Aug. 18, 1942. J. M. HALL 2,293,541

PUMP

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Fig. 1

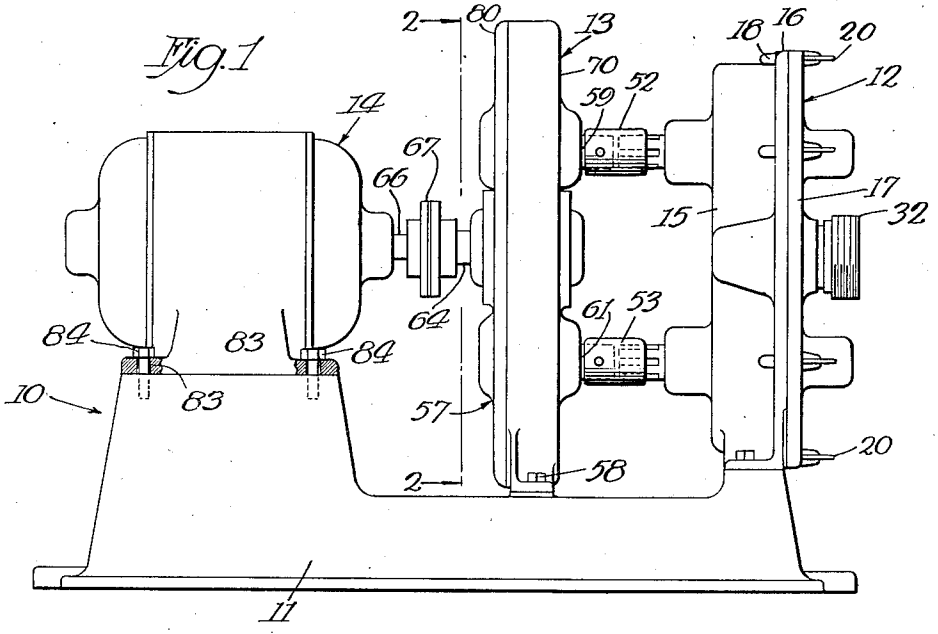


Fig. 2

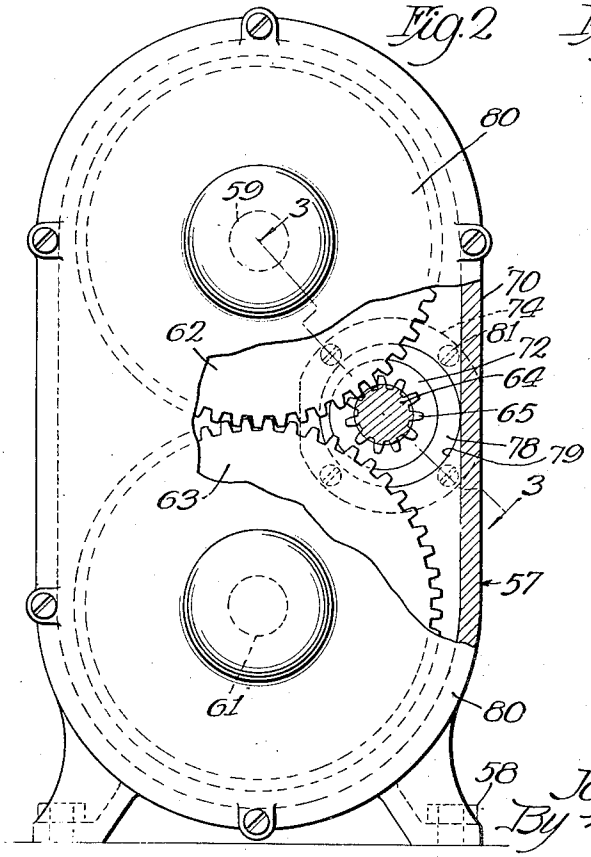


Fig. 3

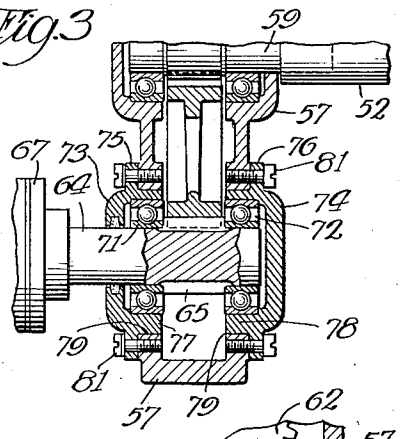
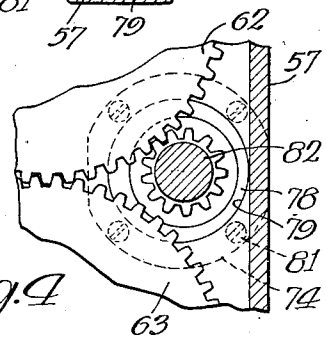


