

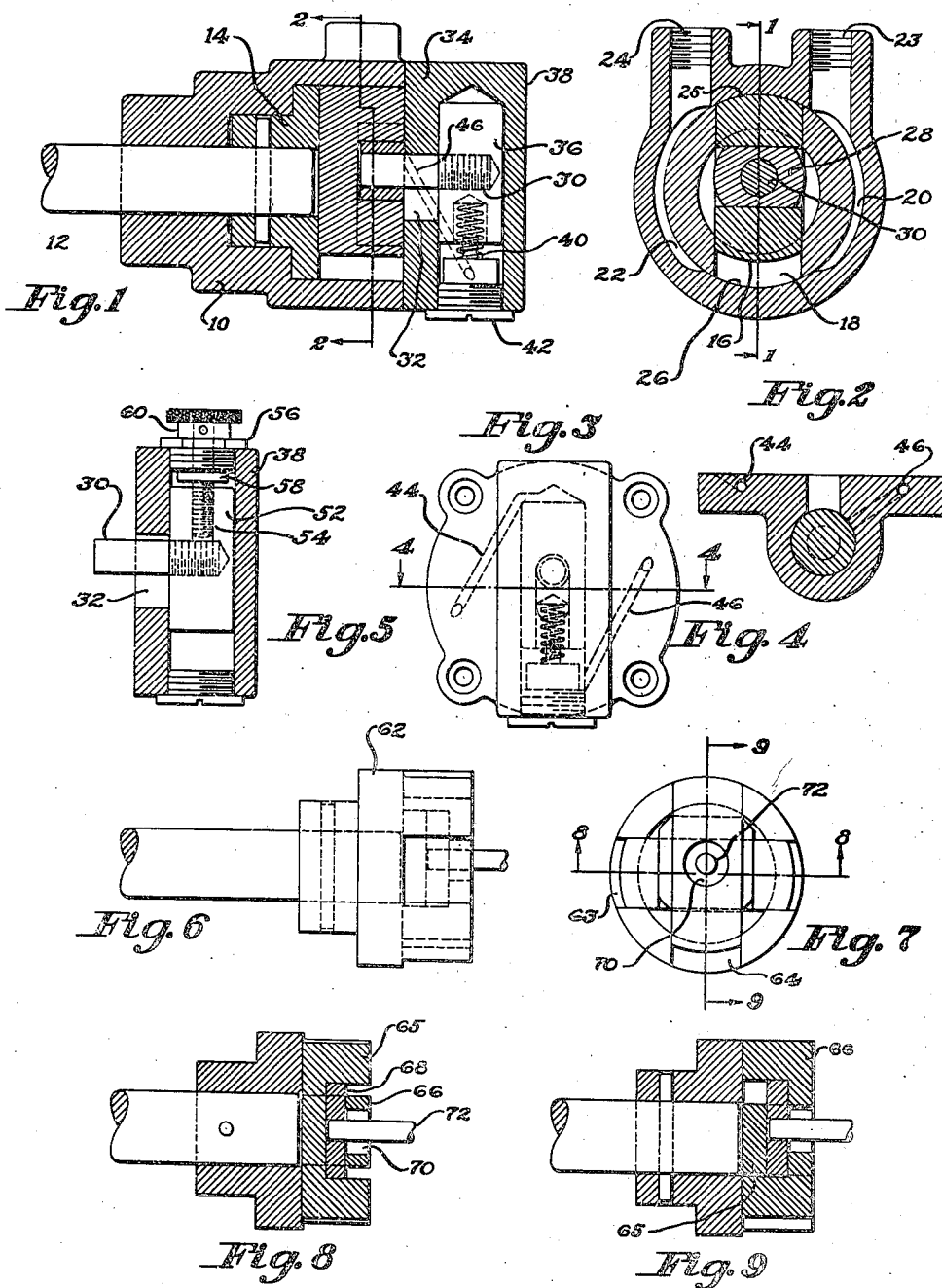
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ROTARY PUMP

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ROTARY PUMP

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The present invention relates to rotary pumps.

The objects of the present invention are to provide improvements in rotary pumps with a particular view to obtaining adjustment or automatic control of flow under varying conditions and also to provide a rotary pump capable of producing smooth and non-pulsating flow of liquid under all conditions.

