Feb. 11, 1941. G. A. WAHLMARK 2,231,100

FLUID MOTOR AND PUMP

Filed May 9, 1938 4 Sheets-Sheet 1

Fig. 1.

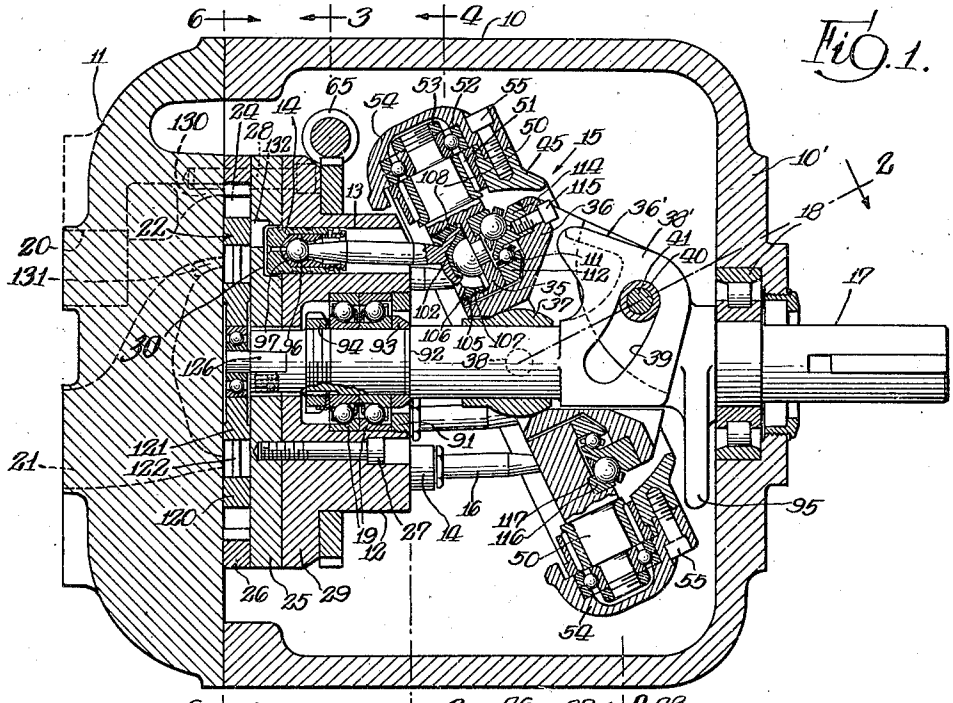
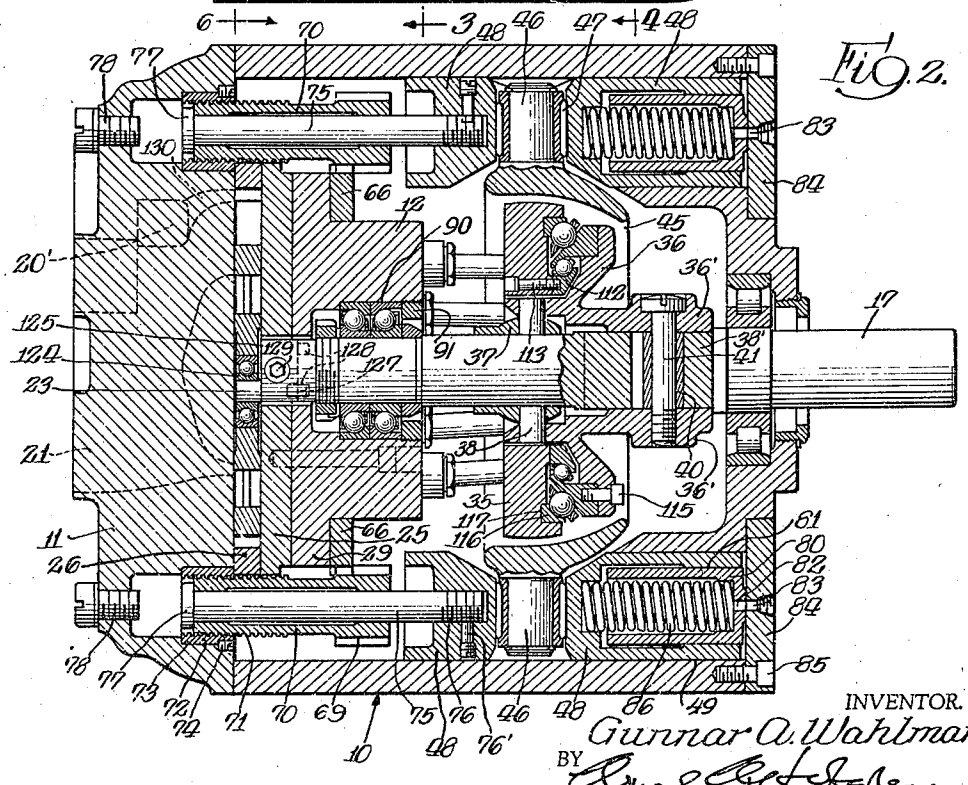


Fig. 2.



INVENTOR.
Gunnar A. Wahlmark,
BY
ATTORNEY.

Feb. 11, 1941. G. A. WAHLMARK 2,231,100

FLUID MOTOR AND PUMP

Filed May 9, 1938 4 Sheets-Sheet 2

Fig. 3.