Fig. 4



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Fig. 5

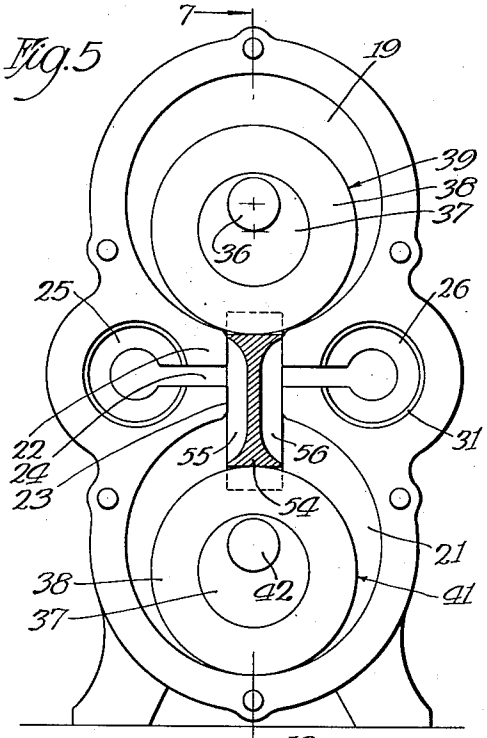


Fig. 6

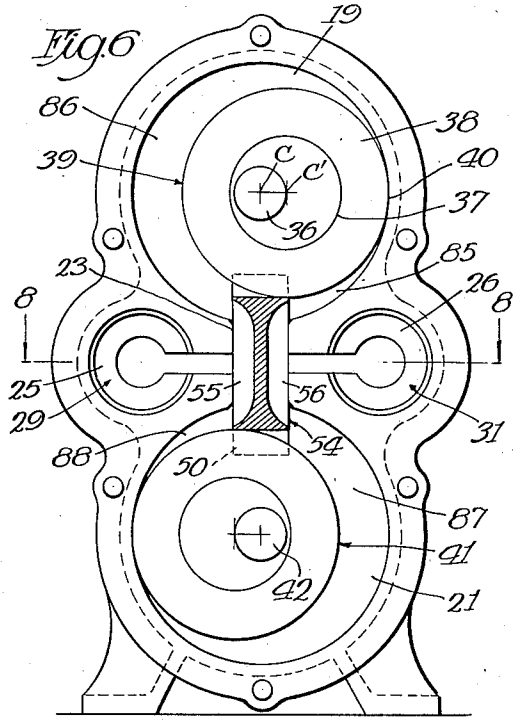


Fig. 7

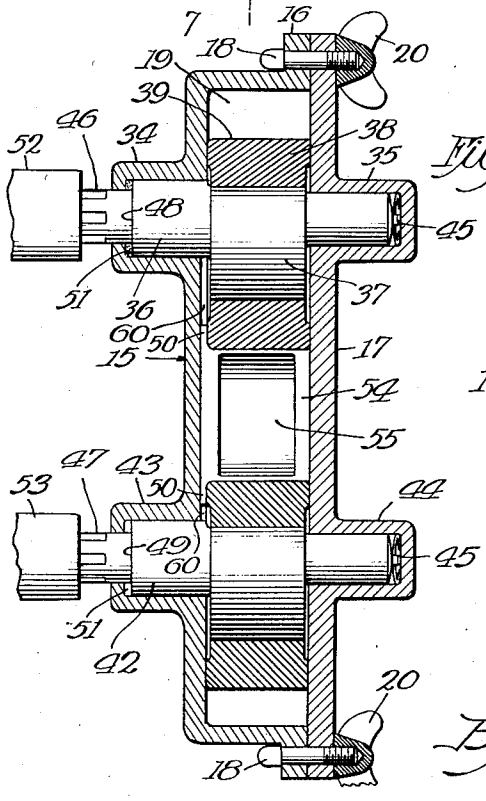
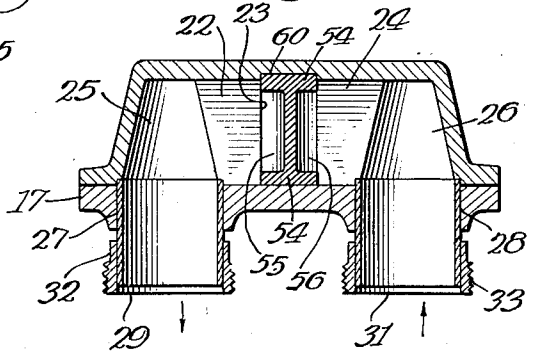


