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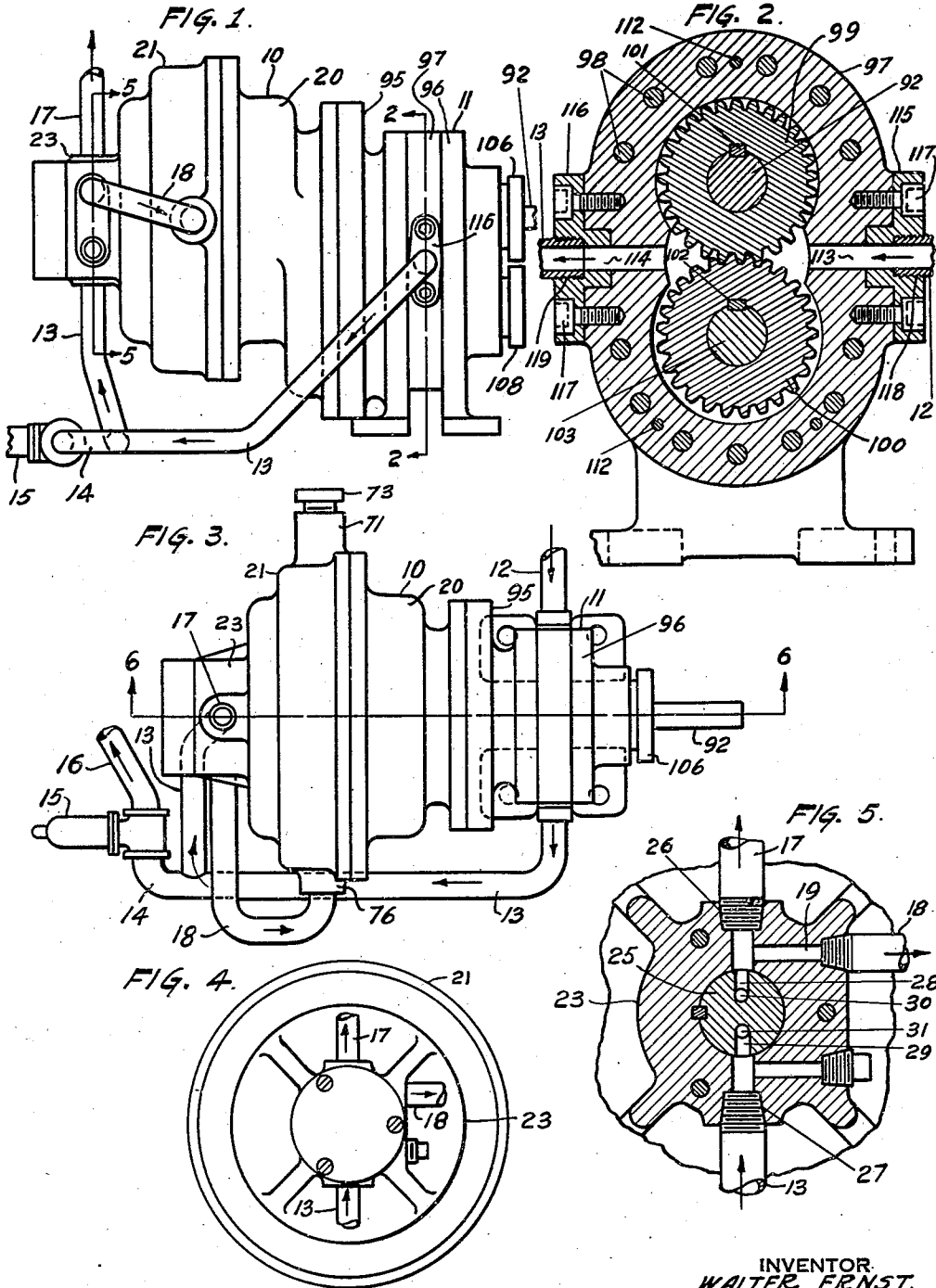
W. ERNST

