

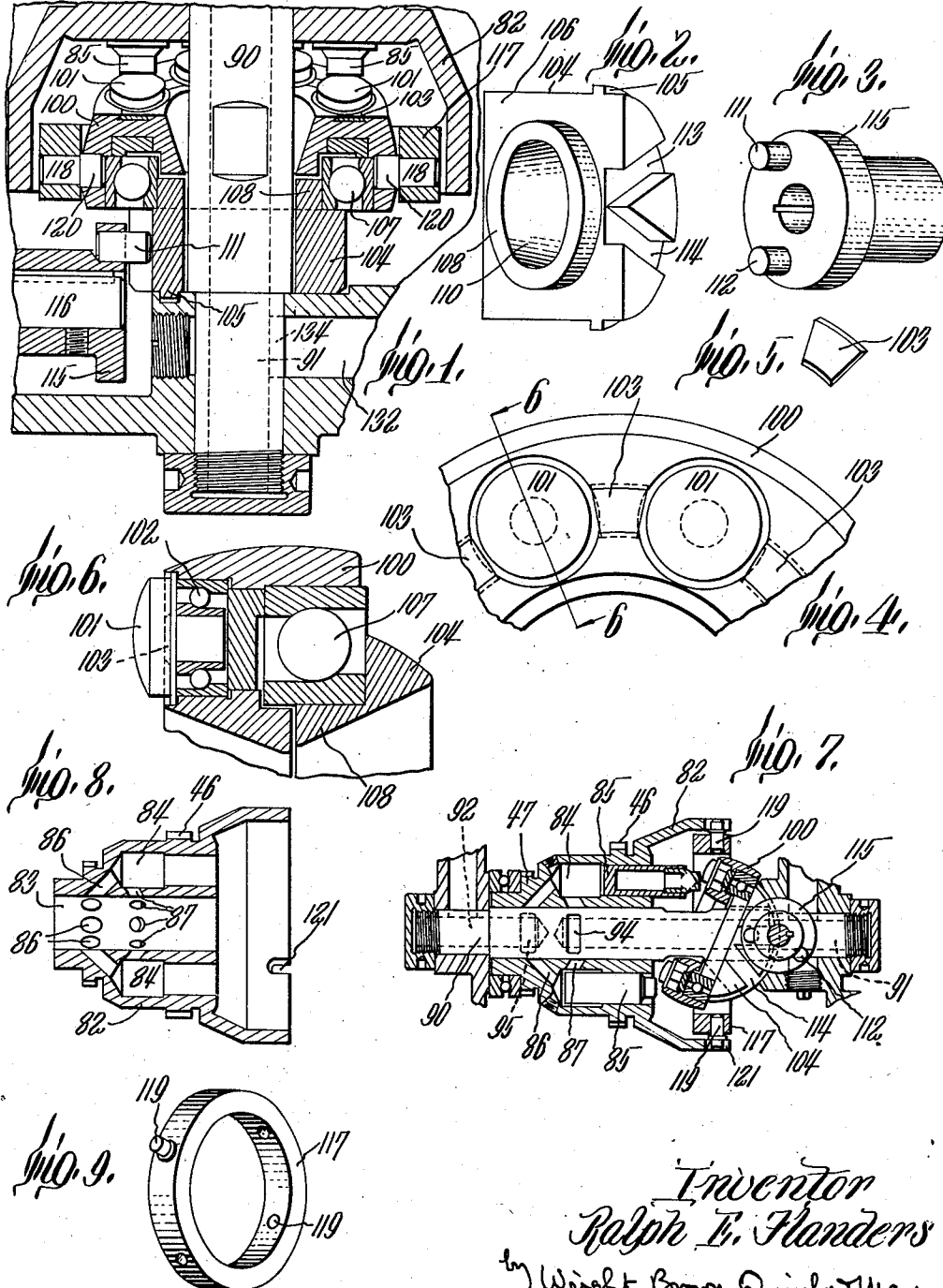
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HYDRAULIC PUMP OR MOTOR

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HYDRAULIC PUMP OR MOTOR

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1 Claim. (Cl. 103—162)

This invention relates to improvements in hydraulic mechanism which can be employed as a pump or motor. It is an object of the invention to provide a pump or motor of the swash plate type having all of the advantages of that type of pump or motor, but with improvements in structure which reduce the friction loss of the mechanism and materially lengthen its term of service. To this end, the plungers of the motor or pump may have flat end faces to engage convex faces of corresponding rotatable contact elements carried by the swash plate, frictionless bearings being preferably provided to minimize wear between the engaging parts.