Fig. 8



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Fig. 9

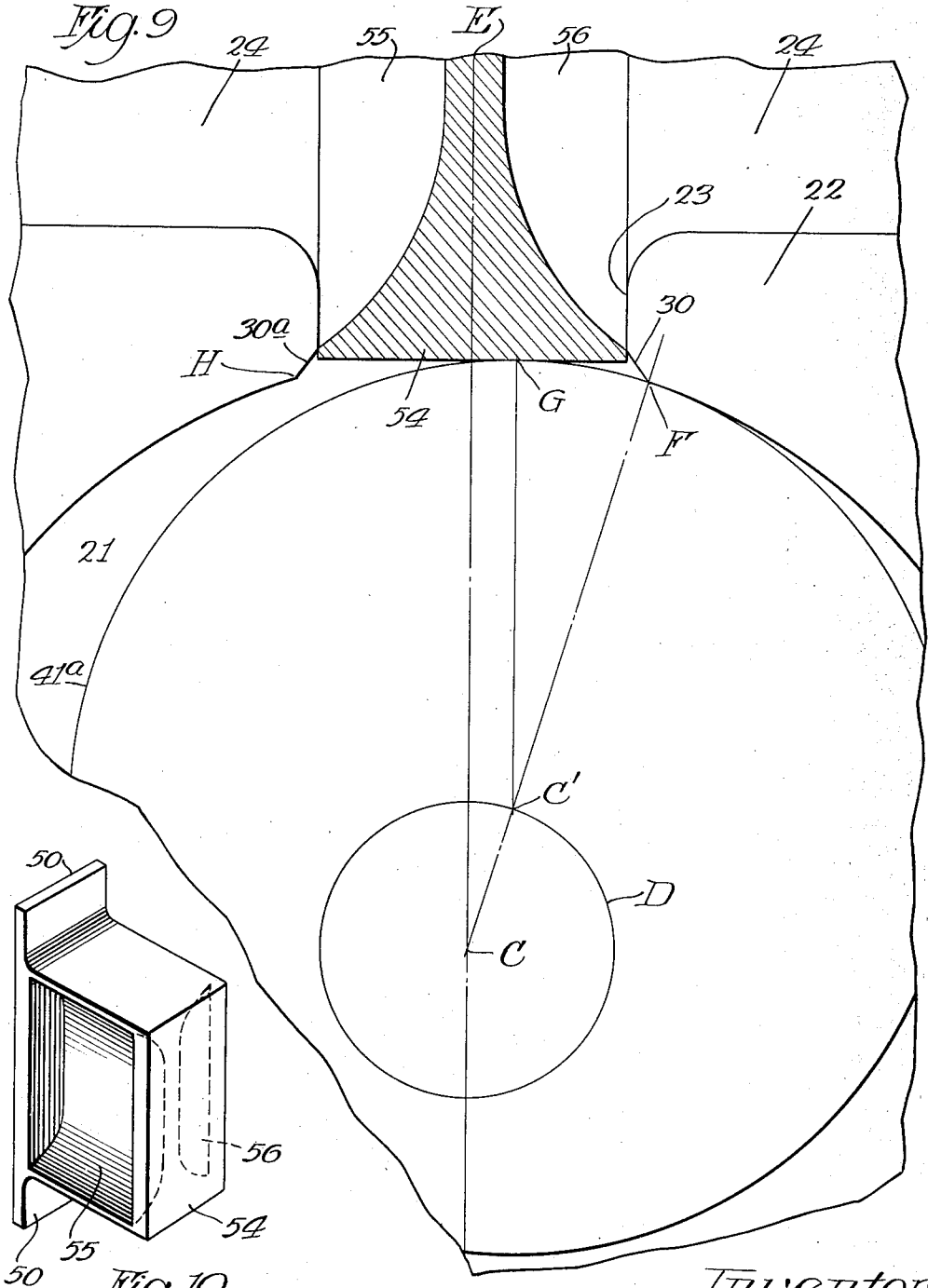


Fig. 10

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UNITED STATES PATENT OFFICE

2,293,541

PUMP

Joseph M. Hall, Chicago, Ill.