2,130,299

RADIAL PUMP

Filed Feb. 10, 1936

3 Sheets-Sheet 1



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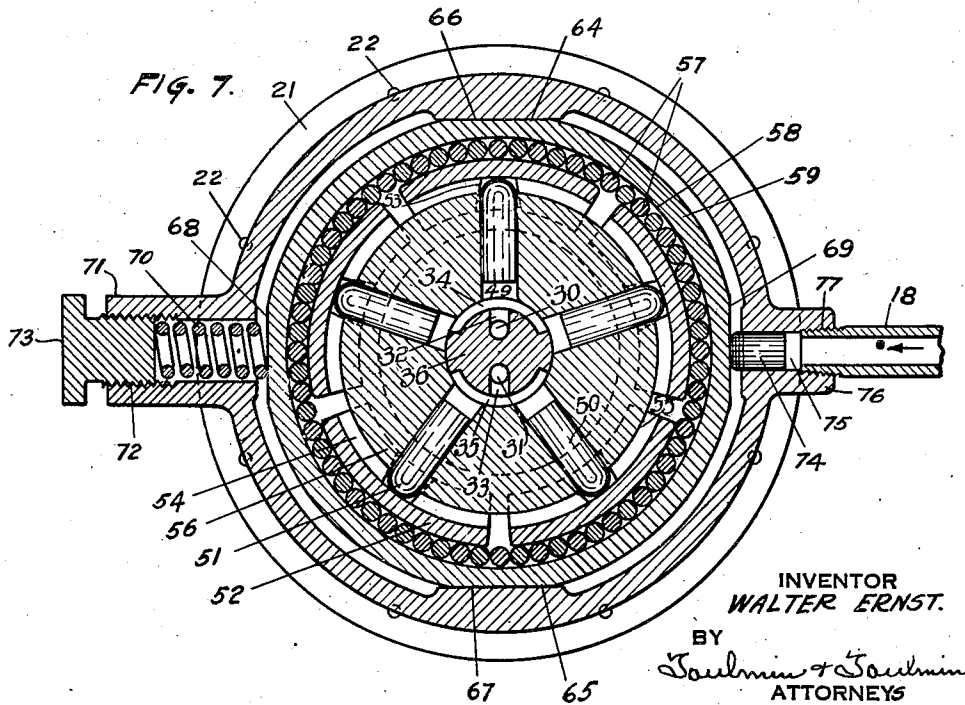
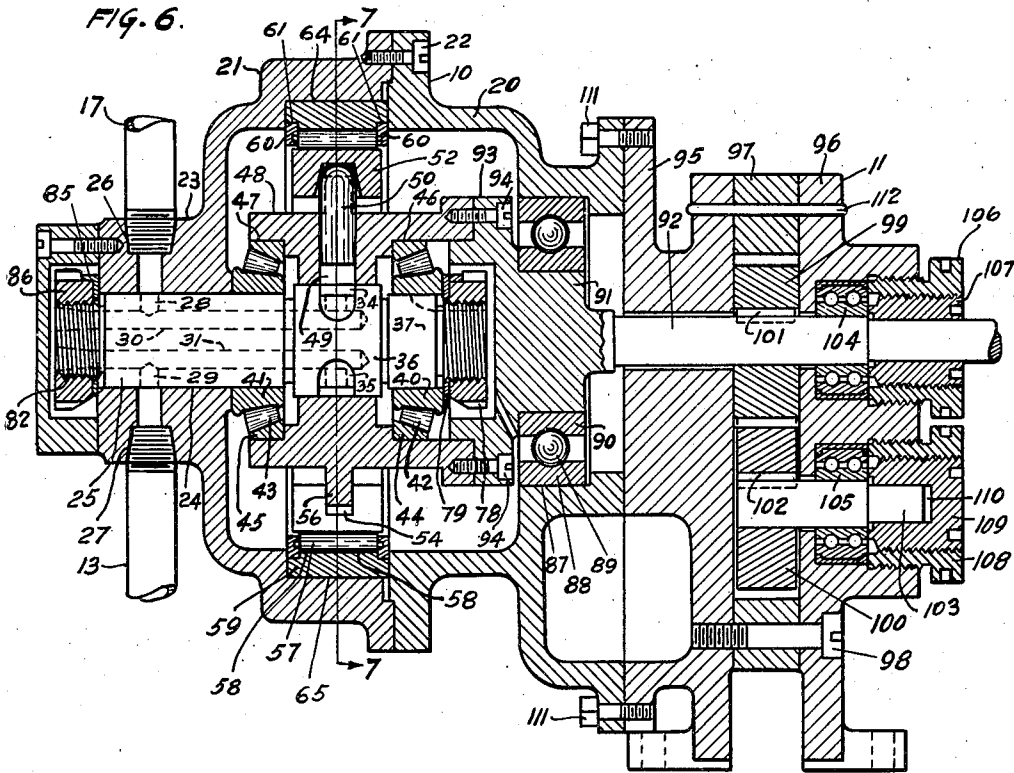
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3 Sheets-Sheet 2



