision of a novel lubricating system operative at all times and during the operation of the pump in the neutral phase.

The invention further resides in certain novel and improved structural details and features hereinafter set forth and illustrated in the attached drawings, in which:

Figure 1 is an end elevational view of a pump made in accordance with my invention;

Fig. 2 is a section on the line 2—2, Fig. 1;

Fig. 3 is a section on the line 3—3, Fig. 2;

Fig. 4 is a view in perspective of the relatively fixed valve element;

Fig. 5 is a view in perspective of the novel duplex distributing fitting forming a part of my invention;

Fig. 6 is a view in perspective of one of the slipper elements;

Fig. 7 is a view in perspective of one of the pump plungers;

Fig. 8 is a section on the line 8—8, Fig. 1;

Fig. 9 is a section on the line 9—9, Fig. 8; and

Fig. 10 is a side elevational view of a pump illustrating a modification within the scope of the invention.

With reference to the drawings a pump made in accordance with my invention may comprise a housing 1, which in the present instance comprises a single end closure plate 2 secured to the housing 1 by means of studs 3. Fixed within the housing is a cylindrical main valve 4, see Figs. 2 and 4, one end 5 of the valve being supported in an opening 6 in the housing 1, and the other end being supported at 7 in the cover plate 2. This valve as illustrated in Figs. 2, 3 and 4 is provided intermediate its ends with oppositely arranged cut-out portions 8 and 9 which constitute ports communicating, respectively, with two pairs of passages 11—11 and 12—12, which passages extend longitudinally through the valve and terminate in that end of the valve which projects beyond the cover plate 2. This end of the valve is flanged, as illustrated at 13, and is adapted to have secured thereto by means of an annular clamp 14 a fitting 15, see Fig. 5, this fitting comprising two sets of channels 16—16 and 17—17 which in effect constitute extensions of the passages 11 and 12 of the valve 4. The fitting 15 also comprises a port 18 which communicates with the channels 16—16 and a second port 19 which communicates with the two channels 17, and each of the ports 18 and 19 is provided with supplemental or branch ports 21 and 22, respectively. This fitting accordingly provides for connection of the pump with associated fluid-actuated mechanism, or with distributing ducts extending to and from any desirable outlet or source. In addition to the clamping means 14, the fitting is secured to the valve 4 through the medium of a stud 23, the inner end of which is threaded into a tapped hole 24 in the projecting end of the said valve.

The valve 4 further comprises an axial channel 25 extending inwardly from that end which is supported in the housing opening 6, this channel being connected through branch ducts 26 with a number of recesses 27 in the peripheral surface, these channels and recesses constituting a part of a lubricating system hereinafter described.

Mounted in bearings 31—31 and 32 within the

housing, and closely embracing the cylindrical exterior of the valve 4 is a rotary cylinder body 33, this body as best illustrated in Fig. 3 having a series of radial cylinders 34, these cylinders being in alignment with the ports 8 and 9 of the valve 4 and directly communicating with said ports as said body rotates in the housing. Each cylinder carries a piston 35, these cylinders being respectively pivotally connected by pins 36 with a series of slipper elements 37 slidably secured against the inner face of a ring 38, which ring forms the inner race for an annular series of roller bearings 39. As illustrated in Fig. 2, the slippers 37 are secured against the ring 38 by means of a pair of flanged retaining rings 41—41 which are secured by means of bolts 42 to the ring 38, and which embrace the edges of said ring and the projecting edge portions or flanges 43 of the said slippers, the latter being free to adjust themselves circumferentially in the inside of the ring 42. As shown in Figs. 3, 6 and 7 the outer ends of the pistons 35 are adapted to fit between lugs 44 on the inner sides of the slippers 37, the extremities of the pistons being rounded on an arc finding its center in the axis of the retaining pin 36 and bearing against a correspondingly curved surface 45 on the inside of the associated slipper. Pressure applied to the outer ends of the pistons is thus transmitted directly to the slippers over relatively extended surfaces, rather than through the wrist pins 36.

The outer race for the roller bearings 39 is constituted by a ring 47, which is confined between inwardly extending radial flanges 48—48 on a guide block 49 slidably supported in the housing, the flange 48 at one side of this block being a separable element secured to the main body by screws 51. This block, as shown in Fig. 3, has an outer substantially rectangular form corresponding to the rectangular form of the housing 1, and the block finds sliding bearings in the housing at 52—52 and 53—53, respectively, detachable wearing plates or shoes 54 being interposed between the housing and the said block, and in the present instance being fixed to and movable with the block. Guide pins 55 in the form of studs threaded into one side of the guide block extend slidably into guide cylinders 56—56 on the casing, and at the opposite side rods 57 extend through suitably packed openings in the side of the housing and constitute means for adjusting the guide block in the latter. It will be noted that the adjustability of said block affords an adjustment of the ring 37 and the series of pistons connected thereto from a position concentric with the rotary axis of the cylinder body 33 to eccentric positions at opposite sides of the said axis. In the concentric position of the ring, rotation of the cylinder body 33 results in no reciprocatory movement of the plungers in their cylinders. Movement into either of the eccentric positions, however, results in a reciprocatory movement of the plungers; and the ports 8 and 9 of the valve 4 are so arranged relative to this eccentric adjustment that the plungers act successively and progressively to evacuate one of said ports and to apply fluid pressure to the other of said ports, depending on the adjustment with respect to the rotational axis of the cylinder body. In the position shown in Fig. 3, the flow of fluid is as indicated by the arrows, the plungers functioning to withdraw fluid from the port 8, and to subsequently discharge this fluid into the port 9; and adjustment of the block 49 carrying the ring 38 into the opposite eccentricity with respect to the rotational axis will result in a reversal of the flow and a circulation from the port 9 to the port 8. The mode of operation of this type of pump is well known in the art and requires no further description in the definition of the present invention.

