July 12, 1938. J. E. WHITFIELD 2,123,391

FLUID PUMP

Filed April 15, 1935 4 Sheets-Sheet 1

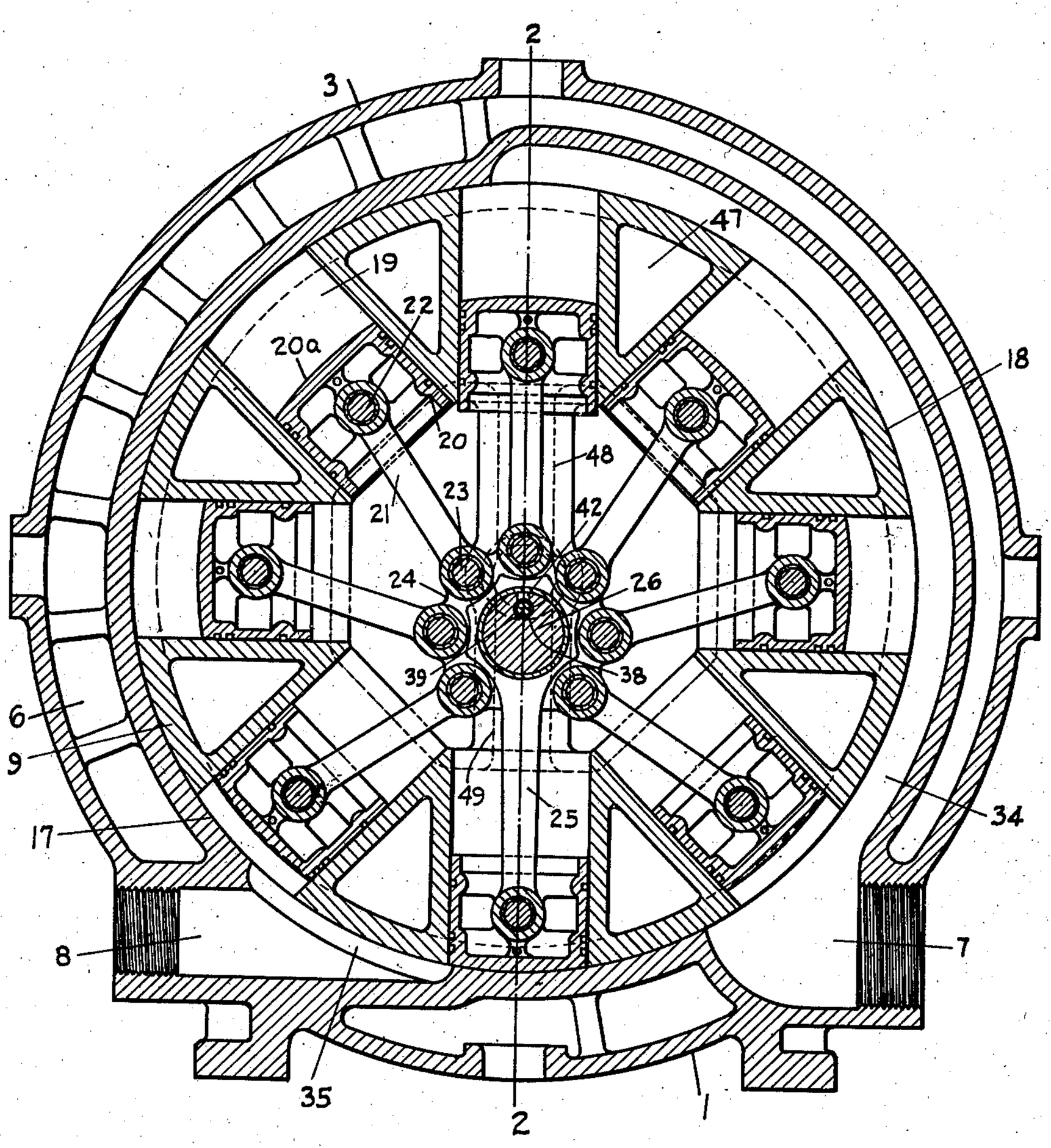