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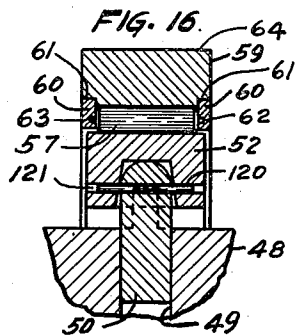
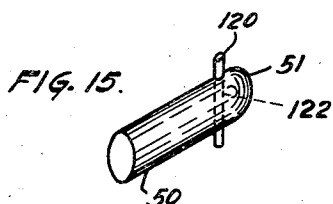
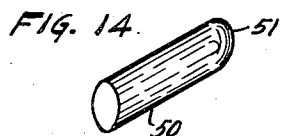
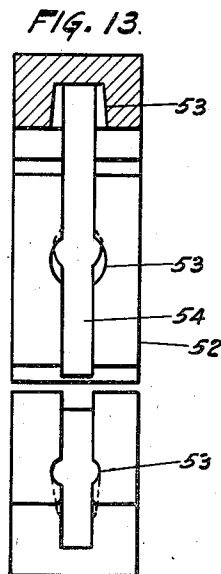
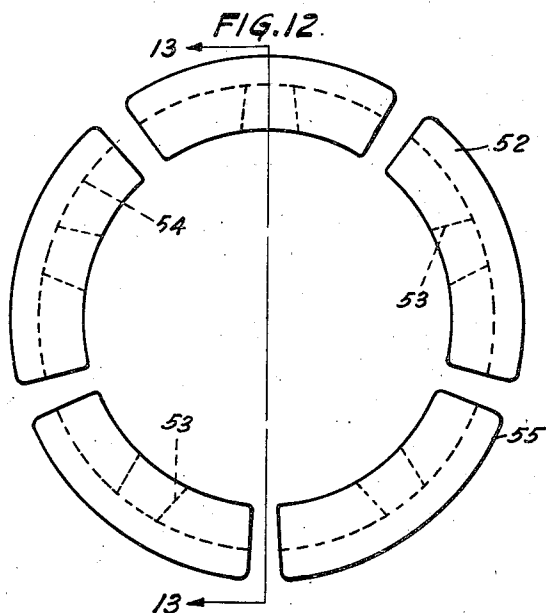
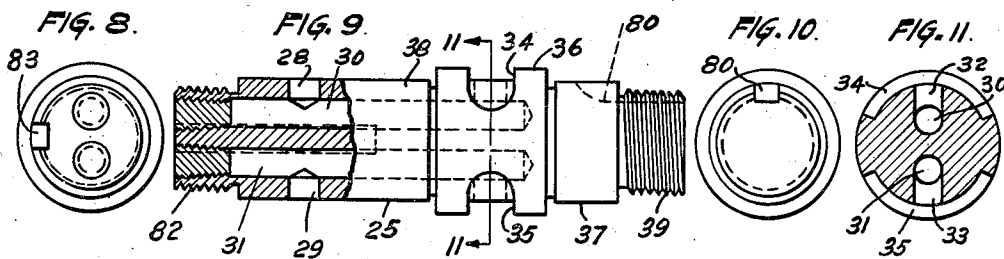
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RADIAL PUMP

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,130,299

RADIAL PUMP

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mington, Del., a corporation of Delaware

Application February 10, 1936, Serial No. 63,146

12 Claims. (Cl. 103—161)

This invention relates to hydraulic pumps or motors, and in particular, to a hydraulic pump having radial pistons and cylinders.

