

March 29, 1949.

O. W. BONNAFE
HYDRAULIC PUMP

2,465,510

Filed Oct. 23, 1944

2 Sheets-Sheet 1

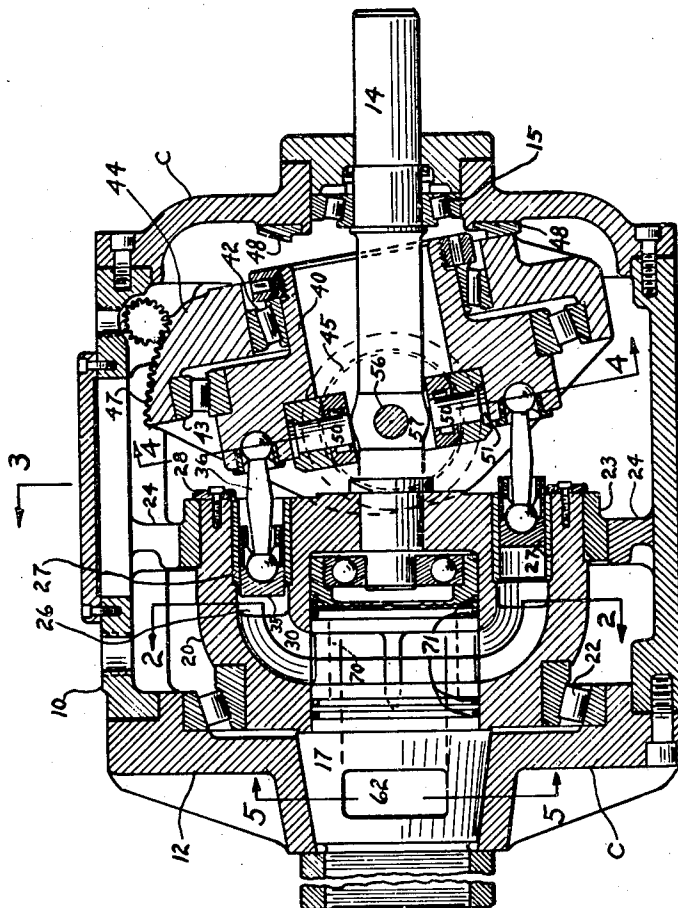


Fig. 1

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2 Sheets-Sheet 2

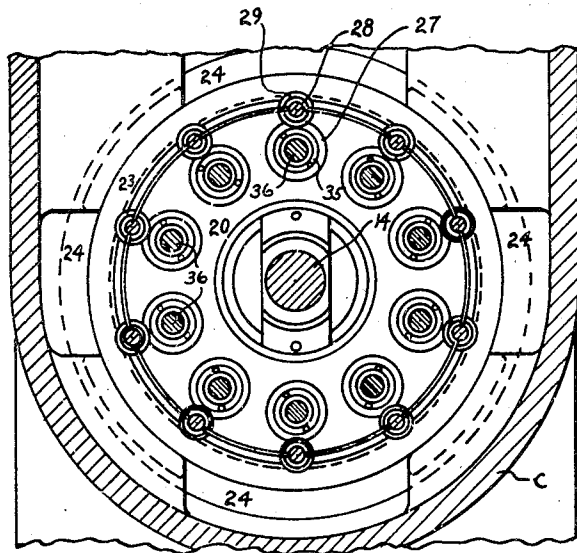


Fig. 3

Fig. 2.

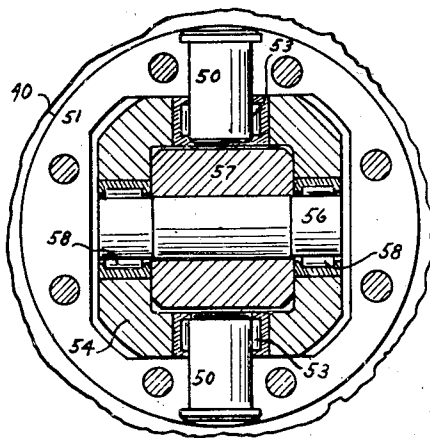
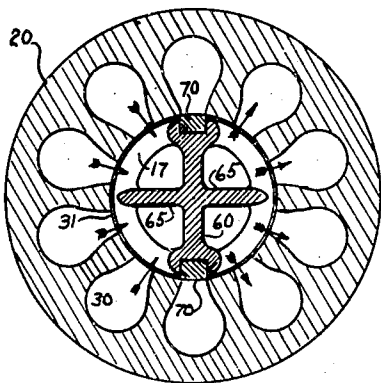