FIG. 1

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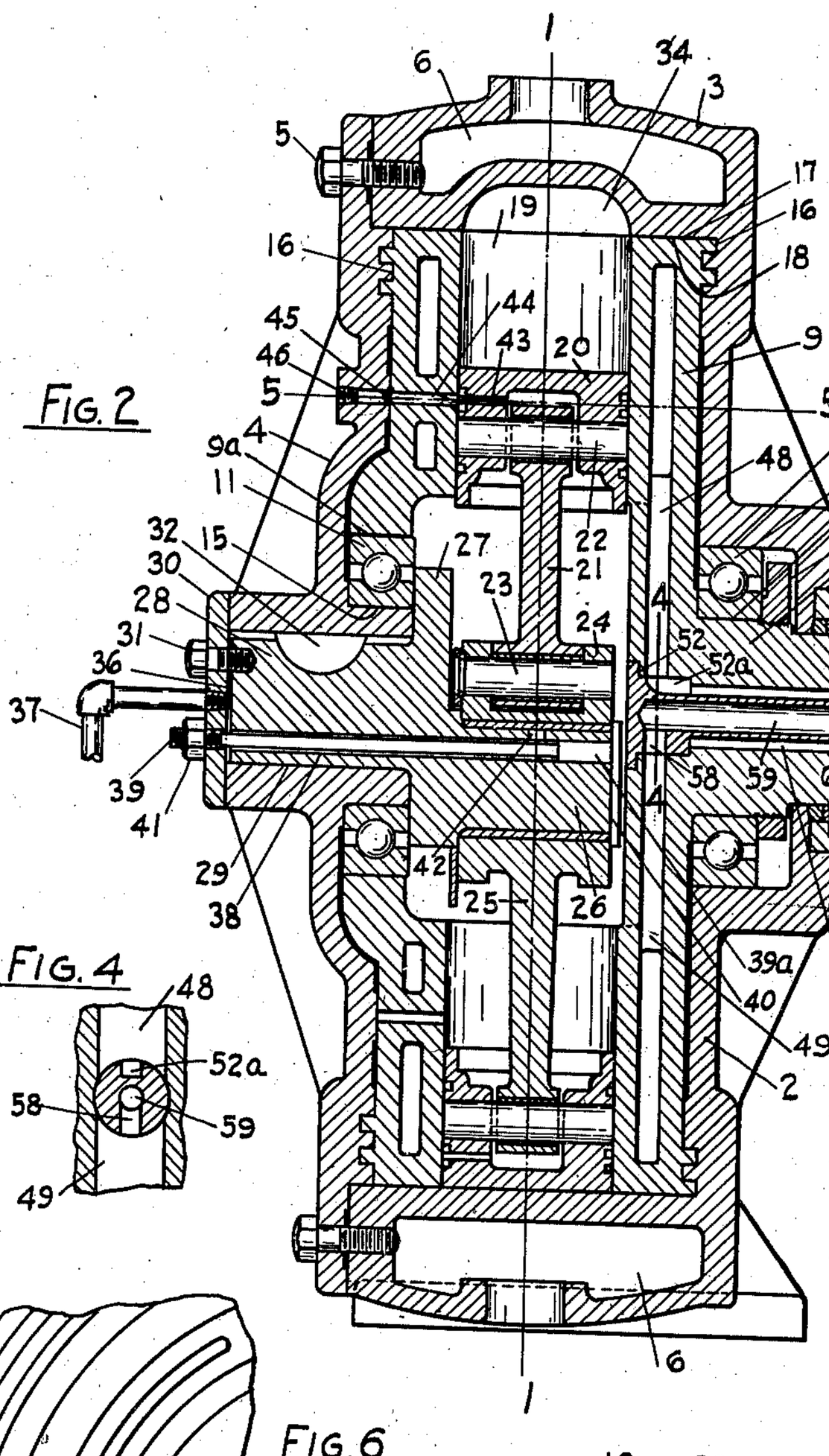

