

Nov. 7, 1944.

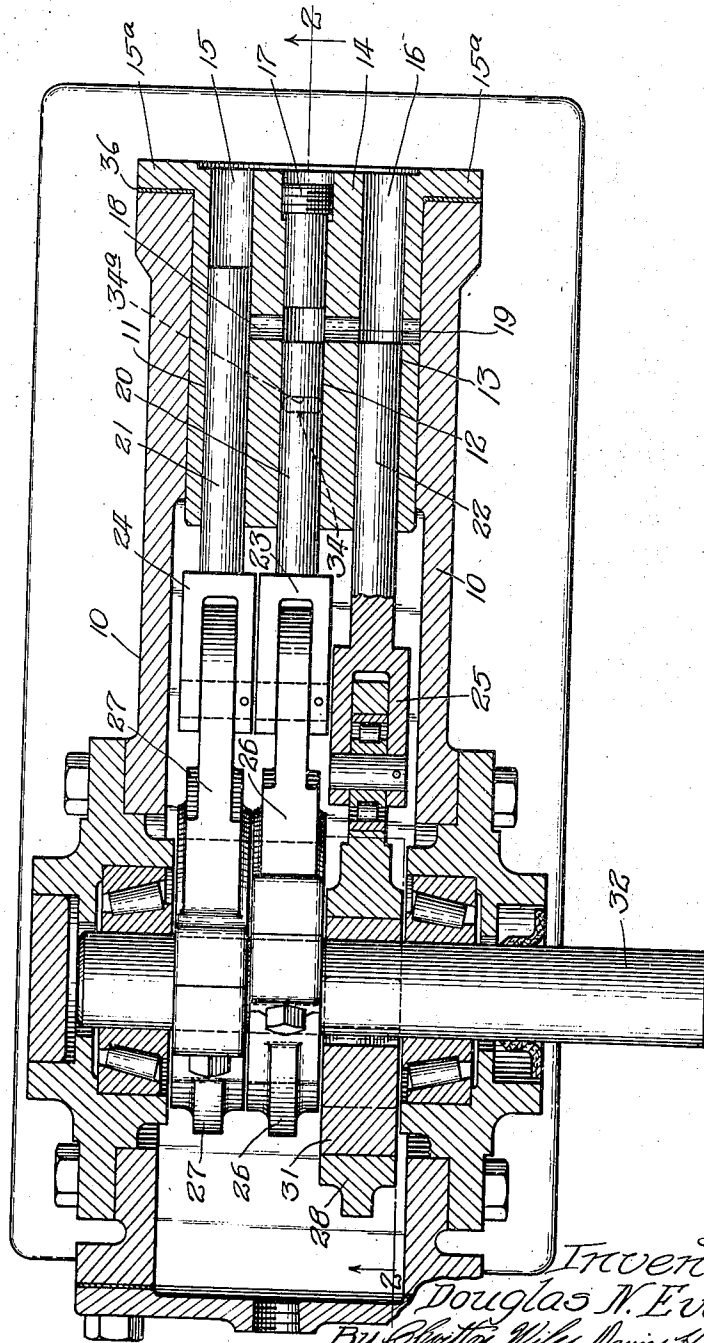
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2,362,365