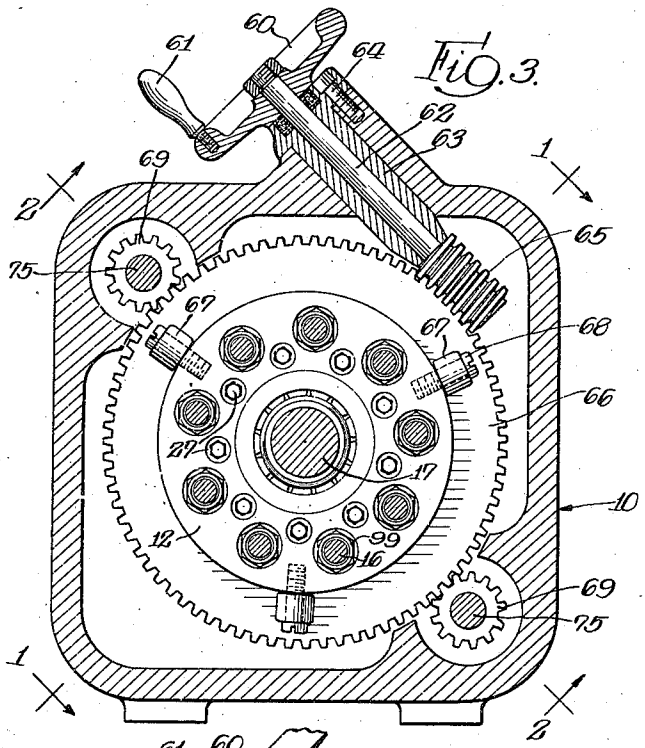
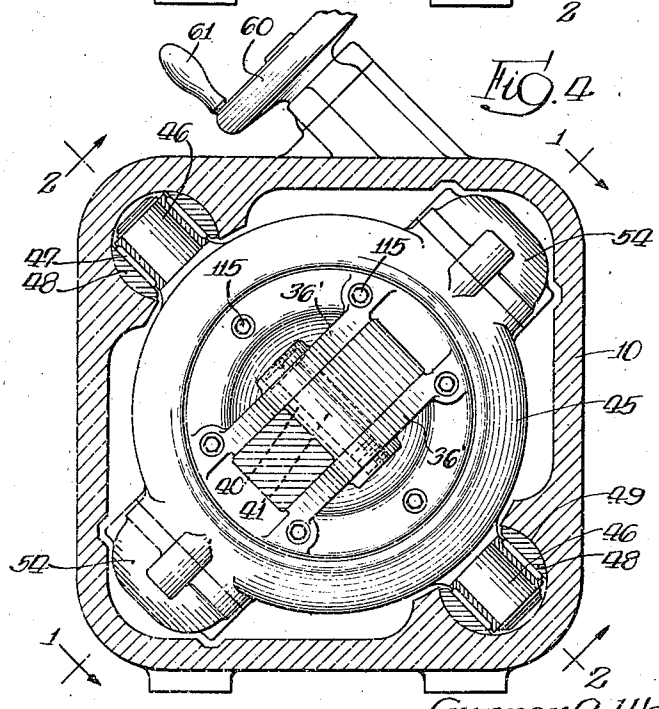


Fig. 4.



INVENTOR.

BY Gunnar A. Wahlmark

Lee Claflin Hopkins

ATTORNEY.

Feb. 11, 1941. G. A. WAHLMARK 2,231,100

FLUID MOTOR AND PUMP

Filed May 9, 1938 4 Sheets-Sheet 3

Fig. 5.

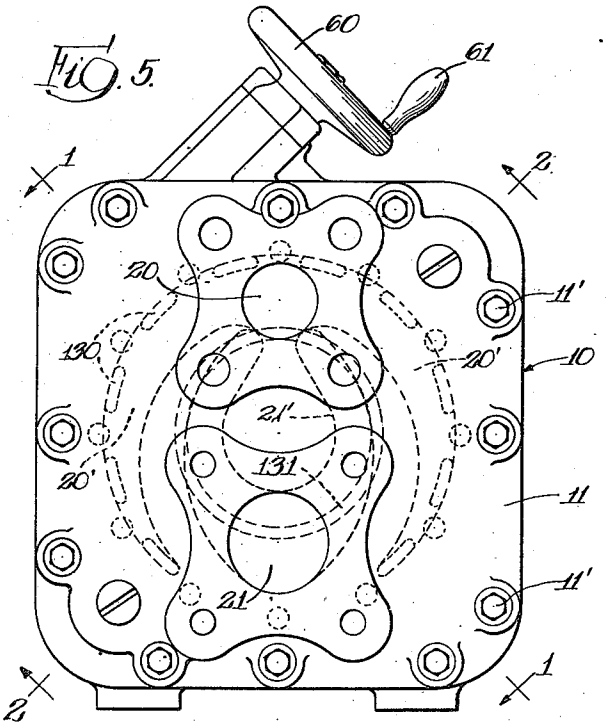


Fig. 6a

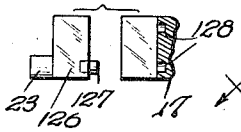
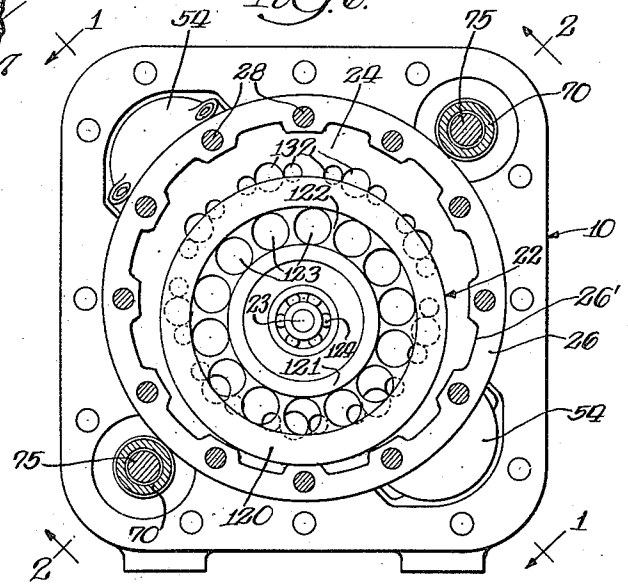


Fig. 6.



INVENTOR.

BY Gunnar A. Wahlmark.

his ATTORNEY.

Feb. 11, 1941. G. A. WAHLMARK 2,231,100

FLUID MOTOR AND PUMP

Filed May 9, 1938 4 Sheets-Sheet 4

Fig. 7.