FIG. 2

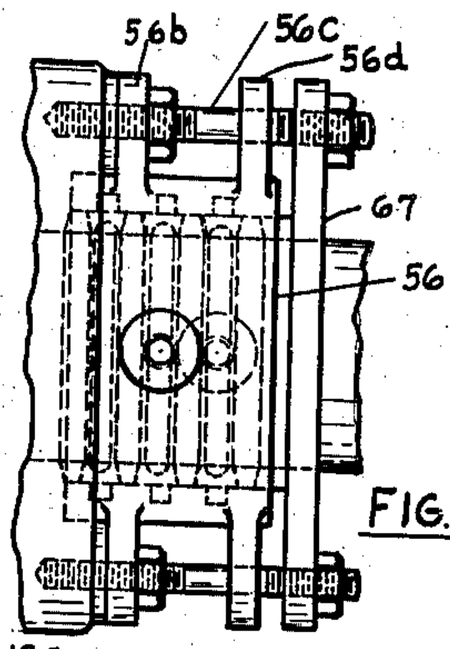

FIG. 3

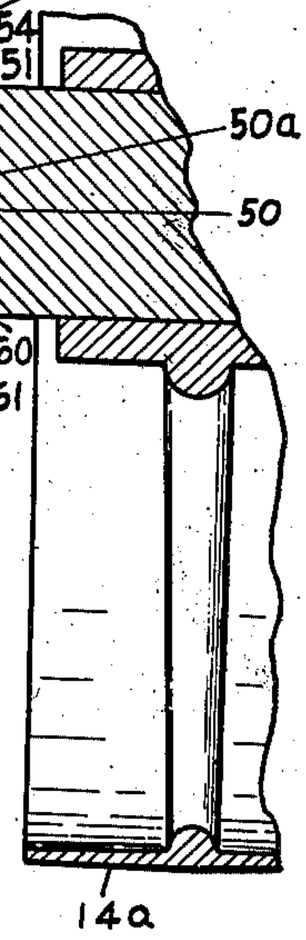

FIG. 4

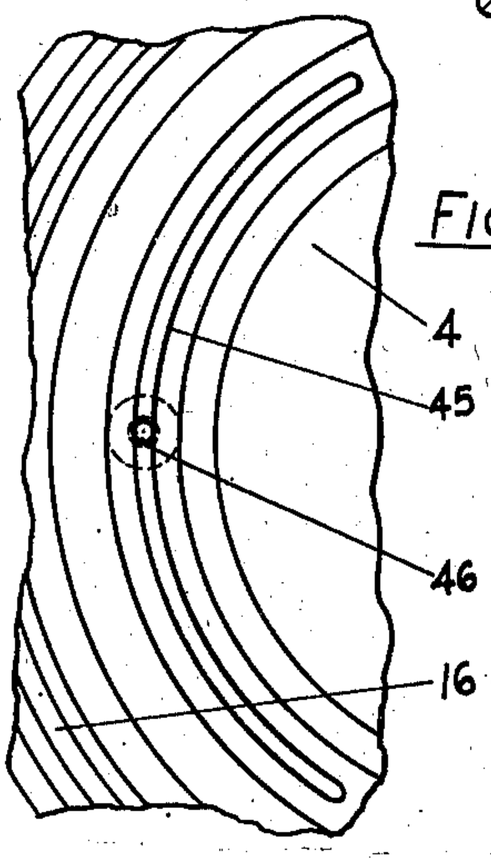