In accordance with the present invention, rotation of the cylinder body 33 is effected through the medium of a gear 61 secured to the hub extension 62 of said body, this gear meshing with a pinion 63 on a shaft 64 journaled in bearings 65 in the housing and projecting through the latter as illustrated in Fig. 2. The shaft 64 thus constitutes the drive shaft of the pump, the transmission being through the reduction gearing 63—61 which is enclosed in the main housing, and thus constitutes a unitary part of the pump structure.

In Fig. 2 the pinion 63 is shown as occupying a position underneath the gear 61, but this character of drive lends itself readily to an adjustment feature providing for a location of the pinion 63 at either side, or above the driving gear 61. Such an arrangement is illustrated in Fig. 10, in which the pinion 63 and its shaft 64 are carried by a cover plate 66 which is symmetrical with respect to the axis of the cylinder body 33 and to the means for securing the plate to the housing. Adjustment of the cover plate through angles of 90 degrees thus provides for a location of the pinion 63 and the shaft 64 at either side or above the gear 61 without effecting the operative connection between said gears. This method of adjustment is a desirable feature of marine installations, where it is frequently desirable to locate the drive shaft 64 in a relatively elevated position.

The present invention also provides an improved and highly effective lubricating system for the pump, this system comprising in the present instance a pair of small gear pumps 71 and 72, respectively secured to the exterior of the housing 1 and actuated from a gear 73, see Figs. 1 and 2, mounted on the cylinder body 33 in the interior of the housing. This gear meshes with gears 74 and 75 also located in the interior of the housing, and respectively operatively associated with the pumps 71 and 72, the connection between the gear 73 and the gear 75 of the pump 72 being illustrated in Fig. 8. The intake of the pump 71 is connected through a pipe 76 with the make-up tank of the pump, from which it draws oil and discharges it through a pipe 77 to a second tank located in an elevated position above the main pump. To this latter tank the intake of the pump 72 is connected through a pipe 78, the discharge of the pump 72 being connected through a pipe 79 with a port 81 in the top of the housing 1. Port 81, pipes 82—82 extend to ports 83 in the top of the housing 1, which port communicates with the bearing surfaces 53. A port 84 extends from the port 81 downwardly through the housing to a point immediately above a recess 85 in the top of the guide block 49, and from this recess 85 channels or ports 86 and 87 provide for passage of lubricant to the outer surfaces of the floating ring assembly, to the bearings 31, and the gear 73, and to the interior of the floating ring assembly including the bearings 39 and the slippers 37. From the port 81, a passage 88 in the housing 1 extends to a chamber 89 located immediately above the gear 61. From this chamber ports 91 permit passage of oil directly to the gear 61, the adjacent bearing 31, the bearing

32, and subsequently to the pinion 63 and the bearings 65. The oil thus discharged through the various ports eventually finds its way into the bottom of the housing and to the bearing surfaces 52, discharging from said housing through pipe 92 to the make-up tank. Also from the chamber 89 a pipe 93 conducts the lubricant to the outer end of the channel 25 of the valve 4, and it will be noted that the pipe 23 includes a check valve 94, preventing a return flow of lubricant towards the chamber 89. From the channel 25 the lubricant passes through branch channels 26 to the recesses 27 in the exterior surfaces of the valve, and so provides lubricant between the contacting surfaces of the said valve and cylinder body 33. With this system a continuous supply of lubricant under pressure is supplied to all moving parts of the mechanism, and it will be noted that this supply of lubricant continues while the pump is in the position of neutral adjustment, during which the plungers are inoperative. In this phase of the pump operation, the lubricant is still continuously supplied to the contacting surfaces of the valve 4 and the cylinder body 33. During the active operation of the pump, leakage of fluid between the valve and the cylinder body and through the recesses 27 and channel 5 is prevented by the check valve 94, which prevents passage of fluid in the reverse direction through the pipe 93, as previously set forth. As shown in Fig. 10, the cover plate 66 is provided with a plurality of chambers 89. These chambers are spaced 90 degrees apart so that regardless of the position of adjustment of the cover plate 66 a chamber 89 will be in position to properly distribute the lubricant.