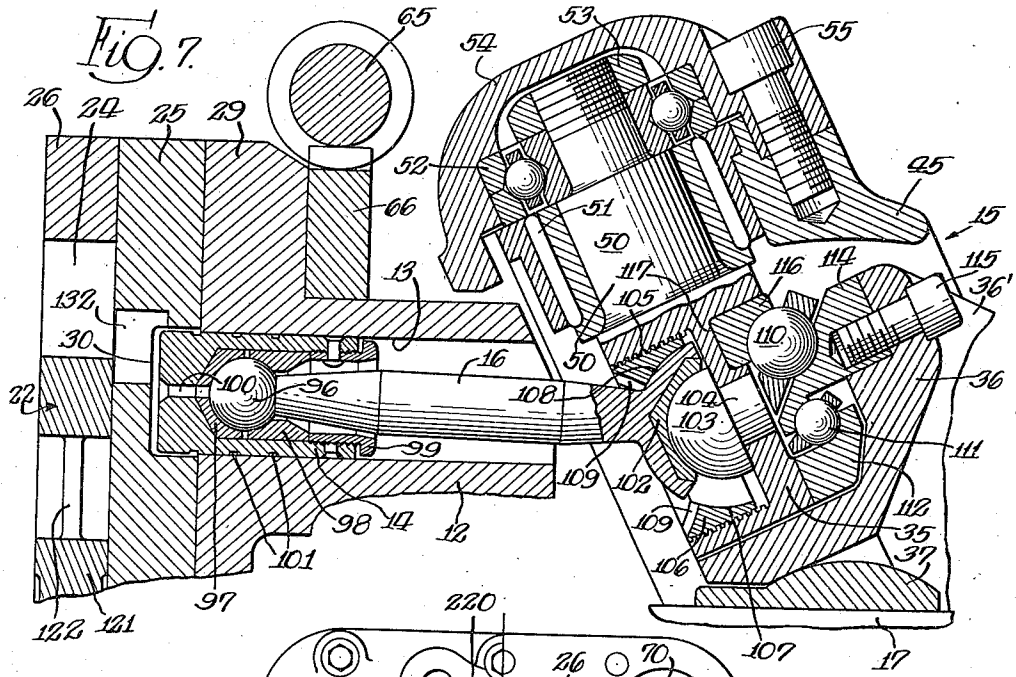


Fig. 8.

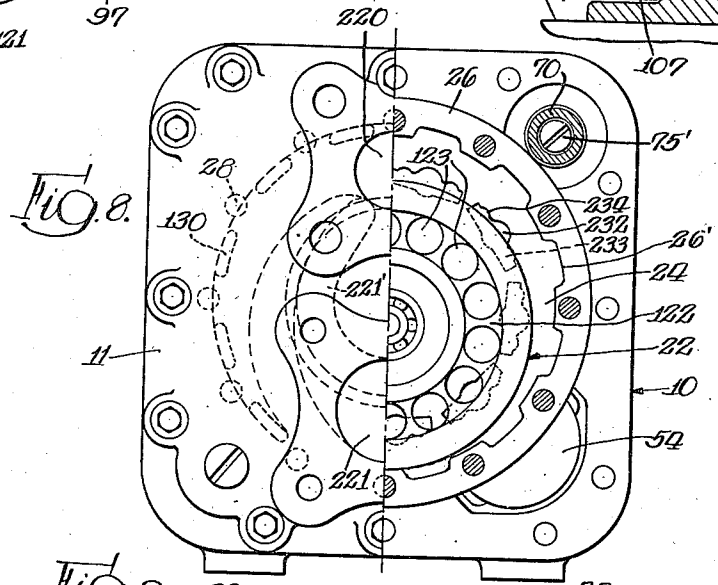
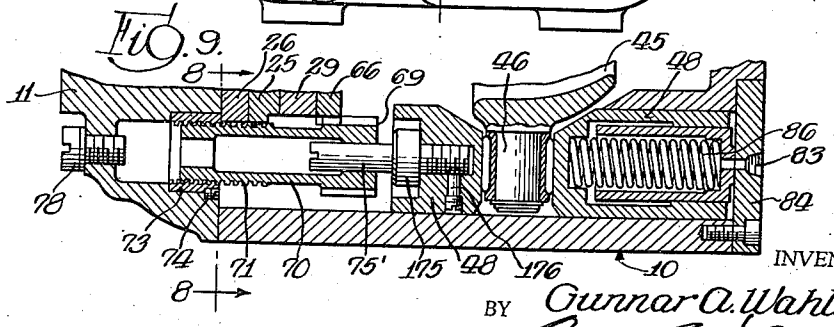


Fig. 9.



INVENTOR.

BY Gunnar A. Wahlmark,

ATTORNEY.

Patented Feb. 11, 1941 2,231,100

UNITED STATES PATENT OFFICE

2,231,100

FLUID MOTOR AND PUMP

Gunnar A. Wahlmark, Rockford, Ill.

Application May 9, 1938, Serial No. 206,716

19 Claims. (Cl. 121—119)

More particularly the invention relates to a fluid handling apparatus embodying piston and cylinder devices and adjustable means connecting the pistons to a rotary shaft so as to permit of varying the stroke of the pistons, it being an object of the invention to provide a new and improved apparatus of this type.

Another object is to provide a fluid handling apparatus of the piston and cylinder type with actuating means for the pistons operable to vary the stroke of the pistons without changing the head clearance in the cylinders.

Another object is to provide a new and improved fluid handling apparatus embodying a wobble plate device and means for supporting the wobble plate device so as to take the thrust load off of the drive shaft.

Another object is to provide such an improved apparatus with a valve mechanism and valve ports arranged so that when the apparatus is operated as a pump the inlet ports are opened quickly and the outlet ports are opened more gradually so as to eliminate noise.

Another object is to provide a new and improved fluid handling apparatus with a valve for controlling the flow of fluid into and out of cylinders and means for driving the valve, reversible to reverse the rotation of the apparatus.

Another object is to provide a fluid handling apparatus of the piston and cylinder type having a wobble plate device that is adjustable longitudinally of the shaft as well as angularly thereto so as to permit the stroke of the pistons to be adjusted without changing the head clearance.

Another object is to provide such a fluid handling apparatus with a wobble plate device and connecting rods of new and improved construction.

Further objects and advantages will become readily apparent from the following detailed description, taken in connection with the accompanying drawings, in which:

Fig. 1 is a longitudinal central section through a preferred or motor form of the invention along the lines 1—1 of Figs. 3 and 4.

Fig. 2 is a longitudinal central section through the preferred form of the invention along the lines 2—2 of Figs. 3 and 4, and partly along line 2—2 of Fig. 1.

Fig. 3 is a transverse section approximately along the line 3—3 of Fig. 1.

Fig. 4 is a transverse section approximately along the line 4—4 of Fig. 1.

Fig. 5 is a view looking at the left end of Fig. 1.

Fig. 6 is a transverse section approximately along the line 6—6 of Fig. 1.