With these and other objects in view, as will hereinafter appear, one feature of the invention comprises the combination with a rotary cylinder, a reciprocating piston and eccentric positioning means for the piston, of a support for the eccentric means which can be adjusted to any desired position to control the rate or direction of flow of the fluid. In the preferred form of the invention, employed under conditions of varying pressure or speed, the eccentric support is spring mounted to float to a position determined by the discharge pressure. This feature not only permits automatic control of flow in accordance with the pressure, but also affords means whereby the pump is rendered inactive when the discharge pressure rises to an excessive value, as when the discharge is blocked. The pump is then permitted to idle but without causing undue agitation of the fluid remaining in the pump, such as may occur in the usual by-pass safety valve ordinarily employed in rotary pumps.

Another feature of the invention contemplates the use of a plurality of pistons working in a single cylinder and controlled to afford an overlap of power whereby the pump operates with greatly decreased vibration and improved smoothness of discharge.

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 elevation of one form of pump according to the present invention, being a section on line 1—1 of Fig. 2; Fig. 2 is a section on line 2—2 of Fig. 1; Fig. 3 is an end view of the casing; Fig. 4 is a section on line 4—4 of Fig. 3; Fig. 5 is a sectional view of a modified form of positioning means; Fig. 6 is a side elevation of a modified form of the invention employing a double piston; Fig. 7 is an end view of the construction shown in Fig. 6; Fig. 8 is a section on line 8—8 of Fig. 7; and Fig. 9 is a section on line 9—9 of Fig. 7.

The pump shown in Figs. 1 and 2 comprises a casing 10, a shaft 12, a rotor or cylinder 14 pinned to the shaft, and a piston 16 slidably received in a diametrical groove 18 of the rotor. The casing

is formed with inlet and discharge chambers 20 and 22 connecting respectively with inlet and discharge ports 23 and 24. Between the chambers 20 and 22, the casing is formed with sealing surfaces 25 and 26, which are continuously engaged by the cylindrical surface of the rotor. The rotor is continuously rotated by the shaft 12 and the piston is reciprocated with respect to the rotor by means of an eccentrically mounted shuttle or block 28 slidably received in a transverse groove of the piston. The parts thus far described are similar to those described in my co-pending application Serial No. 424,208, filed January 29, 1930.

The shuttle 28 is mounted for free rotation on an eccentric pin 30 which passes through a slot 32 in the end plate 34 of the casing. The eccentric pin 30 is secured to a control piston 36 which is slidably received in a housing or cylinder 38 formed integrally with the end plate and having its axis parallel to the center line connecting the sealing surfaces 23 and 24 of the casing. The control piston 36 is bored at one end to receive a coil spring 40 which bears against a nut 42 threaded into one end of the housing 38. The spring holds the pin in an eccentric position.

To control the eccentricity of the pin, a pressure passage 44 is cored in the end plate. This passage runs from the discharge chamber 22 to the top of the housing 38 immediately above the piston 36. By this means, a variation in pressure acts directly on the piston 36 to vary the eccentricity of the pin and to vary the stroke of the piston, thereby restoring the discharge pressure to its normal value. Inasmuch as leakage may occur around the piston 36, a bleeding passage 46 cored in the end plate runs from the lower end of the housing 38 to the inlet chamber 20. The suction of the pump keeps the spring end of the housing drained, so that the pressure cannot build up under the piston 36 to resist the action of the fluid pressure on the opposite end.

In normal operation, the rotor is rotated by the shaft 12. The piston, through the action of the eccentric shuttle, is caused to reciprocate in the cylinder and thereby to pump liquid from the inlet chamber to the discharge chamber of the casing. The stroke of the piston, and hence the pressure and volume of fluid handled by the pump, are determined by the length of the slot 32. If an excessive pressure builds up, the control piston is forced by the fluid pressure to a more nearly concentric position. If, for ex-

ample, the discharge should become blocked, the pressure will force the pin to a practically concentric position, the pump piston will then assume a halfway position and will rotate idly in the chamber without reciprocating. The spring thus affords a convenient means for varying the quantity of flow under varying discharge pressure conditions. The sensitivity of the pump to varying pressure conditions may be varied by changing the size of the spring or by adjusting the nut 42 to different positions. The spring is of a strength such as just to balance, under normal running conditions, the forces applied to the control piston by the fluid pressure at one end and the suction at the other end.

It will be seen that under conditions of blocked discharge, wherein the pump rotates idly, there is practically no agitation of the fluid which remains in the pump, an important feature when pumping materials which are likely to froth or to separate under mechanical agitation.