Fig. 4

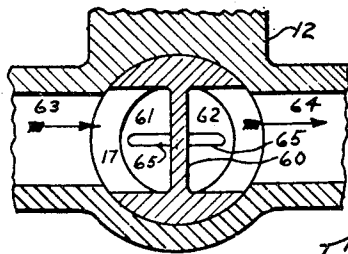


Fig. 5

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HYDRAULIC PUMP

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2 Claims. (Cl. 103—162)

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This invention relates to a variable delivery hydraulic pump of the type in which an annular series of cylinders in a rotating cylinder block successively discharge liquid under pressure to a recessed fixed delivery member or stator, and in which the movements of the pistons are produced and controlled by a transmission plate mounted to rotate in an angularly adjustable or tiltable cradle. Such a pump is shown for instance in the prior patent to West No. 1,722,832, issued July 30, 1929.

It is the general object of my invention to improve the design and construction of a pump of the above-defined type, to the intent that more efficient operation and longer life may be attained.

To the accomplishment of this general object, important features of the invention relate to the provision of an improved driving connection between the main drive shaft and the tiltable transmission plate; to the provision of improved supporting bearings for the cylinder block or rotor, and to the provision of improved valve means for the rotor, which valve means is additional to and independent of the supporting bearings.

My invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

A preferred form of the invention is shown in the drawings, in which

Fig. 1 is a sectional side elevation of my improved pump;

Fig. 2 is a sectional end elevation, taken along the irregular line 2—2 in Fig. 1;

Fig. 3 is a sectional end elevation, taken along the line 3—3 in Fig. 1;

Fig. 4 is a detail sectional view of a universal driving connection, taken along the line 4—4 in Fig. 1; and

Fig. 5 is a sectional end elevation, taken along the line 5—5 in Fig. 1.

Referring to the drawings, my improved pump comprises a fixed casing or supporting frame C having a middle portion 10 and end plates 11 and 12. A main driving shaft 14 is rotatably supported in a thrust bearing 15 mounted in the end plate 11. The inner end of the shaft 14 is supported by a ball bearing 16 mounted at the inner end of a fixed delivery member or stator 17, which in turn is rigidly supported in the opposite end plate 12. The shaft 14 is continuously rotated from any convenient source of power through any usual driving connection, such as a gear or pulley (not shown).

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A cylinder block or rotor 20 is mounted concentric with the stator 17 and is supported at its outer end by a roller thrust bearing 22. At its inner end, it is provided with a ring race 23 rotatable in fixed segmental bearing members 24 (Fig. 3). The rotor 20 is thus rotatably supported free from and independent of the stator 17 but concentric therewith. The rotor 20 is fast to the inner end of the drive shaft 14 and rotates therewith.

The rotor 20 is provided with an annular series of cylinder openings 26, each having a lining sleeve or bushing 27 held from axial displacement by a washer 28 and clamping screw 29. The washers 28 also hold the ring race 23 from displacement. Each cylinder opening 26 is connected by an arc-shaped passage 30 to a peripheral port 31 (Fig. 2) adjacent the stator 17.

A piston 35 is slidably mounted in each cylinder bushing 27 and is reciprocated by a piston rod 36 having a swivel connection at one end to the piston 35 and a swivel connection at the opposite end to a transmission plate 40.

The plate 40 is supported by an inner roller thrust bearing 42 and an outer roller thrust bearing 43, both of which are mounted in a tiltable cradle 44. The cradle 44 is not rotatable with the drive shaft 14 and rotor 20 but may be tilted on horizontal bearings 45 (Fig. 1) perpendicular to the axis of the shaft 14 by a rotating pinion 46 which engages segment gear teeth 47 on the periphery of the cradle.

Any convenient device may be provided for turning the pinion 46 and thus varying the position of the cradle 44, and such device may be either manually or automatically operated. Such a device is shown in the West patent above referred to. Stops 48 limit movement of the cradle 44 in both directions.

It will be particularly noted that the outer bearing 43 for the transmission plate 40 is at a substantially greater distance from the axis of the drive shaft 14 than the swivel bearings for the piston rods 36, while the inner bearing 42 is at a substantially less distance. Consequently, the line of thrust of the piston rods is between the inner and outer bearings and is thus firmly supported and resisted.