FIG. 6

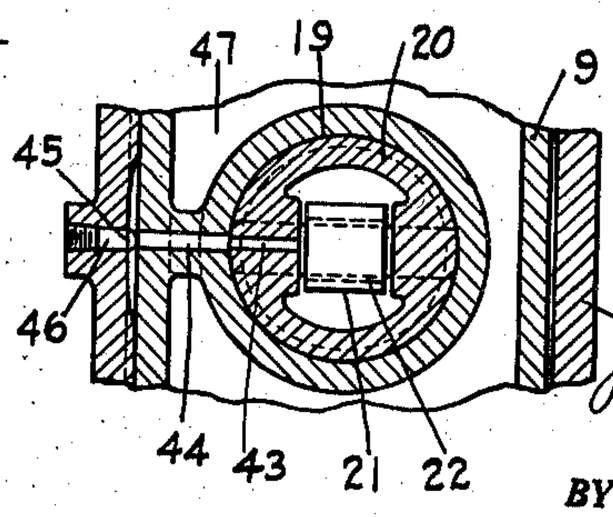

FIG. 5

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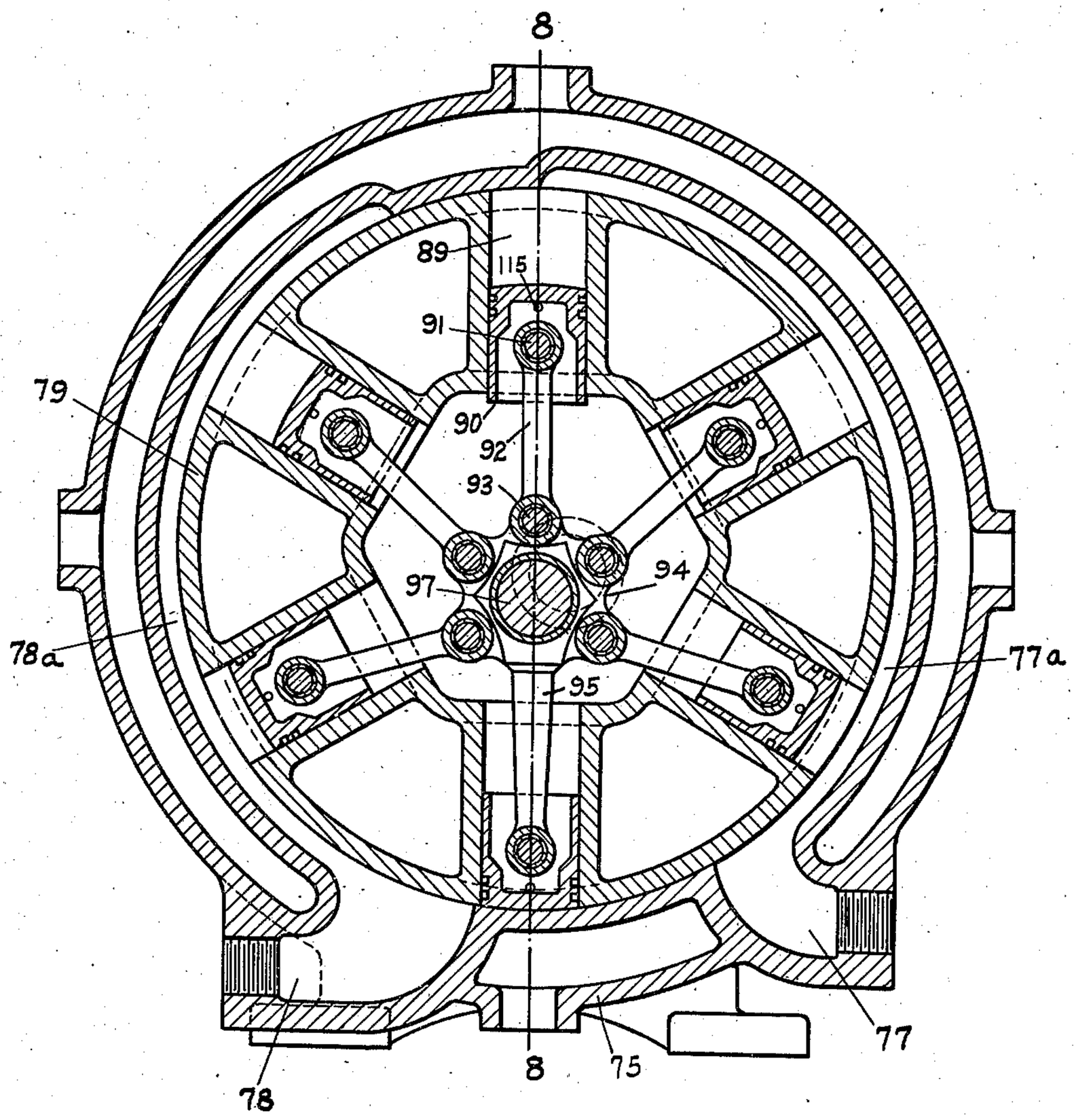