One object of this invention is to provide a hydraulic pump or motor having a primary rotor with radial cylinder bores, the pistons whereof engage segmental crosshead blocks, which in turn, engage anti-friction bearing elements mounted in a shift ring surrounding the entire assembly.

Another object is to provide such a pump or motor, wherein the head of each piston is rounded and rests in a recess in the inner side of the guide block.

Another object is to provide a pump or motor of this description, wherein the segmental guide blocks are spaced apart from one another and separately engage different anti-friction bearing elements disposed around the inner surface of the shift ring, the latter serving as an outer bearing race for the anti-friction bearing elements.

Another object is to provide a hydraulic pump or motor, wherein the radial pistons reciprocating in a radially bored primary rotor have rounded ends resting in tapered recesses in the inner sides of segmental guide blocks so as to enable the pistons to rock back and forth in the tapered recesses, the outer sides of the guide blocks engaging roller bearings held in place by a bearing race which is laterally movable to serve also as a shift ring to vary the eccentricity between the shift ring and the primary rotor, and thereby to produce reciprocation of the pistons.

Another object is to provide a hydraulic pump or motor of the type previously described, wherein a second pump is coupled therewith to provide super-charging for the first-mentioned pump, this super-charging serving also to maintain the pistons in engagement with their crossheads during the suction stroke of the pump.

Another object is to provide a pump of the type described above, wherein means is provided for mechanically securing the piston heads to the guide blocks.

In the drawings:

Figure 1 is a side elevation of the pump of my invention, showing the main pump to the left and the super-charging pump to the right.

Figure 2 is a vertical section through the super-charging pump taken along the line 2—2 of Figure 1.

Figure 3 is a top plan view of the pump assembly shown in Figure 1.

Figure 4 is a left-hand end elevation of the pump assembly shown in Figures 1 and 3.

Figure 5 is an enlarged cross section through the pintle of the main pump, taken along the line 5—5 of Figure 1.

Figure 6 is a longitudinal, vertical section through the pump assembly shown in Figure 1, taken along the axis of the main drive shaft and pintle.

Figure 7 is a transverse section through the main pump, taken along the line 7—7 of Figure 6.

Figure 8 is a left-hand end elevation of the pintle shown in Figure 9.

Figure 9 is a side elevation, partly in section, of the pintle used in the radial or main pump of my invention.

Figure 10 is a right-hand end elevation of the pintle shown in Figure 9.

Figure 11 is a cross section through the pintle taken along the line 11—11 of Figure 9.

Figure 12 is a side elevation of a complete assembly of piston crosshead guide blocks.

Figure 13 is a cross section along the line 13—13 of Figure 12.

Figure 14 is a perspective view of a piston employed in the pump or motor of this invention.

Figure 15 is a perspective view of a modified form of piston, showing a wrist pin for retaining the piston in engagement with its crosshead guide block.

Figure 16 is an enlarged cross section taken along the axis of a piston, and showing the modified form of piston of Figure 15 secured to its crosshead guide block.

General construction and circuit

Referring to the drawings in detail, Figures 1 and 6 show the pump assembly of this invention as consisting of a main pump, generally designated 10, on the left-hand side of the figures, and a super-charging pump, generally designated 11, on the right-hand side thereof. The main pump is of the radial piston type. The super-charging pump may be of any suitable type, and is shown as a gear pump. The two pumps are driven by a common drive shaft, and the super-charging pump supplies pressure to the main pump so that the pistons are maintained in engagement with their crosshead guide blocks even during the suction strokes thereof.