Fig. 6a is a fragmentary detail view showing the driving eccentric for the valve in elevation and the end of the shaft in which the eccentric is received in section.

Fig. 7 is an enlarged fragmentary section along the lines 1—1 of Figs. 3 and 4.

Fig. 8 is a left end view of a modified or pump form of the invention, partly along the line 8—8 of Fig. 9.

Fig. 9 is a fragmentary section (in the plane of Fig. 2) through the modified form of the invention.

In the form illustrated in Figs. 1 to 7 in the drawings, the invention is embodied in a fluid motor comprising generally a square cup-shaped casing 10 having a closure 11 for the open end secured thereto by screw devices 11', a cylinder block 12 having a plurality of cylinders 13 therein, pistons 14 in the cylinders, a wobble plate device or conversion mechanism 15 operated by the pistons through connecting rods 16, and a shaft 17 on which the wobble plate device is carried. The shaft is rotatably mounted in the casing by means of a roller bearing 18 in the integral end wall 10' of the casing and ball bearings 19 carried on the cylinder block 12. Fluid is admitted into and discharged from the cylinders through passages including an intake port 20 and an outlet port 21 in the closure 11 and is controlled by means of a valve 22 which is driven by an eccentric pin 23 carried on the shaft 17 and functions in a manner hereinafter more fully described. The valve 22 is located in a short cylindrical chamber 24 formed intermediate the adjacent faces of the closure 11, a plate 25, and an annular member 26 positioned intermediate the closure 11 and plate 25. The plate 25 is interposed, as shown in Figs. 1, 2 and 7, between the cylinder block 12 and the annular member 26 and forms in effect a head for the cylinder block. This plate is secured to the cylinder block by means of a plurality of screw devices 27, and the cylinder block 12, plate 25, and annular member 26 are all secured together and to the closure 11 by means of a plurality of screw devices 28 which pass through a flange 29 on the cylinder block and directly through apertures in the plate 25 and annular member 26 and into screw-threaded engagement with the closure 11.

The pistons 14 are arranged to reciprocate in the cylinders 13 and into and out of aligned recesses 30 formed in the plate 25 and act through the connecting rods 16 and mechanism

15 to rotate the shaft 17. The conversion mechanism 15, although of the wobble plate type, is constructed in such a manner that the stroke of the pistons may be adjusted without altering the head clearance of the pistons in the recesses 30 when the pistons are at the end of their exhaust stroke, as shown for the upper piston in Fig. 1. In the form illustrated in the drawings, the wobble plate device comprises an annular part or plate 35 carried on but rotatable with respect to a bushing or supporting part 36 which surrounds the shaft 17 and is pivotally connected to a sleeve member 37 by means of a pin 38. The bushing 36 has a pair of laterally spaced projecting portions 36' located one on each side of a radially extending arm 38' formed on the shaft 17. The arm 38' is provided with an arcuate slot 39 (Figs. 1, 2 and 4) in which a roller 40 rides, the roller being carried on a pin 41 which extends through suitable apertures in the projecting portions 36' of the bushing 36. The sleeve 37 is slidable along the shaft 17 so that when the angular position of the wobble plate is changed due to the movement of the roller 40 downwardly and toward the left in the arcuate slot 39, as an incident to axial movement of the wobble plate imparted by means hereinafter described, the pin 38 constitutes a movable pivot for the wobble plate, this pivot moving toward the left (Fig. 1) as the stroke of the pistons is shortened. The movement of the pin 38 longitudinally of the shaft simultaneously with the change in the angular position of the wobble plate maintains a constant head clearance in the cylinders regardless of the length of stroke of the pistons.

As illustrated in the drawings, the adjusting means for the wobble plate includes a ring member 45 (Figs. 1, 2, 4 and 7) having a pair of diametrically opposite, outwardly extending trunnions 46 (Figs. 2 and 4) supported by roller bearings 47 carried on longitudinally movable plungers 48 guided in cylinder bores 49 in opposite corners of the casing 10. The wobble plate 35 has a pair of diametrically opposite, outwardly extending trunnions 50 (Fig. 1) formed integrally therewith. These trunnions are rotatably mounted on the ring member 45 by means of roller bearings 51 and ball thrust bearings 52, the inner races of which are secured to the trunnions 50 by means of nuts 53, and the outer races of which are secured to the ring member 45 by cap members 54 and set screws 55. It will be readily apparent that by moving the plungers 48 toward the left from the positions shown in Fig. 2 the trunnions 46 of the member 45 will be moved toward the left, and the wobble plate, guided by the pivot pin 38 and the roller 40, will be moved toward a more perpendicular position with respect to the shaft 17. The arcuate slot 39 is so arranged that during angular adjustments of the wobble plate the head clearance of the pistons 14 in the recesses 30 will remain constant.

In the exemplary form of the invention, means is provided for adjusting the stroke of the pistons both manually and automatically. The manual adjusting means includes a hand wheel 60 which is provided with a handle 61 and is mounted on one end of a shaft 62 journaled in a sleeve 63 positioned obliquely in the upper portion of the casing 10 and secured thereto by screw devices 64. At its inner end, the shaft 62 carries a worm 65 which meshes with a ring gear 66 rotatably mounted on the reduced portion of the cylinder block 12. The ring gear is held against the flange 29 of the cylinder block by means of guide rollers 67 (Fig. 3) which are secured to the cylinder block by means of screw devices 68. The ring gear meshes with elongated pinions 69 which are formed on sleeve members 70 positioned in alignment with the plungers 48. The sleeve members 70 are screw-threaded at 71 and are mounted in nuts 72 which in turn are received in recesses 73 in the closure 11 and secured therein by means of screws 74. Rods 75 pass through the sleeve members 70 and into screw-threaded engagement with the plungers 48 at 76, the other ends of the rods having heads 77 movable between the adjacent end of the sleeve member 70 and adjustable screw devices 78 threaded into the closure 11. Set screws 76' are used to clamp the rods 75 to the plungers. Thus, by rotating the hand wheel 60 in the proper direction, the sleeve members 70 are turned in the stationary nuts 72 so as to move the sleeve members to the left and thereby carry the rods 75 and plungers 48 toward the left to decrease the stroke of the pistons 14.

