

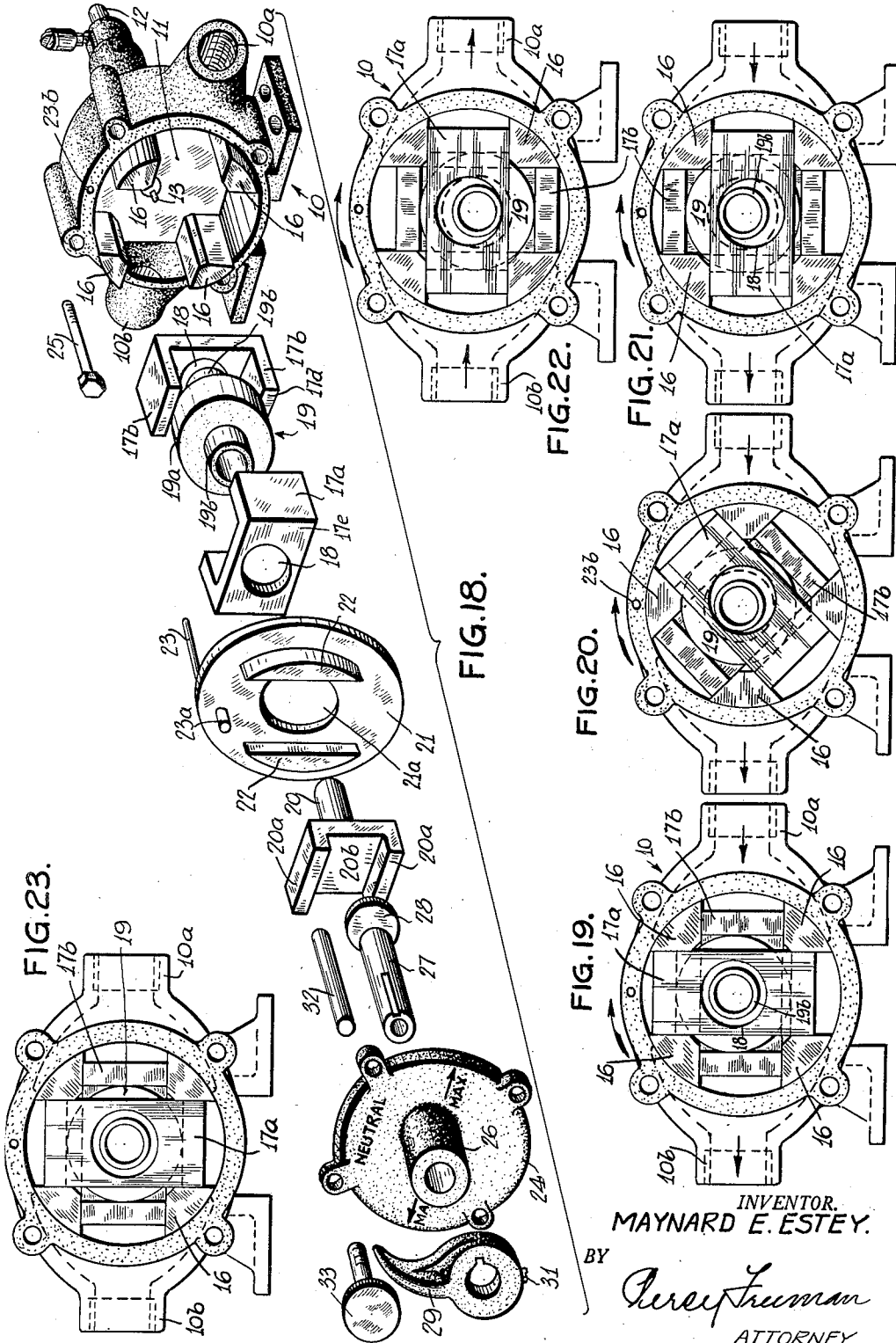
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ROTARY PUMP OR MOTOR

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ROTARY PUMP OR MOTOR

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This invention relates to rotary pumps and, more particularly, to rotary pumps having a unidirectionally rotating drive shaft, variable displacement, variable capacity and identical, interchangeable pistons having equal displacements.

