July 12, 1932. C. F. WAITE 1,867,198

ROTARY PUMP

Filed April 10, 1930

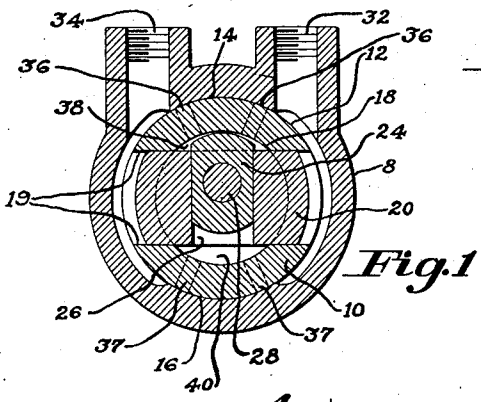


Fig. 1

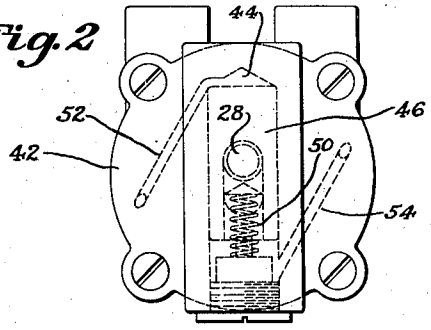


Fig. 2

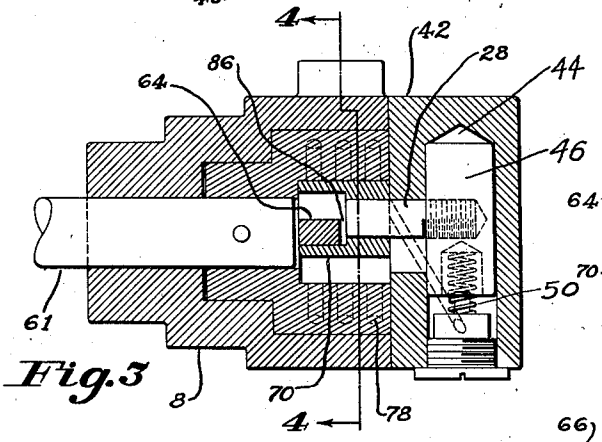


Fig. 3

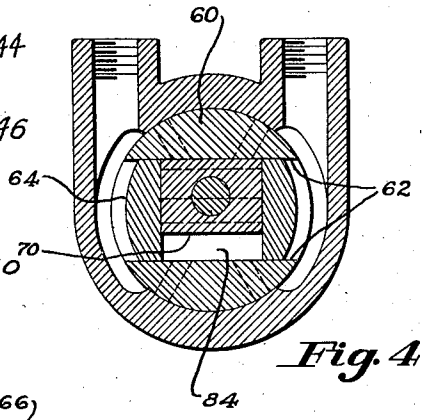


Fig. 4

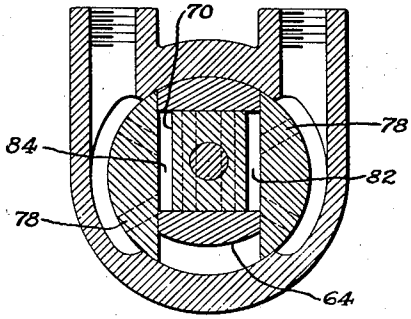


Fig. 5

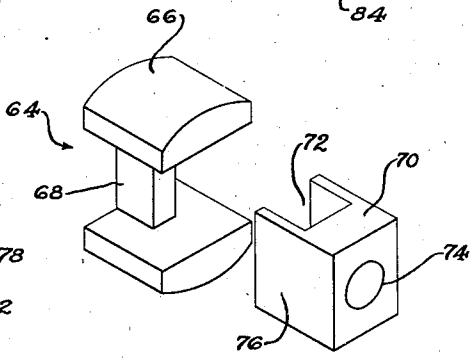


Fig. 6

Witness
Paul F. Bryant

Inventor
Charles F. Waite
by Van Everen Fish
Hilduth Kary Attys

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UNITED STATES PATENT OFFICE

CHARLES F. WAITE, OF SOMERVILLE, MASSACHUSETTS, ASSIGNOR OF ONE-HALF TO ARCHIBALD W. JOHNSTON, OF BRIDGEPORT, CONNECTICUT

ROTARY PUMP

Application filed April 10, 1930. Serial No. 443,054.