PUMP

Filed Feb. 4, 1943

3 Sheets-Sheet 1



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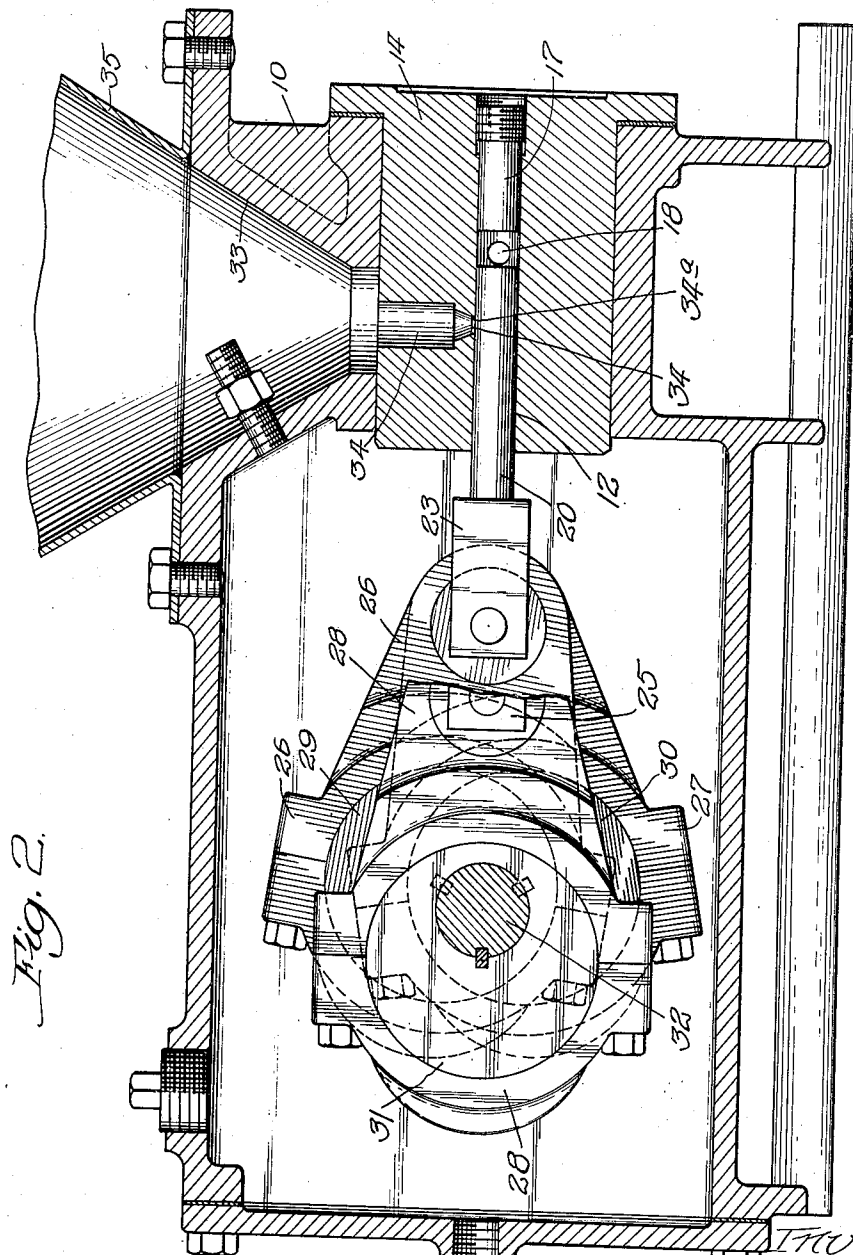
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3 Sheets-Sheet 2



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Fig. 3.