The means for changing the stroke of the pistons automatically includes a pair of pistons 80 (Fig. 2) which are slidable in cylindrical bores 81 in the plungers 48. The cylinders 81 are arranged to receive fluid under pressure through supply ports 82 which extend through the closed ends of the pistons and communicate with passages 83 formed in closure plates 84 secured to the end of the casing 10 by means of screw devices 85. Upon the admission of fluid under pressure to the cylinders 81, the plungers 48 will be moved toward the left (Fig. 2) until the heads 77 on the rods 75 engage the adjusting screw devices 78. The pistons 14 will then have a short stroke so as to provide a high speed operation of the motor. Upon releasing the fluid under pressure from the cylinders 81, the plungers 48 will return to the positions shown in Fig. 2 due to the force exerted on the wobble plate by the fluid pressure in the cylinders 13. Preferably, coil springs 86 are positioned within the hollow pistons 80 as shown in Fig. 2. When the apparatus is used as a motor, the springs function to maintain a seal between the parts 80 and 84.

By way of a more detailed description of certain portions of the invention in the form shown in Figs. 1 to 7, the ball bearings 19 supporting one end of the shaft 17 have their outer races secured in a recess 90 (see Fig. 2) in the cylinder block 12 by means of an annular nut member 91. The inner races of these bearings are secured against a shoulder 92 on the shaft 17 by means of a collar 93 intermediate the shoulder and one face and a nut 94 screw-threaded on the shaft. Preferably, the shaft is formed with a counterweight portion 95 to offset the weight of the radially extending arm 38 and other parts.

Each connecting rod 16 has spherical ends 96 which form the ball of a ball and socket joint, the socket being formed in the pistons 14 by means of a conical insert 97 and a sleeve 98 (see Figs. 1 and 7) both provided with spherically formed surfaces. These members are positioned on opposite sides of the ball 96 and are secured in place within the hollow pistons 14 by means of bushings 99. Preferably, ports 100 are provided in the pistons so as to permit the fluid under pressure (generally oil) to contact and lubricate the joint. Annular grooves 101 are formed on the periphery on the pistons for like reasons. The other ends of the connecting rods

are provided with spherically cupped inserts 102 which engage spherically headed members 103 secured to the wobble plate 35 by means of shanks 104. These members 103 are positioned in recesses 105 in the wobble plate so that annular nut devices 106 may be screw-threaded into the recesses and provided with spherical surfaces 107 for engagement with external spherical surfaces 108 on the ends of the rods 16. Oil grooves 109 are provided to lubricate the ball and socket joints thus formed. The members 103 are preferably formed by grinding away a portion on a steel ball so as to form the shank 104 and the shoulder which abuts the bottom of the recess 105.

The wobble plate 35 is mounted on the bushing 36 by means of ball bearings 110 and 111. Bearing 111 has one race 112 (Figs. 1, 2 and 7) secured to the wobble plate 35 by means of a plurality of screw devices 113 (Fig. 2). An annular member 114 serves as an intermediate race for both of the ball bearings 110 and 111 and is secured to the bushing 36 by means of a plurality of screw devices 115. A race member 116 is placed in an annular recess 117 in the wobble plate. Thus, the shaft 17 and bushing 36 carried thereon are freely rotatable with respect to the wobble plate.

The valve 22 for controlling the flow of fluid to and from the cylinders 13 is of the general type disclosed in my prior application Serial No. 143,069, filed May 17, 1937, now Patent No. 2,190,812 of Feb. 20, 1940. This valve is somewhat in the form of a wheel with an annular rim 120 and an annular hub 121 connected by a web of reduced thickness 122 which is provided with a plurality of apertures 123 (Fig. 6). The valve is mounted on the eccentric pin 23 by means of a ball bearing 124 so that during rotation of the shaft 17 the valve is given an orbital movement. As illustrated herein, the eccentric pin 23 is formed on a flat member 125 positioned in a diametrical slot 126 in the end of the shaft 17. The member 125 also carries an eccentric pin 127 extending in the opposite direction which is insertable in either one of two recesses 128 in the shaft. The member 125 may be inserted in the slot in the shaft with the eccentric pin 23 in a lower position, as shown in Fig. 2, in which event the device will operate as a motor rotating in a counterclockwise direction looking at Fig. 5. By reversing the position of the member 125, the direction of rotation of the motor may be reversed. A screw device 129 is preferably provided for securing the member 125 in its adjusted position.

The fluid on entering the intake port 20 is distributed through arcuate connecting ports 20' (Fig. 5) to a plurality of supply ports 130 which communicate with the outer portion of the valve chamber 24. Similarly, arcuate connecting ports 21' establish communication between the outlet port 21 and a plurality of ports 131 which join with the valve chamber 24 at a point spaced inwardly from the outer wall of the chamber 24. The plate 25 is provided with a plurality of cylinder ports 132, preferably grouped and shaped as indicated in Fig. 6 for a fluid motor. These ports communicate directly with the recesses 30 which form the head ends of the cylinders. It will be readily apparent from Fig. 5 that with the valve in the position shown fluid supplied to the outer portion of the valve chamber 24 will pass directly to the cylinder ports 132 for the uppermost cylinders, and that the valve in its orbital movement will successively uncover cylinder ports to the incoming fluid and at the same time at a point 180° removed successively uncover cylinder ports so that the fluid may flow out through the apertures 123 in the valve and into the outlet ports 131. In the fluid motor form of the invention, as illustrated in Figs. 1 to 7, the cylinder ports 132 consist of groups of three drilled holes, the middle one of which is substantially larger than the outer two, as shown most clearly in Fig. 6.

In order to operate the invention in the form illustrated in Figs. 1 to 7, it is merely necessary to connect a suitable source of fluid under pressure to the intake port 20, whereupon the pistons 14 will be actuated in succession to operate the wobble plate 35 which in turn transmits rotary motion to the shaft 17. The speed of the shaft, assuming a constant volume supply of fluid, will depend upon the stroke of the pistons as determined by the angular position of the wobble plate. With the wobble plate set for a maximum stroke, as shown in Figs. 1 to 7, the shaft 17 will be driven at its minimum speed for a given volume of fluid. With the parts as shown in the drawings, the lowest speed of the motor may be adjusted by means of the hand wheel 60 and the top speed of the motor may be adjusted by means of the screw devices 78. In the form of the invention shown, the change from low speed to high speed is attained by supplying fluid under pressure to the ports 83 so as to force the plungers 48 to the left (Fig. 2) until the heads 77 of the rods 75 engage the screw devices 78. During the movement of the plungers, the ring member 45 is shifted axially, the wobble plate is swung on the shifting pivot pin 38 and the pins 38 are shifted axially in accordance with the shape and location of the slot 39. As mentioned hereinbefore, this slot is shaped and located so that for different strokes of the pistons the head clearance, when the pistons are at the top of their stroke, as shown in Fig. 1, for the upper piston, remains substantially constant. Thus, when the pistons are operating on a relatively short stroke, the head clearance is just as small as it is when they are operating on a long stroke.