FIG. 7

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FIG. 8

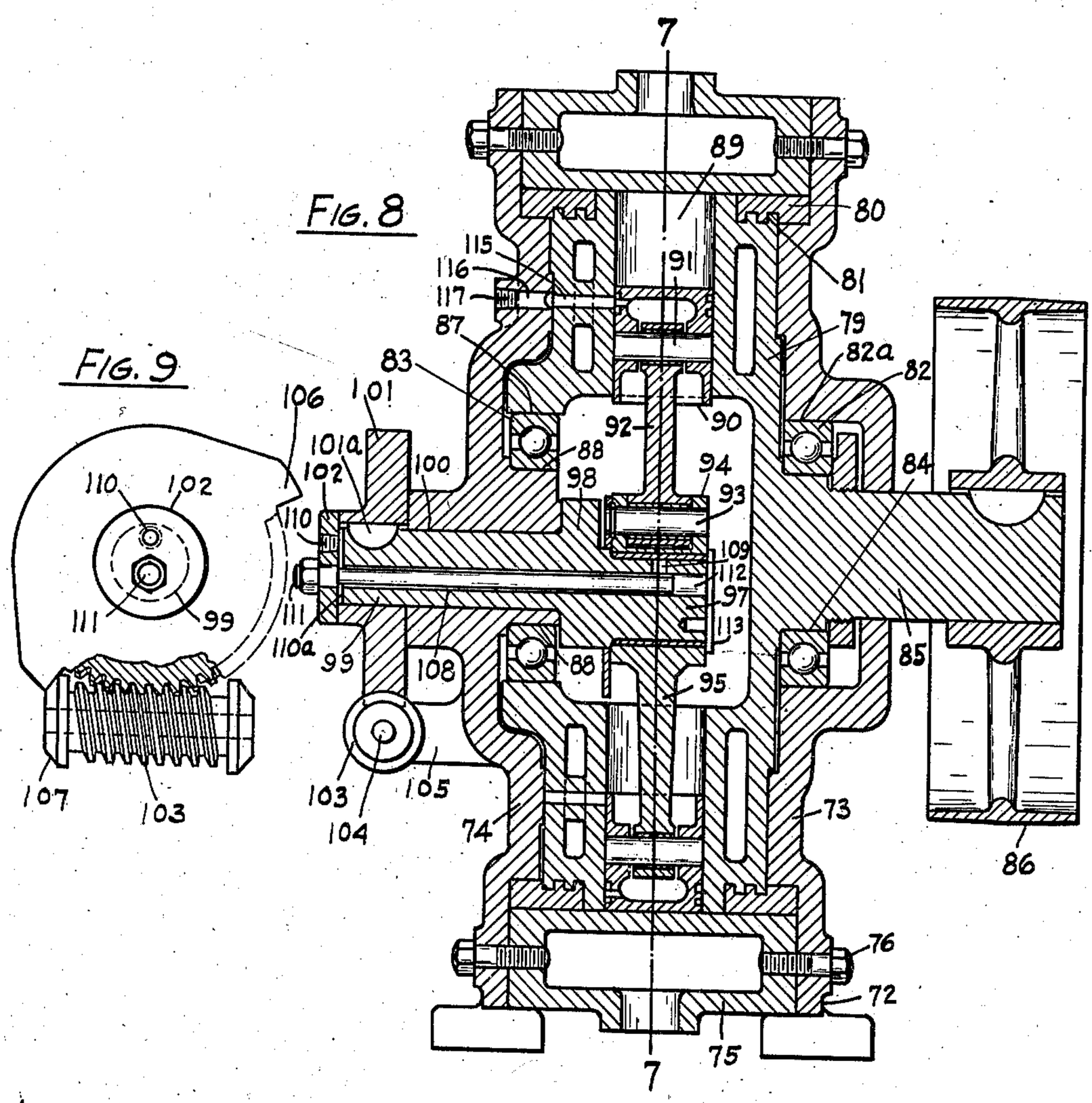
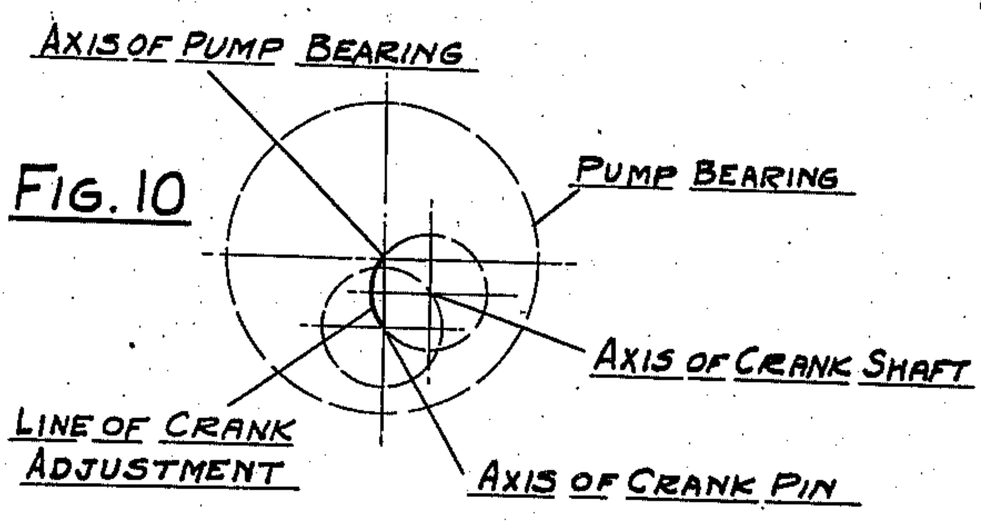