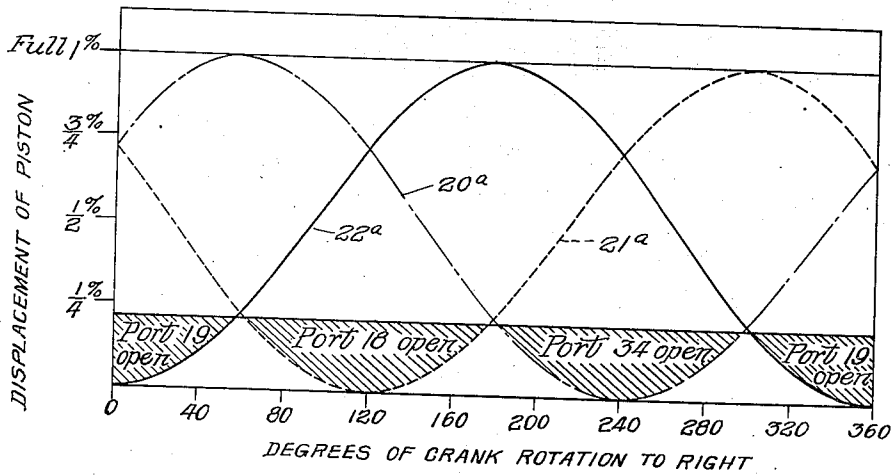
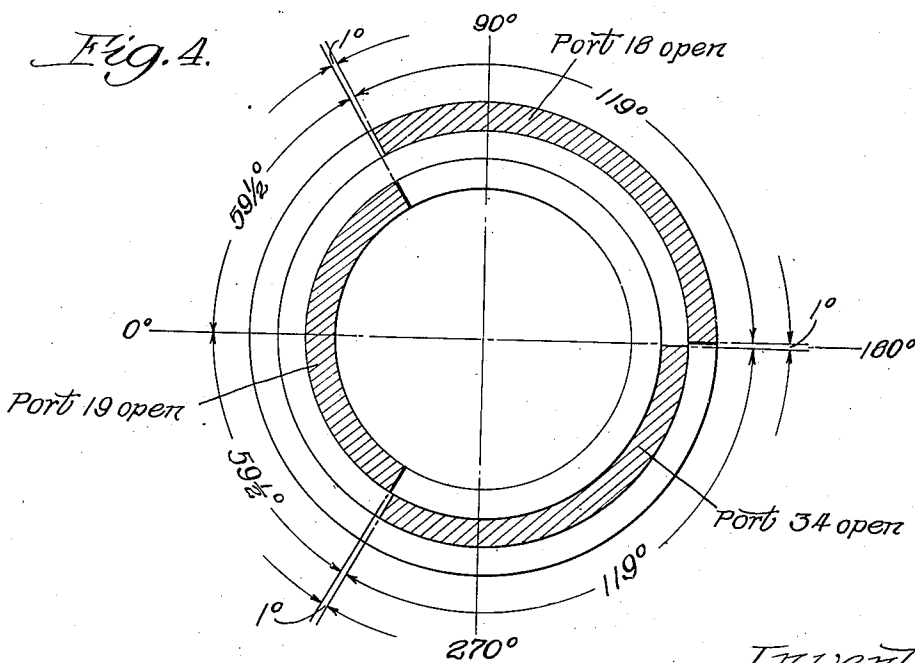


Fig. 4.



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UNITED STATES PATENT OFFICE

2,362,365

PUMP

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Application February 4, 1943, Serial No. 474,635

4 Claims. (Cl. 103—2)

My invention relates to pumps for pumping, by way of example and more particularly, though not exclusively, non-gaseous fluids such as those used as hydraulic mediums and grease or oil to be supplied under pressure for lubricating purposes and more especially to pumps of the type employing a main pumping piston and auxiliary piston valve means operating in timed relation to the pumping piston and controlling the fluid flow.

My object generally stated is to provide a construction of pump of the type above referred to which will be highly improved over pumps of this type as hitherto constructed, and, as to its use in certain situations, simplify construction of the structure and dispense with adjuncts thereto such as, for example, reversing valve mechanisms which often give trouble in operation, are expensive to maintain in working condition, and at times fail in operation.

Certain of my more particular objects are as follows:

To provide a pump for operating double-line centralized lubrication systems or single-line double-flow centralized lubrication systems.

To provide a pump which will operate hydraulic systems without hydraulic controls—where the operation of the pump is electrically controlled, the pump being controlled solely by the electric control. Examples of such systems are those provided for operating cylinders on industrial equipment such as presses, guide rolls, lifts, etc.; raising and lowering landing gear, wing flaps, etc., of aircraft; steering mechanism for marine vessels; and the control of parts of machine tools.

To provide a pump which requires no packing and by which wear is compensated for by mere adjustment of parts of the pump.

To provide a pump by which reversal of flow of the fluid operated on by the pump may be effected by merely reversing the direction of rotation of the shaft by means of which the pump is driven, and

To provide a construction of pump which may be stopped in any position without any of its ports becoming cross-connected thus locking the pump against flow of the fluid therein when at rest.

Referring to the accompanying drawings:

Figure 1 is a plan sectional view of a pump embodying my invention;

Figure 2 is a longitudinal sectional view of the pump, the section being taken at the broken line 2—2 on Figure 1 and viewed in the direction of the arrow;

Figure 3 is a diagram illustrating the piston displacement; and

Figure 4 is a diagram showing the timing of the pistons.