Application January 17, 1939, Serial No. 251,369

5 Claims. (Cl. 103—130)

This invention relates to pumps, and more particularly to pumps of the rotary type.

One of the objects of the invention is the provision of a new and improved rotary pump having novel means for insuring a continuous even flow of the pumped fluid during the pumping operation.

Another object of the invention is the provision of a new and improved multi-rotor pump having a novel vane or blade for separating the intake and discharge portions of the pump from each other.

A further object of the invention is the provision of a new and improved pump operating or power transmission mechanism whereby change in speed of rotors of the pump may be effected with a minimum expenditure of time and labor.

Another object of the invention is the provision of a new and improved apparatus having rotary cylinders that may be operated as a pump or motor, as desired; and that may be operated in either direction as occasion may require.

A still further object of the invention is the provision of a new and improved multi-rotor pump and operating mechanism that is simple in construction, easily assembled and disassembled, composed of few moving parts, comparatively inexpensive to manufacture and efficient in operation, and one in which there is a minimum of agitation of the pumped fluid during the pumping operation.

Other and further objects and advantages of the invention will appear from the following description, taken in connection with the accompanying drawings in which

Fig. 1 is a side elevation of the device;

Fig. 2 is a section along the line 2—2 of Fig. 1, with parts broken away;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a detailed sectional view showing the mechanism for changing the speed of the pump rotors;

Fig. 5 is a front elevation of the pump with a portion of the casing removed, the vane in vertical section, and showing the rotors in one position;

Fig. 6 is a view similar to Fig. 5, but showing the rotors in position at right angles from that shown in Fig. 5;

Fig. 7 is a section on the line 7—7 of Fig. 5;

Fig. 8 is a section on the line 8—8 of Fig. 6;

Fig. 9 is a more or less diagrammatic view, on a relatively enlarged scale, of the arrangement shown in Fig. 6, in which the eccentric and annulus are integral and form the pump rotor; and

Fig. 10 is a perspective view of the valve member shown in Fig. 9.

The apparatus may be operated as a pump or as a motor, and the rotors may be turned in either direction when operating either as a pump or motor with equal facility and efficiency, as will presently appear.

Great difficulty has been experienced in the pumping of milk, in the concentrating and dehyrating or desiccating of the same, due to the fact that agitation tends to cause the constituent parts of milk to become disassociated. Especially is this true in the pumping of buttermilk with conventional pumps that greatly agitate the liquid. It requires but a relatively small amount of agitation to destroy this liquid emulsion. In order to avoid excessive agitation of buttermilk it is common practice to transfer the milk in buckets as occasion may require, rather than transfer the liquid by conventional pumps.

The present invention seeks to provide a pump in which the stirring and agitation of the milk is reduced to a minimum. The present pump has been found, in practice, to give excellent results in a smooth even flow of the fluid.

For simplicity in description the apparatus will be described as a pump, but it is understood that such description is not intended as words of limitation.

Referring now to the drawings, the reference character 10 designates the pumping mechanism, which comprises a base 11 on which is mounted a pump or apparatus 12, transmission or power transmission mechanism 13, and a motor 14 for operating the pump. The pump is of the rotary type, and is provided with two rotors or pistons that are in phase but are rotated positively in opposite directions and have common intake and discharge passages whereby the fluid is delivered in a steady stream and in an even flow, as will presently appear.

The pump 12 comprises a hollow casing 15, having an apertured flange 16 extending outwardly therefrom, to which the front plate 17 is adapted to be attached by bolts 18 having wing nuts 20 thereon. The casing 15 is provided with a pair of cylindrical recesses forming the pump cylinders 19 and 21 (Figs. 5 and 6). These cylinders are spaced apart, thus forming a partition 22 between them. In the construction shown the cylinder 19 is above the cylinder 21, but they may be arranged in a horizontal position, if desired.

The partition 22 has an opening in the form

of a transverse slot 23, extending from the bottom of the cylinders to the front of the casing, and having its longitudinal axis in the plane of the axes of the pump cylinders. Intake and discharge passages for the pumps are also formed in the partition 22. In the form of the construction shown, the partition 22 is provided with a horizontal slot 24 extending transversely of the casing on each side of, and in communication with, the vane slot 23, and terminating in openings 25, 26 (Figs. 5 and 8) extending transversely of the casing. The plate 17 is provided with openings 27, 28 (Fig. 8) opposite the openings 25, 26. The openings 27, 28, have secured therein, by a pressed fit, tubular members forming discharge and inlet passages 29 and 31 for the pump. On the outer end of each tube is secured the screw-threaded coupler members 32, 33, to which the discharge and intake tubes of the pump are connected. For the sake of clearness these tubes are not shown.