Among the objects of the invention is the provision of a pump which is rugged and simple in operation having a minimum number of parts which may be readily disassembled, cleaned and reassembled; which may be readily adjusted for variable capacity at any time during its operation by the manipulation of an external control arm; which may have its direction of flow reversed by the same control arm which serves to vary the capacity of the pump; and which is designed and constructed in such a manner as to be successfully employed for pumping viscous materials and even liquids containing solid matter suspended therein.

In order to attain the foregoing objects, the invention contemplates the provision of a pump casing or housing having intake and discharge ports disposed on diametrically opposite sides thereof and communicating with a rotor chamber within which a unidirectionally driven rotor rotates. The rotor is preferably squared off to provide hydrostatic balance and is formed with forwardly projecting guides disposed peripherally and symmetrically to define a pair of channels for slidably retaining a pair of identical, interchangeable pistons or shuttles capable of both rotary motion and relative reciprocatory motion within said channels in paths normal to each other. The pistons or shuttles are preferably U-shaped, each having a pair of terminal lateral wings or extensions and said pistons are slidably retained normally one to the other within the mutually perpendicular channels defined by the rotor guide, the wings of one piston being disposed in inverted position with respect to the wings of the other piston and with a guide roller interposed between the pistons and operating on the wings of both pistons simultaneously. The roller is formed with a central portion having a diameter substantially equal to the distance between the inner surfaces of the wings of each piston and with a pair of side portions of reduced diameter, each reduced side portion of the roller being received within a central piston aperture of relatively large diameter to allow relative reciprocatory motion of the pistons. The guide roller is mounted upon a roller shaft which may be controlled eccentrically by means of an external control arm for varying the axis of rotation of the roller with respect to the axis

of rotation of the rotor drive shaft. Thus the position of the roller shaft and the axis of rotation of the roller may be varied from a maximum eccentric position with respect to the axial drive shaft to establish a substantially coaxial relationship when the control arm has been moved 90 degrees from its initial position. At the latter neutral position the axis of the roller coincides with the axis of rotation of the rotor and there will be no relative reciprocation of the pistons and consequently no pumping action. However, by continuing the movement of the control arm through another 90 degrees from the neutral position, or 180 degrees from the initial maximum pumping position, the axis of rotation of the roller will move again to a maximum eccentric position with respect to the axial drive shaft but in a direction diametrically opposed to the initial maximum eccentric position so as to reverse the pumping direction even though the drive shaft continues to rotate in the same direction.

Since the reciprocating pistons are identified and cause equal displacements during their combined rotary and reciprocatory motions and since also there is no continuously movable, eccentrically shaped element in the improved pump, the pump is exceedingly smooth-running and substantially free from vibration and pulsation.

The feature and further advantages of the invention will be readily understood in the course of the following detailed description taken in connection with the accompanying drawings which illustrate a preferred embodiment of the invention, and wherein:

Fig. 1 is a central vertical longitudinal sectional view of a pump embodying the features of the invention.

Fig. 2 is a transverse vertical sectional view taken substantially on line 2—2 of Fig. 1.

Fig. 3 is a detail view illustrating the operative engagement between the control sleeve eccentric and the square head of the roller shaft, the roller shaft being shown in neutral position.

Fig. 4 is a view similar to Fig. 3 but with the roller shaft raised upwardly to maximum eccentric position.

Fig. 5 is a front plan view of the pump in assembled condition.

Fig. 6 is a side elevation of the rotor.

Fig. 7 is a front elevation of the rotor.

Fig. 8 is a side elevation of one of the pistons or shuttles.

Fig. 9 is a front elevation of the piston or shuttle.

Fig. 10 is an elevational view of the roller which spaces apart and centers the axis of rotation of the pair of pistons.

Fig. 11 is a top plan view of one of the pistons showing one of the wings and the central aperture for the reception of one of the reduced side portions of the roller.

Fig. 12 is a side elevation of an auxiliary coverplate and guide member positioned intermediate the external end plate and the pump housing proper.

Fig. 13 is a front plan view of the member shown in Fig. 12.

Fig. 14 is a side elevation of the adjustable roller shaft upon which the roller is mounted.

Fig. 15 is a front elevation of the roller shaft of Fig. 14.