FIG. 9

FIG. 10



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Patented July 12, 1938 2,123,391

UNITED STATES PATENT OFFICE

2,123,391

FLUID PUMP

Joseph E. Whitfield, Grove City, Pa.

Application April 15, 1935, Serial No. 16,441

2 Claims. (Cl. 103—161)

The present invention is designed to improve pumps for gaseous, or liquid fluids. Generally the object of the invention is to provide a positive displacement pump having a large capacity for small space and high efficiency.

In carrying out the invention a cylinder block is driven rotatively in a stationary case, the rotation of the cylinder opening and closing the cylinder to the inlet and exhaust and the surface relations between the cylinder and case sealing the cylinder. The cylinders are provided with pistons connected to a stationary crank. Preferably the rotating cylinder block is journaled independently of the sealing surfaces so that wear on the sealing surfaces may be avoided. For some purposes, particularly liquid pumping, the crank throw is made adjustable to vary the capacity of the pump. The invention further involves details of lubrication, cooling and construction. Features and details of the invention will appear from the specification and claims.

Preferred embodiments of the invention are illustrated in the accompanying drawings as follows:—

Fig. 1 shows a section through the line 1—1 in Fig. 2.

Fig. 2 is a section through the line 2—2 in Fig. 1.

Fig. 3 is a plan view of the water connection leading to the cooling passages.

Fig. 4 is a section on the line 4—4 in Fig. 2.

Fig. 5 is a section on the line 5—5 in Fig. 2.

Fig. 6 is a view of a side portion of the wall of the pump case.

Fig. 7 is a central section on the line 7—7 in Fig. 8 showing a modification.

Fig. 8 is a section on the line 8—8 in Fig. 7.

Fig. 9 is a side elevation of a crank adjusting means.

Fig. 10 is an elevation of the crank.

1 marks the case. This is made of the side wall 2 having a peripheral wall 3 extending therefrom and a side wall 4 secured to the peripheral wall by screws 5. The peripheral wall of the case has the braced passage 6 which may be used for a cooling medium, if desired. The case is provided with an inlet passage 7 and an exhaust passage 8.

A rotating cylinder block 9 is mounted in the case. It is carried by ball bearings 10 and 11. The ball bearing 10 is secured in a bore 12 in the side 2 of the case and engages a ring surface 13 on a driving shaft 14, the ring of the ball bearing on the shaft being clamped in position by a screw-threaded ring 13*a*. The ball bearing 11 fits on an extension 15 of the side 4 and is arranged in an opening 9*a* in the cylinder block. The shaft 14 is provided with a driving means, such as a drive pulley 14*a*. The sides of the cylinder block have a labyrinth sealing surface 16 with the side walls 2 and 4 and forming a sealing surface. The case has a peripheral sealing surface 17 sealing with the peripheral surface 18 on the block. The ball bearings take the radial load on the cylinder block and maintain the concentricity of the cylinder block. It is possible, therefore, to provide a seal between the surfaces 16 and 17 and avoid a wearing contact between those surfaces. Consequently those surfaces may be maintained in sealing relation for a long period of time.

Cylinders 19 are arranged radially in the block. Pistons 20 reciprocate in relation to the cylinders. In the embodiment in Figs. 1 and 2 which is designed as an air compressor, the outer surface 20*a* of the piston is curved to conform to the peripheral surface 17 so that with the piston in its extreme position clearance is practically eliminated.

The pistons have pins 22 on which connecting rods 21 are journaled and the connecting rods extend to pins 23 on a crank ring 24. A master rod 25 is rigid with the ring 24 and operates in the usual manner. The ring 24 is journaled on a crank pin 26.

The crank pin extends from a disc 27 and a crank shaft 28 extends from the disc. The shaft 28 extends through an opening 29 in the case side 4. A cap 30 is secured by screws 31 on the end of the shaft and extends over the side wall 4 at the end of the opening 29. The crank is locked against rotation by the key 32. The screws 31 clamp the disc 27 against the inner bearing ring of the ball bearing 11 and clamp it in place. The crank, it will be noted, from this structure is fixed with the case and remains stationary so that as the cylinder block is rotated the pistons are reciprocated in the cylinder block.