The connection of the transmission plate 40 to the drive shaft 14 is best shown in Figs. 1 and 4 and comprises trunnions 50 mounted in a ring 51 fixed in the plate 40. Each trunnion 50 extends into a roller bearing 53 mounted in a hollow rectangular transmitting member or cage 54. A

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cross shaft 56 is mounted in an enlarged rectangular portion 57 of the drive shaft 14 and extends into additional roller bearings 58 also mounted in the rectangular member or cage 54. The sides of the cage 54 adjacent the bearings 58 slidably engage the sides of the portion 57 of the drive shaft, while the sides of the cage adjacent the bearings 53 have substantial clearance with respect to the portion 57 of the drive shaft, as clearly shown in Fig. 1.

The cage 54 is thus free to rock on the cross shaft 56 about an axis perpendicular to the axis of the drive shaft 14, and the ring 51 and transmission plate 40 are free to rock about the axis of the trunnions 50, which axis is at all times perpendicular to the axis of the cross shaft 56. A strong and effective universal driving connection is thus provided between the drive shaft 14 and the transmission plate 40. As has been previously explained, the rotor 20 also rotates with the shaft 14 and consequently rotates synchronously with the transmission plate 40.

The stator 17, as previously stated, is firmly secured in the end plate 12 and is provided with a longitudinally extending upright partition 60 (Figs. 2 and 5) which extends longitudinally of the stator and provides an intake passage 61 and a discharge passage 62. The liquid to be pumped is supplied to the passage 61 through an entrance passage 63 (Fig. 5) and the liquid delivered under pressure by the pump is discharged through the passage 64. The pump is, however, reversible, depending on the angular position of the cradle 44 and transmission plate 40, and consequently the passages 64 and 62 may supply the liquid and the passages 61 and 63 may act as discharge or delivery passages, if the direction of rotation is reversed. Partial cross vanes 65 reenforce the stator and assist in uniform distribution of the liquid to the ports 31 which are acting as intake.

Valve blocks or wipers 70 (Fig. 2) are mounted in the enlarged outer ends of the partition 60 and closely engage the internal cylindrical surface in which the ports 31 are formed. The valve blocks 70 thus supplement the partition 60 in separating the intake and discharge sides of the pump. The blocks 70 are slightly wider circumferentially than the ports 31 and also than the spaces between adjacent ports.

As the blocks 70 act only as valve members and not as supporting bearings for the rotor, they are not subject to heavy wear and have correspondingly long life. If, however, a set of blocks becomes worn, these blocks may be easily removed and replaced at comparatively slight expense.

Two pairs of packing rings 71 (Fig. 1) are preferably provided in the stator 17 to engage the cylindrical inner surface of the rotor 20. The inner rings 71 engage the abutting ends of the valve blocks or wipers 70. The rings 71 prevent axial leakage between the stator 17 and rotor 20.

The operation of this general type of pump is well known and is fully explained in the West patent previously referred to.

Further description thereof is considered unnecessary.

Having thus described my invention and the advantages thereof, I do not wish to be limited

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to the details herein disclosed, otherwise than as set forth in the claims, but what I claim is:

1. In a variable delivery hydraulic pump comprising a stator, a cylinder block rotatable concentric therewith and having an annular series of axially elongated cylinders therein, with a port for each cylinder successively and alternately coacting with separate intake and delivery passages in said stator, pistons in said cylinders connected to and reciprocated by a tiltable rotated transmission plate, means to tilt the plane of rotation of said plate, and means to synchronously rotate said transmission plate and cylinder block, that improvement which consists in providing driving means for the tiltable transmission plate which comprises a drive shaft, and a universal driving connection between said shaft and said plate which has a cross shaft fixed in said drive shaft, a rectangular hollow cage mounted to rock on said cross shaft and to rotate with said drive shaft, and trunnions fixed in said transmission plate and projected into bearings in said cage which are located on an axis perpendicular to the axis of said cross shaft.

2. In a variable delivery hydraulic pump comprising a stator, a cylinder block rotatable concentric therewith and having an annular series of axially elongated cylinders therein, with a port for each cylinder successively and alternately coacting with separate intake and delivery passages in said stator, pistons in said cylinders connected to and reciprocated by a tiltable rotated transmission plate, means to tilt the plane of rotation of said plate, and means to synchronously rotate said transmission plate and cylinder block, that improvement which comprises providing separate spaced valve blocks in said stator positioned to slidably engage the internal cylindrical port surface of said cylinder block, said valve blocks being approximately equal in circumferential width to the circumferential length of a cylinder port and to the distance between adjacent ports, and in providing packing rings in said stator to engage the inner surface of said cylinder block adjacent both ends of said valve blocks, whereby axial leakage is substantially avoided.

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