The casing 15 and plate 17 are provided with projections 34, 35, which are opposite each other and are provided with recesses forming bearings for a rotor shaft 36. Rigidly mounted on the rotor shaft 36, as by being integral therewith, is an eccentric 37 (Figs. 5, 6 and 7), which is circular in cross-section, and on this eccentric is mounted an annulus or annular member 38. The eccentric 37 and annular member 38 constitute the rotor or rotary piston 39 for the cylinder 19, and may be integral, as shown in Fig. 9, if desired, but are preferably in two parts, whereby the annulus may roll around the interior of the cylinder and thus reduce the friction between the piston and cylinder wall to a minimum. The parts are so constructed, or are of such dimensions, that the annular member 38 is at all times internally tangent to the inner periphery of the cylinder 19 at one line only, as indicated at 40 in Fig. 6 of the drawings.

In the form of construction selected to illustrate one embodiment of the invention, two pumps are employed, and these pumps, as shown, are of the same dimensions so that their combined discharge will remain uniform. The lower cylinder 21 is provided with a rotor or rotary piston 41, which is similar in structure to the rotary piston 39 described above. This piston is mounted on a shaft 42, which is journaled in projections 43, 44, of the casing 15 and plate 17, and since the construction is similar to that described above further detailed description appears to be unnecessary.

The forward ends of the shafts 36 and 42 are spaced from the bottom walls of the openings in the projections 35 and 44, and a spring member 45 is mounted in this space. The shafts 36 and 42 are provided on their inner or rear ends with reduced portions 46, 47, which form shoulders 48, 49, spaced from the bottom wall of the respective recess bearings or projections 34, 43. A gasket 51 is mounted between each shoulder and the bottom wall of the corresponding recess, and the spring 45 is adapted to hold the shaft against this gasket in order to form a liquid-tight joint at this point. The inner ends or reduced portions 46, 47, of the shafts 36 and 42 are slidably splined to sleeves 52 and 53 rigidly mounted on the driving shafts of the transmission mechanism 13 (Figs. 1 and 7). The construction is such that the pump shafts may be readily disengaged from the driving shafts by sliding the former forwardly.

Suitable means are provided for separating the intake from the exhaust of each of the two pumps. In the form of construction shown, a vane 54, operating in the slot 23, is employed for this purpose. This vane is provided with recesses 55, 56, on opposite sides thereof, each of the recesses terminating adjacent each end of the vane, as shown more clearly in Figs. 5 and 6. The extreme ends of the vane 54, as well as the side edges, are of maximum width and make a snug sliding fit in the slot 23, whereby when the vane is in its lowermost or uppermost positions the recesses 55 and 56 in the vane 54 are not in communication with the lower or upper cylinder, respectively. This vane is of such length and width that it is tangent to both pistons at all times during their rotation, whereby the intake and discharge passages of the two pumps are continuously separated by this vane in all positions of the pistons.

The length of the vane is such that during the rotation of the pistons or rotors both rotors will remain tangent to the vane during the entire rotation thereof. In order that this may be done it is necessary that the width of the vane be at least twice the eccentricity of the rotor or piston. For instance, if the axis of the shaft 36 in Fig. 6 be in the position designated by the reference character C on the drawings, and the position of the axis of the eccentric member 37 by the reference character C′, then the width of the vane should be at least twice the distance between C and C′. In practice it is made slightly wider than this in order to avoid extreme accuracy in its width.

This arrangement is shown on an enlarged scale, more or less diagrammatically in Fig. 9, in which the eccentric and annulus are integral and form the rotary piston 41*a* having its center or axis at C′ with the axis of the cylinder at C. The locus of the axis of the eccentric piston 41*a* is shown by the circle D in this figure. The line CE, which is the longitudinal axis C of the cylinder 21, is normal to the plane of the end faces of the valve 54. It will thus be seen by inspection that the valve 54 is slightly wider than twice the length of the radius of the circle D.