A pump constructed in accordance with my invention has material advantages over pumps of the same type as made in accordance with the prior practice. By providing a rigid support for the valve at both sides of the inner ports, axial displacement of this element by the unbalanced fluid pressures is effectively prevented. In the cantilever type of support previously employed, the tendency of the valve to flex from the normal axis resulted in undue frictional wear between the valve and the cylinder body with consequent loss of efficiency, and in some instances resulted in the binding or freezing together of these relatively movable parts.

Another improving feature resides in the incorporation in a unitary structure with the other pump elements of the reduction gearing for actuating the cylinder body, thus permitting direct connection of the pump unit to a high speed motor and elimination of extraneous gear reduction mechanism. As previously set forth, this structural feature also affords by a simple adjustment an alternative positioning of the pump drive shaft with respect to the housing and the associated driven parts, and affords a desirable flexibility in the location of the driving motor with respect to the pump. By providing for direct connection of the distributing pipes or fittings directly to the central valve element independently of the housing, fluid pressure is entirely eliminated from the latter, thereby simplifying and reducing the cost of manufacture of the housing and effecting a material improvement in the pump structure.

A still further improvement is to be found in the rectangular form of the housing which without materially increasing the overall dimensions of the pump effects a considerably larger radiating surface to carry off the heat generated in the operation of the pump. This rectangular form also permits a corresponding form of adjustable guide block with relatively extended support surfaces in the housing, conferring a greatly increased stability, reducing vibration, and providing a generally stronger and more durable construction.

My improved lubricating system also constitutes a material improvement over the prior art. This improved system provides direct lubrication of all operating parts, and particularly to the opposed surfaces of the valve and cylinder body, and the lubrication is maintained at all times during operation of the pump and particularly in the neutral phase of operation.

It will be understood that there may be modification of the construction as herein described without departure from the invention.

I claim:

1. In a pump of the stated character, the combination with a housing comprising a cover plate, a cylindrical valve element mounted in the housing, a cylinder body embracing said valve and rotatably mounted in the housing, means for rotating said body including a gear mounted on the latter, and a pinion journaled in said cover plate, a shaft projecting through the cover plate in driving relation with said pinion, said cover plate being adjustable to a plurality of different positions on the housing to afford an adjustment of the position of said pinion and shaft about the axis of said cylinder body.

2. In a pump of the stated character, the combination with a housing comprising a cover-plate, a cylindrical valve element mounted in the housing, a cylinder body embracing said valve and rotatably mounted in the housing, means for rotating said body including a gear mounted on the latter and a pinion journaled in said cover-plate, a shaft projecting through the cover plate in driving relation with said pinion, said cover-plate being adjustable to a plurality of different positions on the housing to afford an adjustment of the position of said pinion and shaft about the axis of said cylinder body, a lubricating system for said mechanism, said cover-plate having a chamber constituting a part of said system, and additional chambers formed in said cover-plate and adapted in different adjusted positions of the latter to function in the lubricating system.

3. In a pump of the stated character, the combination with a housing, of a cylindrical valve element mounted in said housing, and having circumferentially aligned ports, a cylinder body concentric with said valve and having cylinders adapted to register at one end with said ports, plungers operating in said cylinders, a floating ring mounted for rotation in said housing and adjustable to alternative positions concentric and eccentric to said cylinder body, slippers slidably mounted for circumferential movement in said ring, said slippers being pivotally secured to said plungers, a bearing for said floating ring, chambers provided in said housing having passages communicating with the bearings for said floating ring and cylinder body, a longitudinal channel provided in said central valve, a series of passages connecting said channel with the external surface of said valve, means establishing communication between said channel and one of the chambers of said housing, and means actuated by the relative rotation of said cylinder body and central valve for introducing a lubricating medium to the passages of said housing and to the longitudinal channel of said central

valve whereby the bearings and contacting surfaces of the central valve and cylinder body are automatically lubricated.

4. In a device of the stated character, the combination with a housing, of a cylindrical valve element supported within said housing and having circumferentially aligned ports, a cylinder body concentric with said valve and having cylinders adapted to register at one end with said ports, plungers operating in said cylinders, gearing mounted within said housing for rotating said cylinder body, a floating ring mounted for rotation in said housing and adjustable to alternative positions concentric and eccentric to said cylinder body, a pump driven by movement of said cylinder body, bearings for said cylinder body and floating ring, a series of chambers provided in said casing having passages leading therefrom to the bearings for said floating ring, cylinder body and gearing, a longitudinal channel provided in said central valve, passages leading from said channel to the outer surface of said central valve, means establishing communication between said longitudinal channel and one of the chambers provided in said housing, said parts being so constructed and arranged that upon rotation of said cylinder body a lubricant is distributed to the bearings of said floating ring and cylinder body, the contacting surfaces of said cylinder body and central valve, and to the gearing provided within said housing for actuating said cylinder body.

ALBERT R. KUZELEWSKI.