Where conditions of varying pressure are not met with, an adjustable fixed eccentric may be employed, as shown in Fig. 5. In this construction, the eccentric pin 30 is mounted in an adjustable piston 52 which is similar in general construction to the control piston 36 previously described, except that no provision is made for reception of a spring. The piston 52 is adjustable in the housing 38 of the end plate by means of a threaded screw 54 received in a threaded bore of the piston. The screw 54 passes through a nut 56 which is received in the end of the housing. The screw has a shoulder 58 bearing on the inside of the nut and has secured to it externally a collar 60. By turning the screw 54 in or out, the eccentric may be adjusted to any desired position. With this means, the eccentric can be adjusted to either side of the center position, so that the pump may operate to pump fluid in either direction with the same direction of rotation of the rotor.

In order to provide a greater smoothness of flow than is possible with a single piston rotary pump, the construction shown in Figs. 6 to 9 is useful. This construction comprises a rotor 62 of the same general form as the rotor of the pump described above, except that it is provided with two intersecting diametrical grooves 63 and 64 to receive two interlocking pistons which have their center lines intersecting at the axis of the rotor. The casing and end plate of the pump are identical with those employed in the single piston pump and are not shown in these figures. The two pistons 65 and 66 are of rectangular cross-section and each has a central transverse groove to accommodate a shuttle 68. The width of each transverse groove and of the shuttle is necessarily somewhat greater than the width of each piston to allow for the compound sliding movements of the two pistons. The shuttle 68 comprises a square block which is of greater width than the width of either piston by an amount at least as great as the length of the stroke. As shown in Fig. 6, the shuttle has its corners beveled to permit them to clear the inner walls of the rotor. As shown in Figs. 7 and 8, the pistons are placed across each other with their transverse grooves registering and enclosing the shuttle. The outer piston 66 is provided with an opening 70 to permit the eccentric pin 72 to pass therethrough and to be received in the shuttle block. The opening 70 is of such a size as to permit reciprocation of both pistons without causing the walls of the outer piston to press

on the eccentric pin 72. The pin 72 may be mounted in fixed eccentric position with relation to the driving shaft or it may be mounted as shown in Figs. 1 and 2 in adjustable position.

In operation, each piston works independently of the other. As shown in Fig. 6, the outer piston 66 is in vertical position and is closing the upper cylindrical surface of the rotor, while the inner piston 65 is in its 90° or halfway position. Upon turning the rotor through an angle of 90°, 10 the former piston will turn into the halfway position, and the latter will assume the position now occupied by the former. Each piston therefore follows its own series of motions independently of the other and the two pistons succeed 15 each other at an angle of 90°. Each piston gives two pumping strokes during each revolution, making a total of four strokes for the combined pistons. Because of the overlap of pumping pressure by the double piston construction, pulsations 20 in the flow are effectively eliminated and the pump operates without vibration. For the same stroke as in the single piston stroke, the capacity is doubled but if only the same capacity is desired, the stroke may be halved, thereby conducing to simplification of construction and further smoothness of operation.

In any of the constructions above described, it will be seen that the pump has the advantage of continuous bearing over large surfaces wherever sliding contacts are made. Thus, the piston has a continuous bearing with the walls of the groove within which it slides, and the shuttle block has a continuous contact with the walls of the piston groove. This feature conduces to 35 quiet operation and long wear.

Having thus described the invention, what is claimed is:

1. A rotary pump having, in combination, a rotor provided with a diametrical opening, a piston slidingly received in the opening and having a transverse groove, a block received in the groove and having bearing surfaces in continuous contact with the walls of the groove, an eccentric pin on which the block is freely rotatable, a sliding mounting to carry the eccentric pin, means for adjusting the position of the sliding mounting to vary the stroke of the piston to vary the fluid volume from zero to maximum, and means connecting said adjustment means 50 for positioning by the differential of the discharge and intake pressures of said pump.