In order to reduce turbulence of the pumped fluid to a minimum, the corner edges of the defining walls of the slot 23 are beveled off as at 30, 30*a*. This will permit a free, smooth, streamline flow of the fluid into and out of the cylinder 21. In order to prevent premature opening of the valve 54, the parts are so constructed that the valve will not begin to open until the piston, which may be assumed to move clockwise, has reached a point where its tangency with the interior wall of the cylinder is just beyond the beveled surface 30 as at F in Fig. 9.

In all positions of the rotor, the adjacent end face of the valve is tangent thereto. It is evident that the point of tangency between the end surface of the valve 54 and the rotor may be ascertained by drawing a line CF from C, the center of the cylinder 21, through the point F, the internal tangency of the piston and cylinder wall and then from the point C′ where this line intercepts the locus or circle D, draw the radius CG of the piston parallel to the line EC. Then the point G is this point of tangency because the line C′G, the radius of the piston 41*a*, being parallel with EC, which is perpendicular to the lower face of the valve 54, is also perpendicular to this face, and since this face engages the piston surface, the point of contact must be at the

end G of the radius C'G and hence tangent at this point.

In the operation of the device, the valve 54 begins to open when the tangency of the piston and cylinder wall reaches the point F and continues to open until the point of tangency reaches the line EC extended. From that point on the valve gradually closes until just before the point of tangency reaches the beveled edge 30a as at H and remains closed while this point of tangency travels from the point H to F in Fig. 9.

The two pistons are in phase, that is, in the same relative position in the cylinders but are turning in opposite directions. Consequently, when one piston is tangent to the vane adjacent one face thereof, the other piston is tangent to the other end of the vane adjacent the opposite face. As a result of this arrangement, the discharge and intake will result in a uniform flow of the fluid, for when one reaches its maximum discharge, the other has reached its minimum, and as the discharge of one gradually reaches its maximum, the other gradually reaches its minimum in the same manner, and vice versa, thus insuring a steady, even flow. The same is also true of the intake flow of the two pumps.

The pressure of the fluid on the discharge side of each pump tends to displace the end of the vane extending beyond the end of the partition. This thrust is compensated for by providing extensions 50 on one or both side walls of the vane, which are adapted to slide in corresponding grooves 60 in the end walls of the cylinders. In the construction shown, only one groove is employed, the plate 17 being free from any groove, thereby lessening the labor required in cleaning this plate.

The pump is especially useful in connection with dehydrating or desiccating mechanism although it is understood that it is useful in various other relations. In the use of pumps in dehydrating food products, it is necessary that the pump be thoroughly cleaned at frequent intervals, usually once every twenty-four hours. In the present construction, when it is desired to clean the pumps, it is only necessary to remove the wing nuts 20 from the bolts 18 that retain the plate 17 on the casing 15, after which the rotors or pistons and the vane 54 may be readily removed by pulling the same forwardly. They may be replaced by reversing the operation.

Suitable means are provided for rotating the pistons or rotors in opposite directions, so that the two pumps may be arranged to operate in phase and will utilize the same intake passage and the same discharge passage. Any suitable means may be employed for this purpose. In the form of construction shown, the transmission 13, operated by the motor 14, is employed for this purpose. The transmission comprises a casing 57, consisting of a housing 70 and a closure plate 80 detachably connected thereto, Fig. 2. The casing is rigidly mounted on the base 11, as by means of the bolts 58 and is supported from its end but may be supported from its side edge, if desired. The casing 57 has journaled therein two shafts 59 and 61, on which are mounted the gears 62 and 63, respectively, which are in mesh. Also mounted within the casing 57 is a counter or stub shaft 64, Fig. 3, having thereon a pinion 65, preferably though not necessarily, integral therewith. The pinion 65 is adapted to be in mesh with the gear 62 for operating the transmission. The shaft 64 is adapted to be connected directly to the armature shaft 66 of the motor 14, as by means of a coupling 67.

In pumping different fluid materials, it is desirable, and often necessary, that the pump be operated at different speeds. In the present construction, simple means are provided whereby the pump may be operated at two different speeds. In changing from one speed to the other, in the present device, it is merely necessary to remove the pinion 24 and shaft 64, make the proper adjustment of the bearings, and substitute a shaft and pinion having a greater number of teeth. This is accomplished in the manner that will now be described.