In Figs. 8 and 9, there is illustrated a portion of a modified form of the invention embodied in a pump, the parts not shown being the same as those of Figs. 1 to 7. In this pump form of the invention, 220 is the outlet port and 221 the inlet port. The valve 22 operates in a valve chamber 24 and controls the inlet and outlet of fluid to and from cylinder ports 232. These ports have substantially straight inner sides 233 with square ends and somewhat curved outer edges 234. Since the intake port 221 supplies fluid to the recessed portion 122 of the valve through the intermediate port 221', this arrangement provides cylinder ports which are opened more quickly for the intake of fluid and are opened more gradually for the discharge of fluid. This is advantageous for a pump particularly, to avoid hammering.

The pump type of control illustrated in Fig. 9 comprises a rod 75' screw-threaded into each plunger 48, these rods having collar portions 175 arranged to engage the adjacent end of the pinion 69 to limit the movement of the plungers 48 toward the left and thereby determine the short stroke position of the wobble plate. The rod 75' is preferably secured in position by a set screw device 176.

In operating the pump form of the invention shown in Figs. 8 and 9, the intake port 221 is suitably connected to a source of fluid, and by driving the shaft the pumping mechanism func-

tions to draw fluid in through the intake port and discharge it through the outlet port 220, the volume of fluid discharged depending upon the angular adjustment of the wobble plate device with respect to the shaft. In this form of the invention, the wobble plate is normally at its full stroke position, as shown in Fig. 9, and remains in this position until fluid pressure is supplied to the ports 83 to force the pistons 48 toward the left until the collars 175 engage the ends of the pinion 69. The center stroke of the pistons thus determined may be adjusted by rotation of the pinions by means including the hand wheel 60. With the cylinder ports formed as shown in Fig. 8, the inner portions thereof are uncovered during the intake of fluid into the cylinders, fluid being supplied, for example, through the lowermost port 232, shown in Fig. 8. The outer portions of the ports are uncovered during the exhaust stroke, the uppermost port in Fig. 8 then being uncovered to exhaust fluid from the corresponding cylinder. Because of the squared shape of the inner side of the cylinder ports, these ports are actually opened to a greater extent during the suction strokes of the pistons so as to facilitate inlet of fluid to the cylinders. During the exhaust strokes of the pistons, the openings through the cylinder ports are relatively smaller and thus aid in building up pressure within the cylinders. This cycle of operation is practicularly advantageous in a fluid pump.

It will be apparent that by mounting the wobble plate member 35 by means of the trunnions 50 on the ring member 45, which ring member is in turn mounted on trunnions 46 on the plungers 48, the thrust load on the wobble plate is carried directly by the casing through these parts so as to relieve the drive shaft of this load. Furthermore, the torque load is on the trunnions 46 and 50 and is directly carried therethrough by the casing. Since the wobble plate is adjusted by means of the universal mounting thus formed, these trunnions carry the thrust and torque load at all times and relieve not only the shaft but the cam and roller mechanism of the wobble plate adjusting means. The provision of a fluid handling mechanism, wherein the head clearance is maintained constant and at a minimum for different stroke lengths, results in numerous advantages. Particularly, the constant and small head clearance avoids churning of the fluid in the cylinder and effectively prevents vapor from becoming locked in the cylinder during short stroke operation.

The provision of a reversible valve driver facilitates the changing of the direction of rotation of the invention as a motor and similarly facilitates the changing of the direction of flow through the invention when used as a pump.

I claim as my invention:

1. A fluid handling mechanism comprising, in combination, a casing, a shaft rotatably mounted thereon, a plurality of piston and cylinder devices, means including a valve for controlling the flow of fluid to and from said cylinders, means for connecting the pistons to the shaft comprising a wobble plate device, means for adjusting the position of the wobble plate device comprising means including a pair of fluid operated plungers slidable longitudinally in the casing arranged to move the wobble plate device longitudinally of the shaft, means changing the angular position of said wobble plate device as an incident to such longitudinal adjustment and means for controlling the movement of said plungers comprising a ring gear mounted in said casing, a hand wheel operated device for rotating said ring gear, a pair of screw-threaded members mounted in said casing in alignment with said plungers and having pinions thereon engaging said ring gear, rods secured to said plungers extending through said screw-threaded members and having heads thereon engaging said members for limiting the movement of the plungers in one direction and adjustable screw devices for limiting the movement of said plungers in the opposite direction.

2. A fluid handling mechanism comprising, in combination, a casing, a shaft rotatably mounted thereon, a plurality of piston and cylinder devices, means including a valve for controlling the flow of fluid to and from said cylinders, means for connecting the pistons to the shaft comprising a wobble plate device, means for adjusting the angular and axial position of the wobble plate device comprising a pair of plungers slidable longitudinally in the casing arranged to move the wobble plate device longitudinally of the shaft, and means adjusting the angular position of said wobble plate device as an incident to such longitudinal movement, and means for controlling the movement of said plungers comprising a ring gear mounted in said casing, means for rotating said ring gear and a pair of screw-threaded members mounted in said casing in alignment with said plungers and having pinions thereon engaging said ring gear.

3. A fluid handling mechanism comprising, in combination, a casing, a shaft rotatably mounted thereon, a plurality of piston and cylinder devices, means including a valve for controlling the flow of fluid to and from said cylinders, means for connecting the pistons to the shaft comprising a wobble plate device, means for adjusting the axial position of the wobble plate device to effect an angular adjustment thereof comprising a pair of plungers slidable longitudinally in the casing, and means for moving said plungers in a direction to shorten the piston stroke comprising a pair of screw-threaded members mounted in said casing in alignment with said plungers, and rods secured to said plungers extending through said screw-threaded members and having heads thereon engaging said members for limiting the movement of the plungers in one direction.