An inlet port 34 extends along a large portion of the peripheral wall 3 so that the cylinders are opened for the intake of air through the larger portion of their suction stroke. A discharge port 35 is provided in the peripheral wall in position to permit discharge after compression is sufficient to effect discharge upon the opening of the port. The discharge port remains open practically to the extreme outer position of the piston so that at the closing of the port the piston is in approximate sealing rela-

tion to the peripheral wall 17 and clearance is practically eliminated.

The lubrication is accomplished through the following mechanism. A small chamber 36 is formed between the cap 30 and the end of the crank shaft 28. This is connected with a pipe 37 leading to a forced oil feed (not shown). The chamber 36 is connected with a passage 38 in the crank shaft 28 and a bolt 39 extends through this passage being sufficiently smaller than the passage to provide for the passage of oil. The end of the bolt has a closing portion 39*a* and a plate 40 forms the head of the bolt and extends over the end of the crank pin forming a flange for the crank ring. The outer end of the bolt extends through the cap and is provided with a nut 41. This permits the clamping of the cap 40 in place and assists in clamping the crank in place. A radial passage 42 extends from the passage 38 to the crank bearing and from there the oil reaches the block, thus lubricating the connecting rod bearings, pistons and sealing surfaces. The excess oil is led from the crank chamber by holes 43 in the piston and through an opening 44 in the cylinder block into a segmental groove 45 (see Fig. 6) in the side wall. An opening 46 leads from the segmental groove through the side wall of the case where the excess oil may be discharged.

The cylinder block is provided with a cooling cavity 47 which surrounds the cylinders and ports 48 and 49 lead to this cavity at opposite sides of the cylinder block. The shaft 14 has an axial opening 50 closed at its outer end in which there is a plug 50*a*. This has a closing portion 51 at its outer end, a smaller portion intermediate its ends forming a passage 53. The inner end has a sealing portion 52 and a passage 52*a* which connects the passage 53 with the passage 48. A radial passage 54 is arranged in the shaft 14 and extends to an annular passage 55 in a ring 55*a*. The ring 55*a* is connected with a passage 57 in a gland 56 and the passage 57 is connected with a cooling liquid supply (not shown). The return passage 49 from the cavity 47 leads through an opening 58 in the sealing portion 52 of the plug 50*a*. The plug 50*a* has a central port 59 which leads from the passage 58. A radial passage 60 extends from the port 59 and connects with a passage 61 in the shaft. The passage 61 leads to an annular passage 62 in a ring 63. The ring is connected through a radial passage 64 with a discharge outlet 65. Through this circuit the cylinder block may be cooled. The rings 55*a* and 63 are separated by gaskets 66. A follower 67 is provided for putting pressure on the gaskets and clamping the rings in place. If desired, a ring 68 may be provided with an annular channel 69 connected through a radial passage with a discharge passage 71 in the gland 56 the channel 69 in this arrangement intercepts any leakage and discharges it through the passage 71. The gland 56 is clamped to the case by bolts 56*c* extending through flanges 56*b* and 56*d* (see Fig. 3) and the follower is secured to a flange 56*d* by bolts 67*b* extending through a flange 67*a* on the follower.

It will be noted that the radial arrangement of the cylinder block in close relation gives a large capacity in a very small space; that the utilization of the case as a sealing surface eliminates any moving valves; that the final position of the piston with relation to the sealing surface practically eliminates clearance at the discharge; that the long inlet port assures a full filling of the cylinders even at relatively high speeds; and that the absence of wear on the sealing surfaces at the ends of the cylinders assures an efficient sealing for extended periods with a minimum of friction. It will be noted in this connection that the radial loads on the cylinder block are quite slight in that none of the pressure walls of the cylinder are subjected to radial pressure so that the thrusts on the cylinder block are merely the frictional thrusts of the piston and except for the slight unbalance that may result in that part of the surface covering the ports the cylinder block is largely balanced. The structure lends itself to simplicity of parts which permits of a rugged construction.