Referring to Fig. 3, it will be seen that the counter or stub shaft 64 is rotatably mounted in suitable anti-friction bearings 71 and 72, which are in turn mounted in casing members 73 and 74, respectively. These casing members are each provided with flanges 75 and 76 and with inwardly extending eccentric hub portions 77 and 78 adjacent to the flanges 75 and 76. The inwardly extending eccentric hub portions 77 and 78 are adapted to be received in circular openings 79 in the casing 57. The eccentric hub portions 77 and 78 engage in these openings in each side of the casing 57, and are held in position by bolts or screws 81 which extend through the flanges 75 and 76 and engage in tapped openings in the casing 57. When it is desired to change the speed of the pump, the stub shaft is released from the coupling 67, Fig. 1, the motor 14 moved out of the way, and the screws 81, at the left in Fig. 3, are withdrawn. The eccentric 77 may now be slid to the left, Fig. 3, from the shaft 64, after which the shaft and pinion may be replaced by the shaft and pinion 82. In the form of construction shown, the pinion 82 has a larger number of teeth than the pinion 64 whereby the speed of the pump will be increased.

After the pinion and shaft 82 is substituted for the pinion and shaft 64, the parts are replaced, the eccentrics 73 and 74 turned to the proper position, as shown in Fig. 4, that is, turned to a position so that the shaft will be a sufficient distance from the gear 62 that the pinion 82 will properly mesh therewith. In the form of the construction shown, the eccentric is moved through about 180°. In order that the shaft 66 shall be in alinement with the shaft 64, the base of the motor 14 is provided with slots 83 through which the bolts 84 extend which permit the motor to be slid along the base 11 to the proper position without removing the bolts.

Referring now to the position of the pump as shown in Fig. 6, it will be seen that the piston 38 is tangent to the cylinder wall at 40 and is also tangent to the upper end of the vane 54 adjacent its forward edge, and that these two contacts divide the cylinder into two chambers, viz: an intake chamber 85 and a discharge chamber 86. It will also be noted that the lower piston 41 is divided into an intake passage 87 and a discharge passage 88, and that the intake passages of the two cylinders are substantially complemental. Likewise, the discharge passages are also substantially complemental, that is, their combined capacities remain substantially constant during the whole cycle of the pumping operation. This arrangement insures not only a steady flow but a constantly even flow with a minimum of agitation.

In the operation of the device, the liquid is drawn into the pump through the intake 31 and passes through the recess 56 into the spaces

between the pistons 39 and 41 and the interior of the cylinders 19 and 21 in what will be termed the rear of the vane 54, Fig. 6, and the discharge from the two cylinders passes outwardly through the recess 55 of the vane, passage 24 and the discharge passage 29, as shown in Figs. 6 and 8 of the drawings. From an inspection of Figs. 5 and 6, it will be seen that when one pump is discharging at its minimum rate, that is, not at all, and that as the discharge of one gradually reaches its minimum, the other gradually reaches its maximum, thus insuring a smooth even flow of the fluid.

The pump will operate equally as well by rotating the pistons in the opposite direction. During the reverse movement, the intake and discharge passages will be reversed. The device, when operating as a pump, may be said, therefore, to be reversible.

The apparatus may be employed as a reversible motor, in which event a fluid is forced into the apparatus through the passage 31 for turning the pistons in one direction, or forced into the apparatus through the passage 29 for turning them in the opposite direction. When used as a motor, suitable transmission is employed depending on the work to be done. If, for instance, it is desired to operate the motor 14 as an electric generator, the transmission 13 may be employed, as shown. The device may be operated as a vacuum pump or blower, if desired, and since it is symmetrical, it may be operated in either direction.

It is thought from the foregoing, taken in connection with the accompanying drawings, that the operation and construction of my device will be apparent to those skilled in the art, and that changes in size, shape, proportion or details may be made without departing from the spirit and scope of the appended claims.

I claim as my invention—

1. In a device of the class described, an integral casing having a pair of cylinders opening forwardly, said cylinders being spaced apart to form a partition integral with said casing, said partition having an open slot extending inwardly from its forward edge and opening forwardly, a shaft for each cylinder extending axially thereof and parallel with each other, a cylindrical piston eccentrically mounted on each shaft, a one-piece vane slidably mounted in said slot and engaging each of said pistons, said vane having a recess on each side thereof, said vane being moved by said pistons to bring said recesses alternately into communication with said cylinders, intake and discharge passages in said casing in communication with said casing and separated from each other by said vane, said passages extending to the front surface of said block, a front closure plate for closing the front ends of said cylinders and the front sides of said slot and passages and removable independently of said pistons, said plate having recesses with closed outer ends for receiving the ends of the shafts and forming bearings therefor, a power shaft for each of said shafts, a slip driving joint between each of said shafts and the corresponding power shaft, and means for detachably connecting said closure plate to said casing, whereby upon first removing said plate said pistons and vane may afterward be readily removed simultaneously or separately from said casing by moving the same forwardly therefrom.