The inlet 12 (Figure 3) from the source of fluid, such as a tank, is connected to the intake side of the super-charging pump 11, from the outlet side of which the pipe 13 runs to the inlet side of the main pump 10. A branch 14 of the pipe 13 is

connected to the relief valve 15, having an outlet pipe 16 leading to the tank (not shown). The relief valve 15 serves to discharge any surplus fluid supplied by the super-charging pump 11 in excess of the requirements of the main pump 10. From the outlet side of the main pump 10 the outlet pipe 17 discharges pressure fluid into the circuit which the pump 10 is intended to operate. The branch outlet pipe 18, however, runs to a pilot piston, hereinafter described, this pilot piston serving to shift the control device for the pump and reduce its delivery when the outlet pressure exceeds a predetermined amount.

Main pump construction

The main pump 10 is of the variable delivery radial piston type, and is contained within the casing halves 20 and 21, these being held together by the machine screws 22. The casing half 21 is supplied with a projecting portion 23, having a bore 24 which serves to support the pintle 25. The projecting portion 23 is provided with a threaded passage 26, serving as an outlet port and connected to the outlet pipe 17. A similar threaded passage 27 connects the opposite side of the projecting portion 23 with the inlet pipe 13. The passages 26 and 27 lead inwardly so as to communicate with the ducts 28 and 29, respectively, leading to the outlet and inlet passages 30 and 31 of the pintle 25. From the threaded passage 26 the branch passage 19 leads to the pilot line 18, as shown in Figure 5. The outlet and inlet passages 30 and 31 lead to the transverse ducts 32 and 33, opening into the cutaway portions 34 and 35 near the mid-portion of the pintle. By this means fluid is conducted to and from the cylinders of the pump, as hereinafter explained.

Immediately adjacent the cutaway portions 34 and 35 the pintle 25 is provided with an enlarged portion 36. Immediately beyond the latter is a portion 37 which is substantially the same diameter as the pintle portion 36 supported in the end projecting part 23 of the casing half 21. The pintle terminates at its right-hand end in a threaded portion 38. Surrounding the pintle portions 37 and 38, respectively, are the inner races 40 and 41 of tapered roller bearings 42 and 43, the outer races 44 and 45 of which are mounted in depressions 46 and 47 in the opposite ends of a cylinder barrel or primary rotor 48. The latter at its central portion closely surrounds the pintle portion 36, and is provided with radial cylinder bores 49 communicating with the cutaway portions 34 and 35 of the pintle 25, and having pistons 50 reciprocable therein.

The pistons 50 are provided with rounded outer ends 51 which are adapted to serve as crossheads engaging the segmental crosshead guide blocks 52 in the tapered recesses 53 thereof (Figures 12 and 13). An arcuate groove 54 traverses each segmental guide block from one end to the other. The peripheral surface 55 of each segmental guide block 52 is rounded, or otherwise relieved at its ends so as to provide for the easy motion of the guide blocks 52 as they move to and fro during the operation of the pump or motor. The cylinder barrel 48 is provided with a series of segmental ridges 56, extending between the cylinder bores 49 and adapted to provide additional support for the pistons 50 during their reciprocation. The grooves 54 in the guide blocks 52 are provided to enable the guide blocks to pass easily over the ridges 56, as shown in Figure 6.

The peripheral surfaces 55 of the segmental guide blocks 52 engage anti-friction bearing ele-

ments, such as the rollers 57, these in turn, engaging the inner surface 58 of the shift ring 59, the latter serving as an outer bearing race. The rollers 57 are maintained in position by retaining rings 60 resting in the recesses 61 in the shift ring 59, and having annular grooves 62 engaging the corresponding projections 63 on the ends of the rollers 57. At the top and bottom thereof the shift ring 59 is provided with flattened portions 64 and 65, respectively engaging the corresponding flattened portions 66 and 67 of the casing half 21. A the opposite ends of its horizontal diameter the shift ring 59 is provided with flattened portions 68 and 69. The flattened portion 68 is engaged by a coil spring 70, mounted in a boss 71, having a threaded bore 72 closed by a threaded adjusting plug 73. By varying the position of the plug 73 in the threaded bore 72 the tension of the spring 70 is adjusted. The flattened portion 69, however, is engaged by one end of a pilot piston 74, reciprocating in a cylinder bore 75 in a boss 76 of the casing half 21. The cylinder bore 75 is provided with a threaded outlet port 77, in which is secured the end of the pilot line 18 leading from the pressure outlet side of the pump.