2. A rotary pump having, in combination, a rotor provided with a diametrical opening, a piston slidingly received in the opening and having a transverse groove, a block received in the groove and having bearing surfaces in continuous contact with the walls of the groove, an eccentric pin on which the block is freely rotatable, a floating support for the pin, a spring pressing on the support to position the pin and means connecting said support means for positioning by the differential of the discharge and intake pressures of said pump in opposition to said spring. 65

3. A rotary pump having, in combination, a rotor provided with a diametrical opening, a piston slidingly received in the opening and having a transverse groove, a block received in the groove and having bearing surfaces in continuous contact with the walls of the groove, an eccentric pin on which the block is freely rotatable, a floating support for the pin, a spring pressing on the support to position the pin, an adjustable stop for the support to determine the 75

maximum eccentricity of the pin and the maximum stroke of the piston to vary the fluid volume from zero to maximum, and means connecting said adjustment means for positioning by the differential of the discharge and intake pressures of said pump.

4. A rotary pump having, in combination, a rotor provided with a diametrical opening, a concentric shaft for the rotor, a piston slidably received in the opening and having a transverse groove, eccentric positioning means including a shuttle block received in the groove, a pivot for the block, a sliding mounting for the pivot to permit variations of stroke of the piston, and means controlled by the differentials of the discharge and intake pressures for positioning the eccentric means.

5. A rotary pump having, in combination, a casing having suction and discharge chambers, a rotor, a pumping means in the rotor, an eccentric pivot engaging the piston, an automatic sliding control piston to which the pivot is secured for exclusively adjusting said pumping means from zero to full capacity, a housing for the control piston, a connection from the discharge chamber to the housing to apply the discharge pressure to one end of the control piston tending to move the pivot to a position concentric with the rotor, a spring acting on the opposite end control piston and yieldingly resisting the movement thereof, and means for bleeding the housing of fluid which leaks past the control piston.

6. A rotary pump having, in combination, a casing having suction and discharge chambers, a rotor, a pumping means in the rotor, an eccentric pivot engaging the piston, an automatic sliding control piston to which the pivot is secured for exclusively adjusting said pumping means from zero to full capacity, a housing for the control piston, a connection from the discharge chamber to the housing to apply the discharge pressure to one end of the control piston tending to move the pivot to a position concentric with the rotor, a spring acting on the opposite end of the control piston and yieldingly resisting the movement thereof, and a bleeding connection from the suction chamber to the housing at the spring end of the control piston.

7. A rotary pump having, in combination, a casing having suction and discharge chambers, a rotor, pumping means reciprocating piston in the rotor, an eccentric pivot engaging the piston, an automatic sliding control piston for exclusively adjusting said pumping means from zero to full capacity, a housing for the control piston, the casing and housing having passages connecting the suction and discharge chambers respectively with opposite ends of the control piston, and a spring acting on the piston to press the latter against the movement tended to be imparted thereto by the fluid pressure applied thereto.

8. A rotary pump having in combination, intake and discharge ports, a rotor, a piston mounted for pumping reciprocation in said rotor, automatically adjustable eccentric positioning means for said piston adapted to determine the pumping capacity of said piston from zero to full capacity by varying its degree of reciprocation relatively to the rotor, resilient means normally urging said eccentric positioning means to an extreme eccentric position corresponding to full pumping capacity, an independent pressure passage in the pump between said eccentric posi-

tioning means and the discharge outlet, a second passage between said positioning means and said intake port, whereby the differential of the discharge pressure induced by the pump relatively to its intake pressure will tend continuously to urge said eccentric means to a non-eccentric and non-pumping position, the said resilient means and the said differential pressure being thus exclusively effective through said eccentric positioning means to control the pumping capacity of said pump.

9. A rotary pump having in combination, intake and discharge ports, a rotor, pumping means mounted for pumping movement in said rotor, adjustable positioning means for said pumping means adapted to determine the pumping effort of said means by varying the movement thereof, said positioning means being operable to vary the pumping volume between zero and full capacity, a spring adapted to press said positioning means into full pumping position, a fluid pressure control for said positioning means comprising a pressure passage between the discharge port of said pump and said positioning means and a second passage between said positioning means and the intake side of said pump, whereby the differential of the intake and discharge pressures will urge said positioning means against said spring to a non-pumping position, the said spring and the differential of the intake and discharge pressures being thus exclusively effective through said positioning means to control the pumping capacity of said pump.