For a more complete understanding of the invention, reference may be had to the following description thereof and to the illustration of certain embodiments thereof on the accompanying drawing, of which

Figure 1 is a fragmentary sectional view of a pump or motor embodying the invention.

Figure 2 is a perspective view of the swash-plate block shown in Figure 1.

Figure 3 is a perspective view of a pin gear to control the position of the swash plate.

Figure 4 is a fragmentary plan view of the swash-plate ring shown in Figure 1.

Figure 5 is a perspective view of a spacing and locking element in the swash-plate ring.

Figure 6 is a section on the line 6—6 of Figure 4.

Figure 7 is a fragmentary sectional view of a pump or motor including the mechanism shown in Figure 1.

Figure 8 is a longitudinal sectional view of the cage for the plungers.

Figure 9 is a perspective view of the gimbal ring shown in Figures 1 and 7.

The embodiment of the invention illustrated on the drawing is hereinafter described as a pump, but it is understood that the same mechanism can readily be used as a motor. The pump includes a cage 82 having a central bore 83. Surrounding this bore is a circular series of bores 84 open at one end to receive plungers 85 for reciprocation therein. The outer end face of each plunger is preferably flat. These plungers, as indicated in Figure 7, are preferably made hollow to save weight and reduce inertia. Each plunger is slidably fitted in the outer portion of a bore 84 so as to form a variable pressure chamber therein. The inner end portion of each bore 84 communicates with the central bore 83 by two ports 86 and 87, the ports 86 opening into the bore 83 in a transverse plane axially spaced from

the openings of the ports 87 into the bore 83. The cage 82 is rotatably mounted on a fixed hollow stem 90, but is held against axial movement thereon. The stem 90 has bores 91 and 92 extending longitudinally inwardly from the respective ends of the stem but terminating at a dividing wall 93. The bore 91 opens out laterally through the wall of the stem 90 as by a port 94. The bore 92 likewise opens out through a port 95. These ports are adjacent to the dividing wall 93 and open out in opposite directions. The cage 82 is mounted on the stem 90 in such a manner that the port 95 is in the plane of the ports 86 and the port 94 is in the plane of the ports 87. It is thus evident that as the cage 82 rotates about the stem 90, the ports 86 are successively in communication with the port 95 and the ports 87 are successively in communication with the port 94. Since the ports 94 and 95 are diametrically opposed, it is evident that when any particular bore 84 is in communication with the bore 92 through the port 95, the diametrically opposite bore 84 is simultaneously in communication with the bore 91 through the port 94. The bores 91 and 92 in the stem 90 serve respectively as discharge and suction lines for the pump, or vice versa, according to the direction of operation of the pump. In order to operate the pump, it is necessary that the plungers 85 be forced inwardly in their respective bores 84 while such bores are in communication with the discharge line of the pump, and that the plungers 85 also be permitted to move outwardly when their bores are in communication with the suction line of the pump. This inward motion may be brought about by a tilted ring 100 mounted with its center in the axis of rotation of the cage 82. The ring is located in such a manner as to engage the projecting ends of the plungers 85 and to rotate with the cage 82, but in its own plane and on an axis which is at an angle to the axis of rotation of the cage. Hence each plunger 85 as it swings around the axis of the cage 82 bears alternately against the high and low sides of the ring 100. As each plunger travels from the high side to the low side, it is forced inwardly, thus forcing oil through either the port 94 or the port 95 (according to the direction of tilt of the ring) while the plunger opposite thereto is moving from the low side of the ring to the high side and is receiving oil into its bore 84 through the other port. In order to minimize frictional resistance and to reduce wear of the parts, the ring 100 is preferably provided with a series of rotatable buttons 101, these but-