Fig. 16 is a side elevation of the eccentric control member for varying the eccentricity of the roller shaft with respect to the rotor drive shaft, the eccentric portion of said member being received within the grooved portion of the roller shaft of Fig. 14 and the free end of said member being keyed to the external control arm shown in Figs. 1, 5, and 18.

Fig. 17 is a rear view of the eccentric control member shown in Fig. 16.

Fig. 18 is an exploded perspective view of the pump components with the rotor fitted within its casing.

Fig. 19 is a transverse sectional view taken substantially along line 19—19 of Fig. 1 and illustrating the relative position of the pistons when the roller shaft is in its position of maximum eccentricity with respect to the axis of rotation of the rotor.

Fig. 20 is a view similar to Fig. 19 but with the rotor turned approximately 45 degrees in a clockwise direction from the position of Fig. 19.

Fig. 21 is a similar view indicating further movement of the rotor 45 degrees from the position of Fig. 20.

Fig. 22 is a transverse sectional view showing the roller shaft lowered to a position of maximum eccentricity in a direction diametrically opposed to the position of Figs. 1, 19, 20 and 21 to change of direction of flow without change of direction of rotation of the rotor.

Fig. 23 is a similar view showing the roller shaft in neutral position coaxial with the rotor shaft at which point relative reciprocation of the pistons will cease and the rotor will revolve idly without producing any pumping action.

The pump comprises a housing 10 which encloses a rotor 11 continuously driven by a drive shaft 12 extending axially through said housing. Housing 10 is formed with a pair of ports 10a and 10b disposed on diametrically opposite sides thereof, each of which may function alternately as intake and outlet as will appear hereinafter. In order to transmit motion to rotor 11 the shaft 12 may be secured thereto as by means of a key 13. The rotor 11 is preferably squared off, as clearly shown in Fig. 7, in order to achieve hydrostatic balance by allowing access of fluid back of the rotor to a sufficient extent to establish equalization of the pressure exerted thereupon. In order to augment this effect, if desired, a coil spring 14 may be interposed between the journal end of rotor 11 and a packing member 15, as shown in Fig. 1, to adapt the float back and forth axially to a limited extent and maintain the hydrostatic balance thereof.

Rotor 11 is further provided with forwardly extending guides 16 arranged peripherally and

symmetrically thereof to define a pair of mutually perpendicular channels within which a pair of pistons or shuttles 17a and 17b are slidably retained. Said pistons or shuttles are preferably U-shaped, being provided with a pair of terminal wings or extensions 17c to provide a greater and more efficient pumping area. The main body portion of each piston 17a and 17b is provided with a central aperture 18 for a purpose to be fully indicated hereinafter.

Pistons 17a and 17b are mounted in crossed, mutually opposed relation between the rotor guides 16, and are maintained in spaced apart relationship by a guide roller 19. As clearly shown in Fig. 10, said guide roller is provided with a central cylindrical portion 19a having a diameter substantially equal to the distance between the inner faces of the wings 17c of each piston 17a and 17b and a pair of reduced side portions 19b of a diameter less than the diameter of the central piston aperture 18. Thus the central cylindrical portion 19b of guide roller 19 operates simultaneously on the wings 17c of both pistons 17a and 17b while the reduced side portions 19b, being of smaller diameter than the piston apertures 18, allow relative reciprocatory motion of said pistons as rotor 11 revolves, as will be more fully described hereinbelow. It will be noted that the pair of pistons 17a and 17b are identical, interchangeable and have equal displacements.

Guide roller 19 is mounted upon a guide roller shaft 20 and provision is made for varying the eccentricity of said roller shaft with respect to the axis of the rotor drive shaft 12 in order both to vary the capacity of the pump and to reverse the direction of flow. A preferred arrangement for varying the eccentricity of roller shaft 20 and therefore the axis of rotation of the relatively reciprocable pistons 17a and 17b with respect to the axis of rotor drive shaft 12 is illustrated in the drawings and will now be described.