The threaded portion 38, at the inner end of the pintle 25, is provided with a nut 78 and a lockwasher 79 adapted to engage the inner race 40 of the tapered roller bearing 42. A keyway 80 is also provided in the threaded end portion 38, and extends into the pintle portion 37. A key (not shown) within the keyway 80 engages a corresponding slot in the lockwasher 79 and prevents it from rotating, and at the same time the ear extending from the lockwasher 79 engages one of the flat sides of the nut 78 and prevents the rotation of the latter. The opposite or outer end of the pintle 25 is similarly provided with a threaded portion 82, having a keyway 83 therein. A key within the keyway 83 engages a corresponding slot in the lockwasher 85 and prevents the lockwasher from turning, whereas the ear on the lockwasher engages the flat side of the nut 86, threaded upon the threaded portion 82, and prevents the rotation of the nut.

By turning the nut 86 with the lockwasher 85 released, the pintle 25 may be made to move longitudinally to adjust the clearances of the tapered roller bearings 42 and 43. When, for example, the pintle 25 is moved to the left, the nut 78 and its lockwasher 79 push the inner race 40 against the rollers 42, and the latter push the outer race 46 and the cylinder barrel 48 to the left. This action closes the clearances existing between the rollers 43 and the inner and outer bearing races 41 and 45, the inner bearing race 41 being kept from moving by its engagement with the inner wall of the casing half 21. After this adjustment is made the lockwasher 85 may be bent to lock the nut 86 in the position of adjustment. The casing half 20 of the main pump 10 is provided with a recess 87 in which is mounted the outer race 88 of a ball bearing 89, the inner race 90 of which is mounted upon the enlargement 91 of the drive shaft 92. The latter is provided with a further enlarged portion 93, which is secured to the cylinder barrel 48 by means of the screws 94 (Figure 6).

Super-charging pump

The super-charging pump 11 (Figure 6) may be of any suitable type, the type shown being a gear type of pump. This pump 11 consists of a pair of end plates 95 and 96, spaced apart from

one another by a spacing ring 97, the spacing being maintained by the machine screws 98. Within the compartment formed between the end plates 95 and 96 and the spacing ring 97 are mounted two intermeshing gears 99 and 100. The gear 99 is keyed to the main drive shaft 92, as by the key 101, whereas the gear 100 is keyed by the key 102 to the stub shaft 103. The drive shaft 92 and the stub shaft 103 are journaled in double-row annular ball bearings 104 and 105, respectively, these being held in position by the threaded plugs 106, 107, 108 and 109 (Figure 6). The outer end of the stub shaft 103 extends into the socket 110 in the threaded plug 109, whereas the main drive shaft 92 passes through the threaded plug 107. The end plate 95 of the super-charging pump 11 is joined to the casing half 20 of the main pump 10 by means of the machine bolts 111.

The dowel pins 112 assist in maintaining accurate alignment between the end plates 95 and 96 and the spacing ring 97 (Figure 6). The spacing ring 97 is provided with an intake passage 113 and an outlet passage 114, these terminating in the junction members 115 and 116, secured to the opposite sides of the spacing ring 97 by the machine screws 117. The junction members 115 and 116 are provided with threaded bores 118 and 119, adapted to receive the threaded ends of the intake and outlet pipes 12 and 13, respectively.

The modified construction shown in Figure 16 is similar to that shown in Figure 6, except that a pin 120 passes through a transverse hole 121 in the crosshead guide block 52, and likewise passes through a hole 122 in the piston 50. Consequently, by this construction the pistons 50 are connected positively to the crosshead guide blocks 52 and no pressure is required, as by the super-charging pump 11, to maintain such connection.