4. A fluid motor comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, means for controlling the flow of fluid to and from said cylinders, means for converting the reciprocatory movement of the pistons into rotary movement of the shaft comprising a wobble plate device having a first member rotating with the shaft and a second relatively non-rotatable plate member, means connecting the pistons to said plate member, universal thrust and torque bearing means for supporting said plate member directly on the casing comprising a pair of diametrically opposite trunnions on said plate member, a ring member having bearings for said trunnions and a pair of trunnions extending diametrically therefrom in a plane at right angles to said plate member trunnions, and means on the casing adjustable longitudinally of the shaft having bearings for said ring member trunnions.

5. A fluid motor comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices arranged

parallel to and spaced annularly about said shaft, means for controlling the flow of fluid to and from said cylinders, means for converting the reciprocatory movement of the pistons into rotary movement of the shaft comprising a wobble plate device having a first member rotating with the shaft and a second relatively non-rotatable plate member, means connecting the pistons to said plate member, universal thrust and torque bearing means for supporting plate member directly on the casing comprising a pair of diametrically opposite trunnions on said plate member, a ring member having bearings for said trunnions and a pair of trunnions extending diametrically therefrom in a plane at right angles to said plate member trunnions, means on the casing adjustable longitudinally of the shaft having bearings for said ring member trunnions, and means for adjusting the wobble plate device angularly with respect to the shaft as it is adjusted longitudinally thereof.

6. A fluid motor comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, means for controlling the flow of fluid to and from said cylinders, means for converting the reciprocatory movement of the pistons into rotary movement of the shaft comprising a wobble plate device having a first member rotating with the shaft and a second relatively non-rotatable plate member, means connecting the pistons to said plate member, universal thrust and torque bearing means for supporting said plate member directly on the casing comprising a pair of diametrically opposite trunnions on said plate member, a ring member having bearings for said trunnions and a pair of trunnions extending diametrically therefrom in a plane at right angles to said plate member trunnions, means on the casing adjustable longitudinally of the shaft having bearings for said ring member trunnions, means for adjusting the wobble plate device angularly with respect to the shaft as it is adjusted longitudinally thereof comprising a cam and follower device, one element of which is mounted on said shaft and the other element of which is mounted on said first wobble plate member.

7. A fluid motor comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices spaced annularly about said shaft, means for controlling the flow of fluid to and from said cylinders, means for converting the reciprocatory movement of the pistons into rotary movement of the shaft comprising a wobble plate device having a first member rotating with the shaft and a second plate member, means for connecting the pistons to the plate member, means for supporting said plate member directly on the casing comprising a pair of diametrically opposite trunnions on said plate member, a ring member having bearings for said trunnions and a pair of trunnions extending diametrically therefrom in a plane at right angles to the wobble plate member trunnions, means movable longitudinally in the casing having bearings for said ring member trunnions, means for adjusting the wobble plate device comprising pivot means movable longitudinally on the shaft and mounting said first wobble plate member, and a cam and follower means, one element of which is mounted on said shaft and the other element of which is mounted on said first wobble plate member, arranged to move the pivot means longitudinally of the shaft toward the cylinders and to change the angular position of said wobble plate device when said means providing bearings for said ring member trunnions are moved longitudinally.

8. A fluid motor comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, means for controlling the flow of fluid to and from said cylinders, means for converting the reciprocatory movement of the pistons into rotary movement of the shaft comprising a wobble plate device having a first member rotating with the shaft and a second relatively non-rotatable plate member, means for connecting the pistons to said plate member, universal bearing means for supporting said plate member directly on the casing comprising a pair of diametrically opposite trunnions on said plate member, a ring member having bearings for said trunnions and having a pair of trunnions extending diametrically therefrom in a plane at right angles to the wobble plate member trunnions, and a pair of plungers slidable longitudinally in the casing having bearings for said ring member trunnions, means for adjusting the angular position of the wobble plate device relative to the shaft when its longitudinal position on the shaft is changed to shorten the stroke of the pistons comprising a cam and follower device, one element of which is mounted on said shaft and the other element of which is mounted on said first wobble plate device member, and means for moving said plungers in a direction to shorten the piston stroke.

9. A fluid motor comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, means for controlling the flow of fluid to and from said cylinders, means for converting the reciprocatory movement of the pistons into rotary movement of the shaft comprising a wobble plate device having a first member rotating with the shaft and a second relatively non-rotatable plate member, means connecting the pistons to said plate member, universal bearing means for supporting said plate member directly on the casing comprising a pair of diametrically opposite trunnions on said plate member, a ring member having bearings for said trunnions and having a pair of trunnions extending diametrically therefrom in a plane at right angles to said plate member trunnions, and a pair of plungers slidable longitudinally in the casing having bearings for said ring member trunnions, means for adjusting the wobble plate comprising a sleeve movable longitudinally on the shaft, a pivot pin carried by said sleeve and mounting said first wobble plate device member, and a cam and follower means, one element of which is mounted on said shaft and the other element of which is mounted on said first wobble plate device member, arranged to move said sleeve device longitudinally of the shaft toward the cylinders and to change the angular position of said wobble plate device on the shaft when said plungers are shifted to shorten the stroke of the pistons, means for moving said plungers in a direction to shorten the piston stroke, and means for controlling the movement of said plungers.

10. A fluid motor comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, means for controlling the flow of fluid to and

from said cylinders, means for converting the reciprocatory movement of the pistons into rotary movement of the shaft comprising a wobble plate device having a first member rotating with the shaft and a second relatively non-rotatable plate member, means for connecting the pistons to said plate member, universal bearing means for supporting said plate member directly on the casing comprising a pair of diametrically opposite trunnions on said plate member, a ring member having bearings for said trunnions and having a pair of trunnions extending diametrically therefrom in a plane at right angles to the wobble plate member trunnions, and a pair of plungers slidable longitudinally in the casing having bearings for said ring member trunnions, means for adjusting the angular position of the wobble plate device relative to the shaft when its longitudinal position on the shaft is changed to shorten the stroke of the pistons, means for moving said plungers in a direction to shorten the piston stroke, and means for controlling the movement of said plungers comprising a pair of screw-threaded members mounted in said casing in alignment with said plungers.