The present invention relates to rotary pumps and more particularly to rotary pumps of the general types disclosed in my co-pending application Serial No. 432,061, filed February 28, 1930.

The object of the present invention is to provide improvements in rotary pumps with a particular view toward smoothness of operation.

With this object in view, the principal feature of the present invention comprises a rotary pump having a rotor, a piston reciprocating diametrically in the rotor, and eccentric positioning means for the piston, together with means whereby relative movement between the piston and the eccentric positioning means is availed of to complement the discharge of the piston. This complementary discharge is arranged to occur out of phase with the discharge brought about by the reciprocation of the piston, whereby an overlap of discharge effect is obtained, tending to smooth out any pulsations which might exist in the outlet.

Other features of the invention consist in certain novel features of construction, combinations and arrangement of parts hereinafter described and particularly defined in the claims.

In the accompanying drawing, Fig. 1 is a sectional end elevation of one form of pump according to the present invention; Fig. 2 is an end elevation of the pump shown in Fig. 1 with the end plate in place; Fig. 3 is a sectional side elevation of a modified and in some respects preferable form of pump; Fig. 4 is a section on line 4—4 of Fig. 3; Fig. 5 is a sectional view similar to Fig. 4 showing the parts in different position; and Fig. 6 is a detail view showing the arrangement of the piston and shuttle block.

The illustrated embodiment of the invention as shown in Figs. 1 and 2 comprises a casing 8 enclosing a cylindrical rotor 10 which is continuously driven by a shaft. The rotor has an outer cylindrical surface 12 which engages with the cylindrical surfaces 14 and 16 of the casing, and is counterbored to provide an inner cylindrical surface 18. The rotor is also provided with a diametrical parallel wall groove 19 to slidingly receive a piston 20. Upon rotation of the rotor, the piston is caused to reciprocate with relation to the rotor by eccentric positioning means comprising a parallel-sided shuttle block 24 which is slidingly received in a transverse groove 26 of the piston. The block has an opening to receive a pin 28 which is mounted eccentrically of the rotor axis.

The pump casing is provided with ports 32 and 34. For clockwise rotation of the rotor, the ports 32 and 34 are respectively inlet and outlet ports.

The construction thus far described is similar to that disclosed in my co-pending application Serial No. 424,208. According to the present invention, the walls of the rotor are provided with a series of radial openings indicated at 36 and 37. The chambers included between the ends of the shuttle block 24 and the internal surface 18 of the rotor undergo variations in volume, due to reciprocations of the shuttle block with respect to the piston, and these variations of volume are made use of to effect a discharge which is complementary to and out of phase with the main discharge of the piston 20. It will be seen from Fig. 1 that two of such internal chambers are provided, one of which is indicated at 38 and the other at 40. Upon rotation of the rotor in a clockwise direction from the position of Fig. 1, the chamber 38 will increase in volume and fluid will be drawn into it through the openings 36, whereas the chamber 40 will decrease in volume and the fluid contained therein will be forced outwardly through the openings 37. The chamber 38 will continue to increase in volume and the chamber 40 will decrease during 180° rotation of the rotor. The openings 36 and 37 are so disposed as to span the cylindrical surfaces 14 and 16 of the casing, so that immediately upon advancement from the indicated position, the leading suction opening 36 will draw fluid into the space 38 and the leading discharge opening 37 will have liquid forced out through it. During this operation, the piston 20 acts in its normal manner, as described in the co-pending application, giving a pumping stroke for each 180° rotation

of the rotor. The main and complementary pumping effects obtained by the piston 20 and by the changes in volume of the chambers 38 and 40 are out of phase by 90°. Therefore, the maximum complementary pumping effect occurs at a time when the main pumping effect is zero, and vice versa. Therefore, under the action of the combined pumping means, the pulsations are largely smoothed out and the discharge of the pump may be made practically uniform.