tons being set into holes in the face of the ring 100 which is presented to the plungers 85, and preferably mounted on ball bearings 102 which permit free rotation of the buttons 101. The buttons may be held in place by suitable retaining elements 103 driven into a shallow groove with undercut edges, and overlapping portions of adjacent buttons (Figures 4 and 5). Each button is formed with a rounded face, as shown in Figures 6 and 7, to engage the flat end face of a plunger 85. It is evident from Figure 7 that as the pump rotates, the point of contact between the plungers and the buttons shifts back and forth between the inner and outer edges of the buttons. This results in relative movement between each button and the end of its respective plunger 85. The ball bearings 102 facilitate such relative movement with a minimum of resistance and wear. Moreover, since the rounded faces of the buttons 101 bear on the flat end faces of the plungers 85, the direction of pressure is perpendicular to the end face no matter what the direction of tilt of the buttons 101 may be. Hence in spite of a continual change in the angle of thrust between each plunger and its button, the actual pressure on the plunger is in the direction of its length. Except for slight frictional stresses, the plungers are thus free from lateral stresses which would otherwise tend to cause wear between the plungers and their bores, with resultant leakage and loss of efficiency. According to the present invention, all the lateral stresses incident to the angular thrust between the plungers and buttons are taken up by the buttons, the ball bearings 102 being provided to take care of such stresses. The swash plate block 104 of the pump, as illustrated in Figure 2, is semi-cylindrical in shape and has a semi-circular rib 105 on the cylindrical face to anchor it against axial movement. The block 104 also has a flat face 106 against which the ring 100 bears, this ring being supported by a suitable ball bearing 107 which surrounds and is centered by a raised circular rib 108. The block 104 is pierced by a central bore 110 to receive the stem 90, this bore being flared in one dimension to permit the swash plate to rock through a sufficient angle. The rate of delivery of fluid from the pump, when the speed of rotation of the pump is constant, is determined by the angle of tilt of the swash plate 104. It is evident from Figure 7 that if the swash plate is adjusted to a position in which the plane face 106 is perpendicular to the axis of the stem 90, there will be no high or low side to this face. Hence the rotation of the cage 82 will produce no delivery of fluid from the pump. If the swash plate is tilted to its maximum angle in one direction, as, for example, that illustrated in Figure 7, the fluid is discharged into the bore 91 of the stem 90. If the angle of the swash plate is reversed, the fluid is discharged into the bore 92 so that the flow around the circuit through the motor is reversed. It is obvious that the direction of oil discharge could also be reversed by reversing the direction of rotation of the cage 82. In the structure illustrated, however, the cage 82 is adapted to be driven in one direction only so that reversal of the pump is obtained only by reversing the angle of the swash plate. The swash plate is preferably controlled by a Geneva type of motion resulting from the engagement of one or the other of a

pair of pins 111 and 112 in respective channels 113 and 114 in an end face of the block 104. These pins are mounted in the end of a hub member 115 which in turn is mounted on a shaft 116. When this hub member 115 is turned counter-clockwise, as in Figure 7, the pin 111 enters the channel 113 and swings the block 104 in a clockwise direction. When the hub member 115 is turned in a clockwise direction, the block 104 is swung in the opposite direction. As the pin 111 is leaving the outer end of the channel 113, the pin 112 enters the outer end of the channel 114 and takes up the load, moving the block 104 until it reaches its maximum angle of tilt in the opposite direction. This Geneva type of motion is advantageous in that it permits of a relatively fine adjustment of the angle of the swash plate when the swash plate is in or near its neutral position, that is, a given amount of rotation of the hub member 115 produces minimum corresponding rotation of the swash plate when the latter is in its neutral position with its plane face 106 perpendicular to the axis of the stem 82.

Synchronous rotation of the pump cage 82 and the ring 100 is accomplished by gimbal connections between these two members. As shown in Figures 1 and 9, a gimbal ring 117 is provided with a pair of outwardly projecting trunnions 118 which rest in a pair of notches 121 in the cage 82 so that the ring 117 can rock on the axis of these trunnions. A second pair of trunnions 119 project from the ring 100 and enter a pair of holes in the ring 117 arranged 90° from the trunnions 118. The inner end portions of the trunnion pins 118 are enlarged as at 120 to hold the pins in place. Thus the swash plate ring 100 can rock on any of its diameters by reason of its gimbal mounting. This permits the ring 100 to be driven by its connection with the cage 82 to rotate in its own plane, the angle of which, relative to the axis of the cage, is determined by the block 104 and may be adjusted by movement of the block. The cage 82 may be provided with a ring of gear teeth 46 adapted to mesh with any suitably located gear (not shown) through which the pump or motor may be driven by or may drive other mechanism not shown.

It is obvious that various modifications and changes may be made in the specific embodiment of the invention herein shown and described without departing from the spirit and scope as defined by the appended claim.

I claim:—

A fluid pump or motor comprising a rotatable cage having bores therein parallel to the axis of rotation of the cage, a plunger reciprocable in each said bore, a swash plate rockable on an axis perpendicular to said axis of rotation, a ring rotatably mounted on said plate, said ring having contact elements for engagement with respective plungers, means for rotating said cage and ring in synchronism, and means for rockably adjusting said swash plate, said adjusting means including an operating shaft and a Geneva movement connection between said shaft and said plate, said connection being so arranged that movement of said shaft results in varying rocking movement of said plate, the rate of such rocking movement being minimum when the plane of said plate is perpendicular to the axis of rotation of the cage.

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