The pump shown and illustrated as provided, by way of example, as a part of a lubricating system, comprises a casing 10 having three parallel bores 11, 12 and 13 forming cylinders shown as provided in a flanged cylindrical block 14 housed in an open end of the casing 10 and held in place in any suitable way. The outer ends 15 and 16 of the cylinders 11 and 13 are open for flow of the fluid therethrough, the outer end of the cylinder 12 being closed by a plug 17 screwed into this cylinder.

The cylinder 12 connects with the cylinders 11 and 13 by means of cross ports 18 and 19 located beyond the inner end of the plug 17 and shown as diametrically opposed.

Reciprocal in the cylinder 12 is a pumping piston 20 and reciprocal in the cylinders 11 and 13 are valve pistons 21 and 22, respectively.

The pumping piston 20 and valve pistons 21 and 22 are pivotally connected at yokes thereon, indicated at 23, 24 and 25, with the straps 26, 27 and 28 of eccentrics 29, 30 and 31 secured to a drive-shaft 32 journaled in opposing side walls of the casing 10, the eccentrics being disposed in different angular positions about the shaft 32, in the particular construction shown, at angles of 120° to each other.

The casing 10 is shown as having a funnel shaped opening 33 which communicates with a passage 34, forming a port in the block 14 opening into the cylinder 12, the opening 33 communicating at its upper end with the lower end of a reservoir 35 shown as of hopper form, secured to the casing and provided to receive a supply of the fluid to be pumped.

The pump as provided is adapted for the pumping of fluid supplied to the pump through the outer end of either of the cylinders 11 or 13, selectively, or from the reservoir 35 in connection with the supplying of the fluid to the pump through either of these cylinders, for the discharge thereof through the other of these cylinders, merely by reversal of the direction of rotation of the drive shaft 32, or from the reservoir 35 only, through the cylinders 11 and 13, selectively, merely by reversal of the direction of rotation of the drive shaft 32 and the closing, in any suitable way, of the outer end of the one of these two cylinders other than the one through which the discharge is to be effected.

Assuming that the reservoir 35 is employed in a closed circuit system for making up any deficiency of fluid supplied to the pump through

either of the cylinders 11 and 13; that the fluid to be pumped is in communication with the outer end 15 of the cylinder 11, in which case the outer end 16 of the cylinder 13 would form the outlet for the pumped fluid; and that the shaft 32 is driven clockwise in Fig. 2; the valve piston 21, during the forepart of the back stroke of the pumping piston 20, moves to open the cylinder 11 to port 18 and consequently to the cylinder 12 whereupon fluid to be pumped enters the cylinder 12 ahead of the pumping piston. As the pumping piston continues its rearward movement, the valve piston 21 closes the cylinder 11 to the port 18 and the pumping piston opens the reservoir 35 to the cylinder 12 through the port 34 and fluid, to augment the charge ahead of the pumping piston, flows from the reservoir 35 into the cylinder 12, the valve piston 22 being closed in these operations and thus the cylinder 13 is out of communication with the supply fluid passages of the pump.

On the forward or pumping stroke of the pumping piston 20 the piston 20 closes the port 34 and thereupon the valve piston 22 moves backwardly to open the cylinder 12 to the port 19 and consequently to the cylinder 13, the valve piston 21 in these operations being closed, and thus the charge of fluid in the cylinder 12 ahead of the pumping piston 20 is discharged through the port 19 into and out of the cylinder 13 to the place of use, by the action of the pumping piston 20 augmented by the action of the valve piston 22.

As will be understood, a full charge is presented to the pumping piston 20 for pumping regardless of any deficiency of supply through the inlet cylinder 11 of the pump. Where no such deficiency exists, such of the fluid as enters the cylinder 12 through port 34 on the rearward stroke of the piston 20 is returned to the reservoir 35 through port 34 on the forward stroke of the piston 20.