Operation

In the operation of the pump assembly of this invention, power is applied to the drive shaft 92 from any convenient source, such as an electric motor. The rotation of the drive shaft 92 causes the rotation of the pump gears 99 and 100, and in turn, causes fluid to be drawn from the tank (not shown) through the intake line 12, and discharged through the outlet line 13. The fluid passes from the outlet line 13 of the super-charging pump 11 into the inlet passage 27 of the main pump 10, thence through the pintle passage 31 and the cutaway portion 35, into the various cylinder bores 49 as these present themselves opposite the cutaway portion 35.

When the shift ring 59 is moved laterally so that its axis is eccentric to that of the pintle 25, the pistons 50 reciprocate in their cylinder bores when the rotation of the drive shaft 92 rotates the primary rotor or cylinder barrel 48. As the pistons 50 reciprocate their rounded ends 51 engage the tapered recesses 53 in the segmental guide blocks 52, and the latter will move in an annular path with their peripheral surfaces 55 engaging the rollers 57, approaching the center of the pump during one-half of the revolution and receding during the other half. The pressure constantly delivered through the line 13 from the super-charging pump 11 causes the pistons 50 to be maintained in engagement with the crosshead guide blocks 52. Any excess fluid escapes from the branch line 14 through the relief valve 15, into the discharge line 16, and thence back to the tank.

The reciprocation of the pistons 50 within the main pump 10 in this manner causes pressure fluid to be discharged from the outlet line 17 thereof, and this fluid passes onward to the machinery or circuit which it is intended to operate. If the fluid pressure rises beyond a predetermined point, the fluid reaching the pilot cylinder 75 through the branch line 18 acts upon the pilot piston 74 (Figure 7), urging it to the left and with it the shift ring 59, thereby overcoming the thrust of the coil spring 70. This action tends to return the shift ring 59 to its neutral position and reduce the discharge of the pump.

It will be understood that I desire to comprehend within my invention such modifications as come within the scope of the claims and the invention.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A pump assembly comprising a casing, a pintle, a cylinder barrel with radial cylinder bores, pistons reciprocable therein, segmental guide blocks adapted to have contacting engagement with the outer ends of the pistons, a shift member, anti-friction bearing elements arranged between said shift member and said guide blocks, said anti-friction bearing elements being secured to said shift member in an annular path therearound and having their inner portions exposed for direct engagement by said guide blocks, and means for supplying pressure fluid to the pistons in said cylinder bores to maintain them in said contacting engagement with said guide blocks during the suction strokes thereof.

2. A pump assembly comprising a casing, a pintle, a cylinder barrel with radial cylinder bores, pistons reciprocable therein, segmental guide blocks adapted to have contacting engagement with the outer ends of the pistons, a shift member, anti-friction bearing elements arranged between said shift member and said guide blocks, said anti-friction bearing elements being secured to said shift member in an annular path therearound and having their inner portions exposed for direct engagement by said guide blocks, and an auxiliary pump adapted to supply pressure fluid to the pistons to maintain them in said contacting engagement with the guide blocks during the suction strokes thereof.

3. A fluid pressure pump or motor comprising a cylinder barrel having cylinder bores, pistons reciprocable therein, a segmental guide block for each piston, a shift member, and anti-friction bearing elements directly engaged by and arranged between said guide blocks and said shift member, said anti-friction bearing elements being secured to said shift member in an annular path therearound and having their inner portions exposed for direct engagement by said guide blocks.

4. A fluid pressure pump or motor comprising a cylinder barrel having cylinder bores, pistons reciprocable therein, a segmental guide block for each piston, a shift member, and anti-friction bearing elements directly engaged by and arranged between said guide blocks and said shift member, said anti-friction bearing elements being secured to said shift member in an annular path therearound and having their inner portions exposed for direct engagement by said guide blocks, said pistons having rounded ends and said guide blocks having recesses adapted to receive said rounded ends.