In the modified structure Fig. 7, the pump is shown as arranged for pumping liquids. It is provided with a case 72 which has side walls 73 and 74, and a peripheral wall 75 between the walls 73 and 74 and secured thereto by screws 76. The case has inlet and exhaust passages 77 and 78. A cylinder block 79 largely similar in structure to that of the preferred construction is mounted in the case. Peripheral sealing rings are arranged within the peripheral wall and have labyrinth sealing surfaces 81 between the ring 80 and the sides of the outer periphery of the cylinder block. The cylinder block is mounted on ball bearings 82 and 83, the ball bearing 82 being seated in a bore 82*a* in the case side 73 and on a shoulder 84 of a driving shaft 85. A drive pulley 86 provides a driving means for the drive shaft. The bearing 83 is arranged in an opening 87 in the cylinder block and on an extension 88 in the case side.

Cylinders 89 extend radially and pistons 90 operate in the cylinders. The pistons have pins 91 and connecting rods 92 extend from the pins 91 to pins 93 extending between flanges 94 of a master rod 95. The crank ring is mounted on a crank pin 97. The crank pin extends from a disc 98 and a shaft 99 extends from the disc. The shaft 99 is mounted in an opening 100 in the case side. A worm gear 101 is mounted on the shaft and locked therewith by a key 101*a*. A cap 102 is secured on the outer end of the shaft and a worm 103 is adapted to rotate the worm gear 101. The worm is mounted on a shaft 104 journaled in a bracket 105. The crank shaft 99 is eccentrically mounted with relation to the axis of rotation of the cylinder block so that by swinging the crank on this off-set shaft center the crank may be brought nearer, or more remote from the axis of the cylinder block and thus provide a greater, or lesser throw for the crank and consequently a greater or less travel of the piston. The gear 101 is provided with stops 106 which engage ends 107 of the worm to limit the adjustment of the crank to the desired amount. As the cylinder block rotates, the pistons are reciprocated in the cylinders. The inlet port 77*a* extends through a large part of the cycle of the cylinder block in which the pistons are moving inwardly, or during the suction stroke. The discharge port 78*a* extends through that part of the travel of the cylinder block in which there is a discharge movement of the piston. As shown in Fig. 7 the crank is adjusted to give the pistons extreme movement so that they reach practically to the outer ends of the cylinders at the final discharge passage. In the handling of the liquid, however, the throw of the piston may be less than the end of the cylinder without materially reducing the efficiency of the structure. An oil passage 108 extends through the crank shaft and is connected by a radial passage 109 with the crank bearing from

which the oil is thrown into the cylinder space lubricating the several parts. Oil is admitted through an opening 110 to a chamber 110*a* between the cap 102 and the end of the shaft. A bolt 111 extends through the passage 108 being of smaller diameter than the passage. The bolt is enlarged at the inner end at 112 to seal the passage and is provided with a cap 113 forming a flange for the inner end of the crank pin. An oil escape passage 115 leads through the wall of the cylinder block to a segmental passage 116 in the wall of the case and a discharge passage 117 leads from the passage 116 so as to complete the discharge opening.

What I claim as new is:—

1. In a fluid pump, the combination of a case having a sealing surface to and from which inlet and outlet ports lead said case having an oil discharge passage therethrough; a cylinder having an exterior wall having a surface adapted to rotatively traverse in sealing relation the sealing surface in the case and ported to open and close to the cylinder the ports in the case; a rotative mounting for the cylinder forming a chamber from which the cylinder leads; a piston in the cylinder; a crank normally fixed with the case; and a connecting rod and bearings between the piston and crank, said crank having a lubricating passage leading therethrough and delivering oil from the pump past the crank bearing to the chamber in the mounting, the side wall of the cylinder being provided with an oil discharge passage registering with the oil discharge passage in the case as the cylinder rotates.

2. In a fluid pump, the combination of a case having a sealing surface to and from which inlet and outlet ports lead said case having an oil discharge passage therethrough; a cylinder having an exterior wall having a surface adapted to rotatively traverse in sealing relation the sealing surface in the case and ported to open and close to the cylinder the ports in the case; a rotative mounting for the cylinder forming a chamber from which the cylinder leads; a piston in the cylinder; a crank normally fixed in the case; and means delivering oil to the chamber, said rotative mounting and case having between them a segmental groove forming a part of the oil discharge passage, an opening through the side of the cylinder wall being brought into register with said groove by the rotation of the mounting and being opened and closed by the movement of the piston over said opening.

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