It will be seen that the overlapping discharges are obtained by the complementary reciprocations of the piston and the shuttle, which reciprocations take place along axes at right angles to each other. The piston reciprocates along the axis of the diametrical groove of the rotor, and the shuttle reciprocates in effect along the axis of the transverse groove of the piston.

The eccentric pin 28 may be fixed in position, but where it is necessary to vary the volume of discharge or to maintain a constant pressure under varying conditions, the adjustable eccentric described in my co-pending application Serial No. 432,061 is preferred. According to this construction, the end plate 42 of the casing is provided with a chamber 44 having a plunger 46 which carries the eccentric pin 28. The plunger is acted upon by a spring 50 to urge the pin into eccentric position. Two control openings 52 and 54 which are cored in the end plate connect respectively with the discharge and inlet of the pump. An increase of discharge pressure acts through the opening 52 to depress the plunger 46 and thus to move the pin 28 into a position more nearly concentric with the rotor, thereby reducing the discharge. The opening 54 is provided to bleed the space below the plunger 46 of any liquid which may leak past the plunger. It will be seen that the adjustable eccentric acts upon both the main and auxiliary pumping means in a similar manner. Thus, as the eccentric is moved towards its center position, the stroke of the piston 20 is decreased and moreover, the variations in the volumes of the internal chambers 38 and 40 are diminished. When the eccentric reaches a position concentric with the rotor, the piston 20 remains in its mid position and does not reciprocate in the rotor. Also, the spaces 38 and 40 are of equal volume and do not vary as the rotor rotates. In this condition, the rotor rotates idly without pumping any fluid. It will be noted that under such conditions, there is practically no agitation of the fluid.

The pump described above produces a marked improvement in the smoothness of discharge through the overlapping of the main and complementary discharges. Inasmuch as the complementary discharge, however, is less than the main discharge, pulsations may not be entirely avoided. A still further improvement in the smoothness of operation may be attained by the construction shown in Figs. 3 to 6, wherein pumping effects practically equal in magnitude but out of phase with each other are produced. In this construction, the casing 8 and end plate 42 are identical with those described above. The rotor 60 is similar to the rotor 10 except that it is not required to be counter-bored. The rotor is continuously driven by a shaft 61. A diametrical groove 62 having parallel walls is provided, as before. The piston 64 comprises an integral structure having two curved end pieces 66 connected by a web 68 of considerably less depth and width than the end pieces. The shuttle 70 is of the same length as the web 68 but is somewhat narrower than the piston. The shuttle is provided with an undercut groove 72 of greater width than the web 68, whereby the shuttle may fit over the web 68 but out of engagement therewith, so that a relative reciprocating movement between the piston and the shuttle may take place. The shuttle has an opening 74 to receive the eccentric pin 28. Each edge face 76 of the shuttle block has a pumping area substantially equal to the effective pumping area of each face of the piston. The rotor is provided with a plurality of radial openings 78. As shown in Fig. 3, a number of these openings may be arranged longitudinally of the rotor. As shown in Fig. 5, the internal chambers 82 and 84 between the shuttle and the rotor undergo variations in volume as the rotor rotates. In Fig. 4, the space 82 is reduced practically to zero and the space 84 is of maximum volume. In turning clockwise into the position of Fig. 5, the space 82 increases in volume, thereby sucking liquid from the inlet, and the space 84 diminishes in volume, thereby forcing liquid into the discharge. The stroke of the shuttle is measured by the combined width of the passages 82 and 84. For equal pumping effects, the stroke and effective area of the piston 60 and of the shuttle 70 are equal. By this construction, the overlapping of equal discharges which are half a stroke out of phase with each other produces a practically uniform pressure in the outlet.

Inasmuch as the internal space under the shuttle 70 may eventually become filled with liquid, the web 68 is made of reduced depth to provide a clearance space 86. As shown in Fig. 3, when the shuttle reciprocates with respect to the piston, the fluid which may be trapped in the groove 72 is free to flow over the web 68 from one side to the other thereof, without requiring excessive power to move it back and forth.