A combined coverplate and guide member 21 may be employed, said member preferably being provided with a raised inner face 21a against which the outer surface 17e of the outermost piston 17a and edges 18d of the inner piston 17b abuts. Member 21 is provided with a central aperture 21a of greater diameter than roller shaft 20 which extends therethrough, said roller shaft being formed at its forward end with an enlarged, substantially square head 20a, the rear of which is slidably engaged against the outer face of member 21, as shown in Fig. 1. The side edges of head 20a are slidably retained between a pair of integral guiding elements 22 formed on member 21 so that roller shaft 20 is movable in a linear vertical path. Member 21 may be properly located by means of a locating or centering pin 23 insertable within a suitably disposed hole 23b in housing 10 and an additional pin 23a may be received within a suitably disposed hole in endplate 24.

Endplate 24 may be secured to the housing 10 over coverplate member 21 as by means of bolts 25. Said endplate is provided with an integral central bearing member 26 within which is rotatably mounted a control sleeve 27 carrying an eccentric 28 at its inner end and a control arm 29 at its outer end, the sleeve being secured to said control arm as by means of a key 30, a set-screw 31 or the like. Eccentric 28 is operatively connected with head portion 20a of roller shaft 20 so that rotation of control arm 29 will raise or lower said roller shaft 20. Operative connection

between said eccentric and said roller shaft 20 may be conveniently achieved by grooving roller shaft head 20a, as shown most clearly at 20b in Figs. 14, 15 and 18, the eccentric 28 being received within said grooved portion 20b.

Means are further provided for fixing roller shaft 20 in any given adjusted position of eccentricity with respect to axial rotor drive shaft 12. This means may conveniently take the form of a plunger 32 having a sliding fit within control sleeve 27 and adapted to be urged against grooved portion 20b of roller shaft 20, as by means of an adjustment screw 33 threaded into the outer end of said control sleeve 27. Thus, after control arm 29 has been rotated to any given position for a corresponding adjustment of the eccentricity of roller shaft 29, screw 33 is advanced to tightly urge plunger 32 against roller shaft head 20a. The inward thrust of roller shaft head 20a is exerted against a respective portion of plate member 21 to firmly fix the roller shaft 20 in adjusted position, without in any way interfering with the free rotation of rotor 11 at the inner end of said roller shaft.

The operation of the pump will be readily understood taking the positions of Fig. 1 and Figs. 19 to 21 as the reference position, i. e. with roller shaft 20 at its maximum position of eccentricity above axial rotor drive shaft 12, control arm 29 being shown in raised vertical position in Fig. 1 merely for the sake of clarity.

Assuming the reference position of Fig. 1 and clockwise rotation of rotor 11 as viewed from the front (or control arm) side of the pump, ports 10a and 10b (see Fig. 5) are respectively intake and outlet ports. As rotor 11 revolves the pistons 17a and 17b will be caused to reciprocate relatively to each other in normal paths defined between the rotor guides 15. When roller shaft 20 is in its uppermost position, as shown in Fig. 1, of maximum eccentricity with respect to the axis of rotation of rotor 11, the displacement of pistons 17a and 17b will be greatest and the pump will operate at maximum capacity. In order to reduce the capacity of the pump, control arm 29 may be moved gradually in either a clockwise or counterclockwise direction to bring the axis of rotation of roller shaft 20 nearer the axis of rotation of rotor 11, thereby reducing the pump capacity by reducing the displacement of pistons 17a and 17b. When control arm 29 has been moved either clockwise or counterclockwise through 90 degrees the axis of roller shaft 20 will coincide with the axis of rotor drive shaft 12 (Figs. 3 and 23), at which point relative reciprocation of pistons 17a and 17b will cease and rotor 11 will revolve idly without producing any pumping action.

It will be remembered that when control arm 29 is in the position of Figs. 1 and 5 (with roller shaft 20 in its uppermost position of maximum eccentricity) (Figs. 4, 19 to 21) ports 10a and 10b are respectively intake and outlet ports. The direction of flow may be reversed without reversing the direction of rotation of rotor 11 by moving control arm 29 in either direction through 180 degrees from the reference position of Figs. 4 and 19 to 21 to correspond with "Max." position in Figs. 5 and 22. In this latter position roller shaft 20 will have been moved from its uppermost to its lowermost position of maximum eccentricity with respect to the axis of rotation of rotor 11 resulting in a reversal of symmetry and reversal of direction of flow so that ports 10a and 10b become outlet and intake ports respectively, (see Fig. 22). As before it will be understood that the capacity

of the pump may be reduced by adjusting the control arm 29 to any point between "Max." position and the "Neutral" positions indicated in Fig. 5 in a manner similar to that initially described above.