11. A fluid motor comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, means for controlling the flow of fluid to and from said cylinders, means for converting the reciprocatory movement of the pistons into rotary movement of the shaft comprising a wobble plate device having a first member rotating with the shaft and a second relatively non-rotatable plate member, means for connecting the pistons to said plate member, universal bearing means for supporting said plate member directly on the casing including a member having a pair of trunnions extending diametrically therefrom, and a pair of plungers slidable longitudinally in the casing having bearings for said ring member trunnions, means for adjusting the angular position of the wobble plate device on the shaft when its longitudinal position on the shaft is changed to shorten the stroke of the pistons comprising a cam and follower device, one element of which is mounted on said shaft and the other element of which is mounted on said first wobble plate device member, means for moving said plungers in a direction to shorten the piston stroke, and means for controlling the movement of said plungers comprising a ring gear mounted in said casing, a hand wheel operated device for rotating said ring gear, and a pair of screw-threaded members mounted in said casing in alignment with said plungers and having pinions thereon engaging said ring gear.

12. A fluid motor comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, means for controlling the flow of fluid to and from said cylinders, means for converting the reciprocatory movement of the pistons into rotary movement of the shaft comprising a wobble plate device having a first member rotating with the shaft and a second relatively non-rotatable plate member, means for connecting the pistons to said plate member, universal bearing means for supporting said plate member directly on the casing comprising a pair of diametrically opposite trunnions on said plate member, a ring member having bearings for said trunnions and having a pair of trunnions extending diametrically therefrom in a plane at right angles to the wobble plate member trunnions, and a pair of plungers slidable longitudinally in the casing having bearings for said ring member trunnions, means for adjusting the angular position of the wobble plate device on the shaft when its longitudinal position on the shaft is changed to shorten the stroke of the pistons comprising a cam and follower device, one element of which is mounted on said shaft and the other element of which is mounted on said first wobble plate device member, means for moving said plungers in a direction to shorten the piston stroke, and means for controlling the movement of said plungers comprising a ring gear mounted in said casing, a hand wheel operated device for rotating said ring gear, a pair of screw-threaded members mounted in said casing in alignment with said plungers and having pinions thereon engaging said ring gear, rods secured to said plungers extending through said screw-threaded members and having heads thereon engaging said members for limiting the movement of the plungers in one direction and adjustable screw devices for limiting the movement of said plungers in the opposite direction.

13. A fluid handling mechanism having, in combination, a casing, a shaft rotatably mounted thereon, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, a wobble plate device on said shaft, means connecting the pistons to said wobble plate device comprising connecting rods having spherically cupped ends, a steel ball fitted into each connecting rod end and having a portion cut away to form a shoulder anchored against said wobble plate device, and means for maintaining said connecting rods in engagement with said ball surfaces including exterior and concentric spherical bearing surfaces formed on the ends of the connecting rods and corresponding spherical bearing surfaces formed on said wobble plate device.

14. A fluid motor or pump comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, means for controlling the flow of fluid to and from said cylinders, means for converting the reciprocatory movement of the pistons into rotary movement of the shaft or vice versa comprising a wobble plate device having a first member rotating with the shaft and a second relatively non-rotatable plate member, means connecting the pistons to said plate member, and means in said casing supporting said plate member for carrying the thrust and torque developed in the operation of the motor or pump.

15. A fluid motor or pump comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, means for controlling the flow of fluid to and from said cylinders, means for converting the movement of said pistons into movement of said shaft or vice versa comprising a wobble plate device having a plate member and a second member, means connecting the pistons to said plate member, universal thrust and torque bearing means for supporting said plate member directly on the casing comprising a pair of diametrically opposite trunnions on said plate member, a ring member having bearings for said trunnions, and a pair of trunnions extending diametrically therefrom in a plane at right angles

to said plate member trunnions, and means on said casing having bearings for said ring member trunnions.

16. A device of the character described comprising, in combination, a casing having a plurality of cylinders, a port opening to each of the cylinders and fluid supply and return passages, a piston reciprocable in each of the cylinders, a rotary shaft, means for converting one type of motion into the other type of motion, valve means for controlling the supply and exhaust of fluid to and from said ports, an eccentric device arranged to drive the valve means in timed relation with the reciprocation of said pistons comprising a pin upon which said valve means is rotatably mounted and a block carrying said pin, a diametrical slot in one end of said rotary shaft for receiving said block, and means securing said block in said slot releasable to permit removal of said block and reinsertion after the rotation through 180°.

17. A fluid motor or pump comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, means for controlling the flow of fluid to and from said cylinders, means for converting the reciprocatory movement of the pistons into rotary movement of the shaft or vice versa comprising a wobble plate device having a first member rotating with the shaft and a second relatively non-rotatable plate member, means in said casing supporting said plate member for carrying the thrust and torque developed in the operation of the motor or pump, and means for adjusting the wobble plate device angularly on said shaft comprising means on the shaft having a closed cam slot formed therein and a follower carried on said first member and extending into said slot.

18. A fluid motor or pump comprising, in combination, a casing, a shaft rotatably mounted therein, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, means for controlling the flow of fluid to and from said cylinders, means for converting the movement of said pistons into movement of said shaft or vice versa comprising a wobble plate device having a plate member and a second member, universal thrust and torque bearing means for supporting said plate member directly on the casing comprising a pair of diametrically opposite trunnions on said plate member, a ring member having bearings for said trunnions, and a pair of trunnions extending diametrically therefrom in a plane at right angles to said plate member trunnions, means on said casing having bearings for said ring member trunnions, and means for adjusting the wobble plate device angularly on said shaft comprising means on the shaft having a closed cam slot formed therein and a follower carried on said first member and extending into said slot.

19. A fluid handling mechanism having, in combination, a casing, a shaft rotatably mounted thereon, a plurality of piston and cylinder devices arranged parallel to and spaced annularly about said shaft, a wobble plate device on said shaft, means connecting the pistons to said wobble plate device comprising connecting rods having spherically cupped ends, a plurality of members secured to and spaced annularly around said wobble plate device and having spherical surfaces fitted into the cupped ends of said connecting rods, and means for maintaining said connecting rods in engagement with said spherical surfaces including exterior and concentric spherical bearing surfaces formed on the ends of the connecting rods and corresponding spherical bearing surfaces formed on said wobble plate device.

GUNNAR A. WAHLMARK.