The eccentric 28 is shown in Fig. 3 as being of the automatically adjustable type, although it is to be understood that a fixed eccentric may be employed where continuous and uniform pumping is desired. It will be

seen, as in the case of the pump of Figs. 1 and 2, that the adjustable eccentric affords particular advantages in that it effectually controls both the main and complementary pumping actions. Thus, as the eccentric is moved toward the central position, both the piston and the shuttle are brought toward their middle or inactive positions.

Having thus described the invention, what is claimed is:

1. A rotary pump having, in combination, a rotor, a piston mounted for reciprocation in said rotor and provided with a groove, eccentric positioning means in said groove reciprocating with respect to the piston, passages in said rotor leading to an internal pumping chamber defined by surfaces of the rotor and said eccentric positioning means, whereby the reciprocation of said means relatively to the rotor surface produces a pumping effect complementary to the operation of the piston.

2. A rotary pump having, in combination, a rotor, a piston mounted for reciprocation in said rotor and provided with a transverse groove, a shuttle block received in the transverse groove, means for maintaining the shuttle block eccentrically of the rotor whereby rotation of the rotor causes pumping reciprocation of the piston relatively thereto and of the shuttle relatively to the piston, passages in said rotor leading to an internal pumping chamber defined by surfaces of the rotor and shuttle whereby the reciprocation of the shuttle relatively to the rotor surface produces a pumping effect complementary to the operation of the piston.

3. A rotary pump having, in combination, a rotor, a piston adapted to slide radially in said rotor, a shuttle adapted to slide radially in said piston, the directions of movement of the piston and shuttle being at right angles to each other, a pivot eccentrically maintained in the pump and carrying said shuttle, whereby rotation of the rotor causes reciprocation of the piston and shuttle relatively to each other and the rotor, an internal pumping chamber in said rotor defined by walls of the rotor and said shuttle whereby the reciprocation of the shuttle causes, by its movement relatively to the rotor wall, a pumping effect auxiliary to that of the piston.

4. A rotary pump having, in combination, a rotor having a diametric passage, a piston reciprocating in the passage and provided with a transverse groove, a shuttle block received in the transverse groove, means for pivoting the shuttle block eccentrically of the rotor whereby rotation of the rotor causes reciprocation of the piston relatively thereto and of the shuttle relatively to the piston, additional passages through said rotor leading into an internal pumping chamber defined by surfaces of the shuttle and rotor, whereby movement of the shuttle during rotation of the rotor produces a pumping effect complementary to and out of phase with the pumping effect of the piston.

5. A rotary pump having, in combination, a rotor, a piston mounted for reciprocation in said rotor and provided with a groove, eccentric positioning means in said groove reciprocating with respect to the piston, passages in said rotor externally spanning substantially the same arc as the piston and leading to an internal pumping chamber defined by surfaces of the rotor and said eccentric positioning means, whereby the reciprocation of said means relatively to the rotor surface produces a pumping effect complementary to the operation of the piston.

6. A rotary pump having, in combination, a rotor, a piston mounted for reciprocation in said rotor and provided with a transverse groove, a shuttle block received in the transverse groove, means for maintaining the shuttle block eccentrically of the rotor whereby rotation of the rotor causes pumping reciprocation of the piston relatively thereto and of the shuttle relatively to the piston, passages in said rotor externally spanning substantially the same arc as the piston and leading to an internal pumping chamber defined by surfaces of the rotor and shuttle whereby the reciprocation of the shuttle relatively to the rotor surface produces a pumping effect complementary to the operation of the piston.

7. A rotary pump having, in combination, a casing having inlet and outlet chambers and sealing surfaces between the chambers, a rotor having a diametrical opening, a piston reciprocating in said opening and having a transverse groove, a shuttle block in the groove of the piston, means for maintaining the shuttle block eccentrically of the rotor, whereby the rotation of the rotor causes pumping reciprocation of the piston relatively thereto and of the shuttle relatively to the piston, the internal surfaces of the rotor and the shuttle forming chambers of variable volume, and the rotor having passages leading from said chambers and displaced from the transverse groove and externally spanning substantially the same arc as the piston.