2. In a device of the class described, a casing having a pair of cylinders therein opening forwardly, said cylinders being separated by a partition integral with said casing, said partition having a valve receiving slot extending from one cylinder to the other and having a second slot at right angles to said valve slot and also opening to the front surface of said casing, a closure plate detachably connected to said casing, a pair of pistons comprising cylindrical annular members of smaller diameter than the interior of said cylinders, within and engaging the inner peripheries of said cylinders, cylindrical piston elements journaled in said annular members, shafts extending axially through said cylinders, one of said cylindrical piston elements being eccentrically mounted on each shaft in said cylinders, a one-piece valve vane slidable in said valve slot for engaging said pistons, said vane extending across said second slot and separating said second slot into two portions, said vane having a recess on each side in communication with the adjacent portion of said second slot, each of said recesses being alternately in communication with the two cylinders for conducting a fluid to and from said cylinders, an intake passage in communication with one portion of said second slot and a discharge passage in communication with the other of said portions, a transmission comprising a casing, a pair of meshed gears within said casing, a pinion in mesh with one of said gears, means for rotating said pinion, and slip coupling means for the shafts of said gears and pistons whereby said pistons will be rotated in opposite directions and may be separated from the gear shafts by an outward movement along the axes of said piston shafts.

3. In a pump, a casing having a pair of cylinder cavities therein, said cavities being spaced apart to form a partition integral with said casing, said partition having a pair of open-ended slots therein opening to the forward surface of said casing, one of said slots being in communication with said cavities and the other extending transversely thereto and having one end in communication with an intake passage in said casing and its other end in communication with a discharge passage in said casing, a pair of cylindrical piston members eccentrically mounted on shafts extending axially through said cavities, a cylindrical piston sleeve of uniform thickness throughout rotatably mounted on each of said cylindrical members and tangent to the internal periphery of the corresponding cavity of said casing, said sleeves being free to rotate on said cylindrical members, a one-piece vane slidably mounted in one of said slots and in continuous contact with both of said sleeves, said vane separating said intake and discharge passages, said vane having recesses on its sides for constituting passages for connecting the intake sides of said cavities with said intake passage and the discharge sides of said cavities with said discharge passage, and a closure plate detachably mounted on said casing for closing said cavities and slots on their forward ends and sides, respectively, said plate being removable from said casing without disturbing said vane or sleeves, whereby upon removal of said plate said sleeves and vane may be moved outwardly from the corresponding cavity and said cavities and slots be exposed for cleansing.

4. In a device of the class described, a casing opening forwardly, a closure for the forward end of said casing having a pair of recesses

therein forming bearings, a pair of cylindrical cavities in said casing forming cylinders opening forwardly, said cavities being spaced apart to form a partition, said partition having a pair of open-ended slots therein opening forwardly, an eccentrically mounted rotary piston in each cavity, a shaft for each piston, each of said shafts being journaled in one of said bearings, each shaft extending through said casing and adapted to have a slip joint connection with a corresponding drive shaft, a one-piece vane in one of said slots movable in only one plane and engaging said rotary pistons, said vane being removable through the open end of said slot, and common intake and discharge passages for said pump separated by said vane, said passages including one of said slots in said casing opening to the forward side of said casing, and closed by said closure when the closure is attached to said casing.

5. In a device of the class described, a cylinder casing having a pair of cylinder chambers therein opening to one side surface of said casing, a closure plate for said casing, said cylinder chambers being parallel and spaced apart forming a partition, said partition having a slot therein in the plane of the axes of said cylinder chambers, and in communication with said chambers, a rotatable piston eccentrically mounted in each chamber, a vane slidably mounted in said slot and engaging each piston, a second slot extending across the first named slot, an intake passage through said closure plate in communication with one end of said second slot on one side of said vane and a discharge passage through said closure plate in communication with the other end of said second slot on the opposite side of said vane, said vane having concave sides adapted to be brought into communication with said chambers, the piston engaging ends of said vane being of such thickness that they will remain constantly in engagement with both of said pistons during the operation of said pump, said slots and vane being so constructed and arranged that said vane may be removed from said casing independently of said pistons after said closure plate has been removed.

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