10. A rotary pump having in combination, intake and discharge ports, a rotor, pumping means mounted for pumping movement relatively to said rotor, adjustable eccentric positioning means for said pumping means adapted to determine the pumping capacity of said pumping means by varying its degree of movement relatively to the rotor, said positioning means being operable to vary the pumping volume between zero and full capacity, a spring adapted to press said positioning means into full pumping position comprising a fluid pressure control for said positioning means, a pressure passage between the discharge port of said pump and said positioning means and a second passage between said positioning means and the intake side of said pump whereby the differential of the intake and discharge pressures will urge said positioning means against said spring to a non-pumping position, the said spring and the differential of the intake and discharge pressures being thus exclusively effective through said positioning means to control the pumping capacity of said pump, whereby said control means will be affected by the differential of the discharge and intake pressures of said pump for adjusting said positioning means in opposed relation to said spring means.

11. A rotary pump having in combination, intake and discharge ports, a rotor, pumping means mounted for pumping movement relatively to said rotor, adjustable positioning means for said pumping means adapted to determine the pumping capacity of said pumping means by varying the degree of movement thereof relatively to the rotor, said positioning means being operable to vary the pumping volume between zero and full capacity, a spring adapted to press said positioning means into full pumping position comprising a fluid pressure control for said positioning means, a pressure passage between the discharge port of said pump and said positioning means and a second passage between said positioning means and

and the intake side of said pump whereby the differential of the intake and discharge pressures will urge said positioning means against said spring to a non-pumping position, the said spring and the differential of the intake and discharge pressures being thus exclusively effective through said positioning means to control the pumping capacity of said pump, whereby said control means will be affected by the differential of the discharge and intake pressures of said pump for adjusting said positioning means in opposed relation to said spring means.

12. A rotary pump having in combination, a rotor, pumping means mounted for pumping movement relatively to said rotor, adjustable positioning means for said pumping means adapted to determine the pumping capacity of said pumping means by varying the degree of movement relatively to the rotor, said positioning means being operable to vary the pumping volume between zero and full capacity, spring means adapted to urge said positioning means in a full pumping direction, means connecting said positioning means for operation by the differential of the discharge and intake pressures of said pump in a direction opposite the pressure of said spring, the said spring means and the differential of the intake and discharge pressures being thus exclusively effective through said positioning means to control the pumping capacity of said pump.

13. A rotary pump having in combination, intake and discharge ports, a rotor, pumping means mounted for pumping movement in said rotor, adjustable positioning means for said pumping means adapted to determine the pumping effort of said means by varying the movement thereof, said positioning means being operable to vary the pumping volume from zero to full capacity, spring means adapted to press said positioning means into full pumping position, a fluid pressure control for adjusting said positioning means in opposed relation to said spring pressure to decrease the pumping capacity as the pressure is increased and comprising a pressure passage between the discharge port of said pump and said positioning means and a second passage between the intake side of said pump and said positioning means, whereby the differential of the intake and discharge pressures will urge said positioning means, whereby the differential of the pumping position, the said spring and the differential of the intake and discharge pressures

being thus exclusively effective through said positioning means to control the pumping capacity of said pump.

14. A rotary pump having, in combination, a rotor provided with a diametrical opening, a piston slidingly received in the opening and adapted to reciprocate relatively to said rotor to contribute a pumping action, an eccentric pin for determining and varying the throw of said piston as said rotor rotates whereby to vary the pumping volume, a floating support for the pin, a spring pressing on the support to position the pin, and means connecting said support means for positioning also by the differential of the discharge and intake pressures of said pump.

15. A rotary pump having, in combination, a casing having suction and discharge chambers, a rotor, an adjustable pumping member in said rotor, means for adjusting said pumping member to vary its pumping capacity from zero to full capacity, a sliding control piston by which said adjusting means are operated, a housing for the control piston, the casing and housing having passages connecting the suction and discharge chambers respectively with opposite ends of the control piston, and a spring acting on the piston to press the latter against the movement tended to be imparted thereto by the fluid pressure applied thereto.

16. A rotary pump having in combination, intake and discharge ports, a pump body member, pumping means mounted for pumping movement relatively to said pump body member, automatic adjustable positioning means for said pumping means adapted exclusively to determine the pumping capacity of said pumping means from zero to full volume by varying the degree of movement thereof relatively to the pump body member, a spring of predetermined tension adapted to press said positioning means into one extreme position corresponding to full pumping, and means connecting said positioning means for operation by the differential of the discharge and intake pressures of said pump into an opposite extreme position corresponding to zero pumping by said pumping means, the relation between the spring tension and the possible differential pressure which may be developed by said pump being such that the said differential pressure may move said positioning means against the spring into a position corresponding to zero pumping.

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