8. A rotary pump having, in combination, a rotor, a piston mounted for reciprocation in said rotor and provided with a transverse groove, a shuttle block received in the transverse groove, means for maintaining the shuttle block eccentrically of the rotor whereby rotation of the rotor causes pumping reciprocation of the piston relatively thereto and of the shuttle relatively to the piston, passages in said rotor leading to an internal pumping chamber defined by surfaces of the rotor and the shuttle and piston, whereby the reciprocation of the shuttle relatively to the rotor surface and the piston produces a pumping effect complementary to the operation of the piston.

9. A rotary pump having, in combination, a rotor having a diametric passage, a piston reciprocating in the passage and provided with a transverse groove, a shuttle block received in the transverse groove, means for pivoting the shuttle block eccentrically of the rotor whereby rotation of the rotor causes reciprocation of the piston relatively thereto and of the shuttle relatively to the piston, additional passages in said rotor leading to an internal pumping chamber defined by surfaces of the shuttle and rotor and piston, whereby movement of the shuttle during rotation of the rotor produces a pumping effect complementary to and out of phase with the pumping action of the piston.

10. A rotary pump having, in combination, a rotor having a diametric passage, a piston reciprocating in the passage and provided with a transverse groove, a shuttle block received in the transverse groove, means for pivoting the shuttle block eccentrically of the rotor whereby rotation of the rotor causes reciprocation of the piston relatively thereto and of the shuttle relatively to the piston, the reciprocation of said shuttle relatively to the piston being limited by the walls of the rotor defining the diametric passage, additional passages through said rotor leading into the internal pumping chamber defined by the surfaces of the shuttle and rotor and piston, whereby movement of the shuttle during rotation of the rotor produces a pumping effect complementary to and out of phase with the pumping effect of the piston.

11. A rotary pump having, in combination, a rotor, a piston mounted for reciprocation in said rotor and provided with a transverse groove, a shuttle block received in the transverse groove, means for maintaining the shuttle block eccentrically of the rotor whereby rotation of the rotor causes pumping reciprocation of the piston relatively thereto and of the shuttle relatively to the piston, passages in said rotor leading to an internal pumping chamber defined by surfaces of the rotor and shuttle whereby the reciprocation of the shuttle relatively to the rotor surface produces a pumping effect complementary to the operation of the piston, and means for adjusting the eccentricity of said shuttle block to control both the main and complementary pumping effects.

12. A rotary pump having, in combination, a rotor, a piston mounted for reciprocation in said rotor and provided with a groove, eccentric positioning means in said groove reciprocating with respect to the piston, passages in said rotor leading to an internal pumping chamber defined by surfaces of the rotor, and said eccentric positioning means, whereby the reciprocation of said means relatively to the rotor surface produces a pumping effect complementary to the operation of the piston, and means for adjusting the eccentricity of said positioning means to control both the main and complementary pumping effects.

13. A rotary pump having, in combination, a rotor, a piston mounted for reciprocation in said rotor and provided with a groove, eccentric positioning means in said groove reciprocating with respect to the piston, passages in said rotor leading to an internal pumping chamber defined by surfaces of the rotor, and said eccentric positioning means, whereby the reciprocation of said means relatively to the rotor surface produces a pumping effect complementary to the operation of the piston, and means controlled by the discharge pressure to vary the eccentricity of the positioning means and thereby simultaneously to control both pumping effects.

14. A rotary pump having, in combination, a rotor, a piston mounted for reciprocation in said rotor and provided with a transverse groove, a shuttle block received in the transverse groove, means for maintaining the shuttle block eccentrically of the rotor whereby rotation of the rotor causes pumping reciprocation of the piston relatively thereto and of the shuttle relatively to the piston, passages in said rotor leading to an internal pumping chamber defined by surfaces of the rotor and shuttle whereby the reciprocation of the shuttle relatively to the rotor surface produces a pumping effect complementary to the operation of the piston, and means controlled by the discharge pressure to vary the eccentricity of said shuttle block and thereby simultaneously to control both pumping effects.

In testimony whereof I have signed my name to this specification.

CHARLES F. WAITE.