5. A fluid pressure pump or motor comprising

a cylinder barrel having cylinder bores, pistons reciprocable therein, a segmental guide block for each piston, a shift member, and anti-friction bearing elements directly engaged by and arranged between said guide blocks and said shift member, said anti-friction bearing elements being secured to said shift member in an annular path therearound and having their inner portions exposed for direct engagement by said guide blocks, said pistons having contacting engagement with said guide blocks, and means for supplying pressure fluid to said pistons to maintain said pistons against said guide blocks and said guide blocks against said bearing elements during the suction stroke.

6. A fluid pressure pump or motor comprising a cylinder barrel having cylinder bores, pistons reciprocable therein, a segmental guide block for each piston, a shift member, and anti-friction bearing elements directly engaged by and arranged between said guide blocks and said shift member, said anti-friction bearing elements being secured to said shift member in an annular path therearound and having their inner portions exposed for direct engagement by said guide blocks, said segmental guide blocks being spaced apart from each other in a circumferential direction.

7. A fluid pressure pump or motor comprising a cylinder barrel having cylinder bores, pistons reciprocable therein, a segmental guide block for each piston, a shift member, anti-friction bearing elements directly engaged by and arranged between said guide blocks and said shift member, said anti-friction bearing elements being secured to said shift member in an annular path therearound and having their inner portions exposed for direct engagement by said guide blocks, and means for retaining said bearing elements in association with said shift member.

8. A fluid pressure pump or motor comprising a cylinder barrel having cylinder bores, pistons reciprocable therein, a segmental guide block for each piston, a shift member, anti-friction bearing elements directly engaged by and arranged between said guide blocks and said shift member, said anti-friction bearing elements being secured to said shift member in an annular path therearound and having their inner portions exposed for direct engagement by said guide blocks, and retaining members secured to said shift member to retain said bearing elements in association therewith.

9. A fluid pressure pump or motor comprising a casing, a pintle therein, a cylinder barrel rotatably supported on said pintle, pistons reciprocable radially in said cylinder barrel, each piston having an outwardly disposed head, a shift member with orbitally disposed anti-friction

bearing elements, and segmental guide blocks arranged between and directly engaging said bearing elements and said piston heads, said anti-friction bearing elements being secured to said shift member in an annular path with the outer portions thereof engaging said shift member and with the inner portions thereof exposed for direct engagement by said guide blocks.

10. A fluid pressure pump or motor comprising a casing, a pintle therein, a cylinder barrel rotatably supported on said pintle, pistons reciprocable radially in said cylinder barrel, each piston having a rounded head, a shift member with orbitally disposed anti-friction bearing elements, and segmental guide blocks arranged between and directly engaging said bearing elements and said piston heads, said anti-friction bearing elements being secured to said shift member in an annular path with the outer portions thereof engaging said shift member and with the inner portions thereof exposed for direct engagement by said guide blocks, said segmental guide blocks having recesses arranged to receive said rounded piston heads.

11. A fluid pressure pump or motor comprising a casing, a pintle therein, a cylinder barrel rotatably supported on said pintle, pistons reciprocable radially in said cylinder barrel, each piston having an outwardly disposed head, a shift member supported by said casing for lateral movement relatively to said pintle, anti-friction bearing elements carried by said shift member, and segmental guide blocks arranged between and directly engaging said bearing elements and said piston heads, said anti-friction bearing elements being secured to said shift member in an annular path with the outer portions thereof engaging said shift member and with the inner portions thereof exposed for direct engagement by said guide blocks.

12. A fluid pressure pump or motor comprising a casing, a pintle therein, a cylinder barrel rotatably supported on said pintle, pistons reciprocable radially in said cylinder barrel, each piston having an outwardly disposed head, a shift member supported by said casing for lateral movement relatively to said pintle, anti-friction bearing elements carried by said shift member, segmental guide blocks arranged between and directly engaging said bearing elements and said piston heads, said anti-friction bearing elements being secured to said shift member in an annular path with the outer portions thereof engaging said shift member and with the inner portions thereof exposed for direct engagement by said guide blocks, and retaining means secured to said shift ring to maintain said bearing elements in association therewith.

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