It is apparent, that as a result of the unique and novel construction of the pump a single control element, i. e. external control arm 29, may be employed for accomplishing two effects, firstly the reduction of capacity of the pump and secondly the reversal of flow without reversal of the rotor or drive shaft rotation.

Another feature of the invention is the provision of identical, interchangeable pistons 17a and 17b which cause equal displacements. This latter feature together with the absence of any continuously movable, eccentrically shaped member are at variance with conventional practice and cooperate to assure smooth-running performance of the pump and substantially eliminate undesirable vibration or pulsation.

It will be also noted upon reference to Fig. 1 that even when the roller shaft 20 is in its position of maximum eccentricity with respect to the axis of rotation of rotor 11, clearance is provided between the top of upper piston wing 17c and the inner surface of housing 10. This arrangement enables the pump to be effectively employed for pumping not only viscous material but even liquids containing suspended matter therein without causing mechanical failure of the pump components. Moreover hydrostatic balance of the rotor 11 is accomplished, as has been previously indicated, by cutting or squaring off the back of the rotor and mounting it in such a manner that it may float back and forth axially to a limited extent.

Since certain modifications may be made in the pump of the invention without departing from the scope thereof, it is intended that all matter contained in the foregoing specification and shown in the accompanying drawings be interpreted merely as illustrative and not in a limiting sense.

What is claimed is:

1. A rotary pump comprising a housing having inlet and outlet ports, a rotor mounted for axial rotation within said housing and provided with a pair of diametrical, mutually perpendicular channels, a pair of identical, interchangeable pistons slidably retained within said channels for relative reciprocation in paths normal to each other, each of said pistons having a central aperture and a pair of laterally extending wings, said pistons being retained in crossed, mutually opposed relation, a roller spacing said pistons axially apart and simultaneously contacting the inner faces of the wings of both of said pistons, an end plate for said housing provided with an axial bearing member, a control sleeve rotatably mounted within said bearing member and terminating externally of said end plate in a control arm, an eccentric fixed to the inner end of said control sleeve, a roller shaft supporting said roller and having a diameter less than the diameter of the central aperture of each of said pistons, said eccentric being operatively connected with said roller shaft whereby to adjustably vary the eccentricity of said roller shaft with respect to the axis of rotation of said rotor.

2. A rotary pump in accordance with claim 1 having a plunger axially slidable within said control sleeve and an adjustable screw carried by the outer end of said sleeve and engageable against said plunger to urge said plunger against

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said roller shaft for retaining said roller shaft in a given eccentric position.

3. A rotary pump comprising a housing having inlet and outlet ports, a rotor mounted for axial rotation within said housing and provided with a pair of diametrical, mutually perpendicular channels, a pair of identical, interchangeable pistons slidably retained within said channels for relative reciprocation in paths normal to each other, each of said pistons having a central aperture and a pair of laterally extending wings, said pistons being retained in crossed, mutually opposed relation, a roller spacing said pistons axially apart and contacting the inner faces of the wings of both of said pistons, an endplate for said housing provided with an axial bearing member, a control sleeve rotatably mounted within said bearing member and terminating externally of said endplate in a control arm, an eccentric fixed to the inner end of said control sleeve, a cover plate interposed between said endplate and said housing and having a central aperture therein, said endplate being formed on its outer surface with a pair of guide elements defining a guide channel, and a roller shaft supporting said roller and having a diameter less than the diameter of the central apertures of each of said pistons and said coverplate, said head portion having a pair of guide flanges, said roller shaft terminating in a head portion slid-

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able within the guide channel of said coverplate, said eccentric being operatively received between the guide flanges of said roller shaft head portion whereby to adjustably vary the eccentricity of said roller shaft with respect to the axis of rotation of said rotor.

4. A rotary pump in accordance with claim 3 having a plunger axially slidable within said control sleeve and an adjustable screw carried by the outer end of said sleeve and engageable against said plunger to urge said plunger against said roller shaft for retaining said roller shaft in a given eccentric position.

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