Upon reversing the direction of rotation of the drive-shaft 32, the cylinder 13 becomes the inlet of the pump, and the cylinder 11, the outlet of the pump, the valve piston 22 during the forepart of the back stroke of the pumping piston 20 moving to open the cylinder 13 to the port 19 and consequently to the cylinder 12 whereupon fluid to be pumped enters the cylinder 12 ahead of the pumping piston. As the pumping piston continues its rearward movement, the valve piston 22 closes the cylinder 13 to the port 19 and the pumping piston 20 opens the reservoir 35 to the cylinder 12 through the port 34 and fluid to augment the charge ahead of the pumping piston flows from the reservoir 35 into the cylinder 12, the valve piston 21 being closed in these operations and thus the cylinder 11 is out of communication with the supply fluid passages of the pump.

On the forward or pumping stroke of the pumping piston 20, the piston 20 closes the port 34 and thereupon the valve piston 21 moves backwardly to open the cylinder 12 to the port 18 and consequently to the cylinder 11, the valve piston 22 in these operations being closed and thus the charge of fluid in the cylinder 12 ahead of the pumping piston 20 is discharged through the port 18 into and out of the cylinder 11 to the place of use by the action of the pumping piston 20 augmented by the action of the valve piston 21.

To ensure maximum efficiency of the pump it is necessary that the outlet of the pump at no time during the back stroke of the pumping pis-

ton be in communication with the cylinder 12 and that the inlet of the pump at no time during the forward stroke of the pumping piston be in communication with this cylinder. This is accomplished, by way of example, by proportioning and locating the cross ports 18 and 19 relative to the limits of the strokes of the pistons 20, 21 and 22 as shown whereby upon initiating pumping action of the pumping piston 20, following the closing of the pump cylinder 12 to the fluid supply, in the rotation of the drive-shaft 32 in either direction, the one of the valve pistons which controls the outlet of the pump remains closed for an instant, the compressive pressure resulting therefrom becoming dissipated, as for example through the elasticity of the structure subjected to such pressure and/or the compressibility of the fluid or medium being pumped.

Furthermore in those cases in which the reservoir 35 is used it is necessary that the port 34 at no time be in registration with the cylinder 12 when the port 19 or port 18 (when serving as an outlet) is in registration with this cylinder, this being accomplished by locating the cut-off edge 34a of the port 34 as shown, whereby the piston 20 on its forward stroke closes this port before the piston 22 opens the port 19 for discharge through the cylinder 13 in the rotation of the shaft 32 in one direction, or the piston 21 opens the port 18 for discharge through the cylinder 11 in the rotation of the shaft 32 in the opposite direction.

This is illustrated, by way of example, by the diagrams of Figures 3 and 4 wherein the relation between the port openings and the degrees of rotation of the shaft 32 (clockwise in Figure 2) in the above example, is shown.

In Figure 3 the relationship between the displacement of the several pistons and the degrees through which the drive shaft 32 is rotated in making one complete rotation is illustrated.

In further explanation of the diagrams of Figures 3 and 4 the cross-hatched areas represent the relation of the several port openings as indicated, to each other and to the degrees of rotation of the shaft 32 throughout one complete rotation (clockwise in Figure 2) namely throughout 360°, during which rotation no more than one of the three ports 18, 19 and 34 is open at any one time, the spiral lines 20a, 21a and 22a in Figure 3 representing full reciprocations (throughout 360° of rotation of the shaft 32) of the several pistons 20, 21 and 22 respectively.

As shown, each port is open throughout less than 120° of rotation of the shaft 32, by way of example and as shown, 119° only, and as the eccentrics 29, 30 and 31 are positioned about the shaft 32 at 120° to each other and as the several ports are opened in succession, each port is delayed in opening, after the preceding port has closed, throughout the rotation of the shaft 1°.

When the pump is to be used without the reservoir, for selective pumping through either of the cylinders 11 and 13, it is necessary only to eliminate the reservoir or permanently close it to the cylinder 12, no change in the pump being required.

When all the fluid to be pumped is supplied from the reservoir, it is only necessary that the one of the cylinders 11 and 13 through which the fluid is not to be pumped be closed permanently by any suitable means, no change in the pump being required.

As none of the ports of the pump, used for

pumping in any of the different ways above referred to, communicate with each other in any position to which the shaft 32 is rotated, flow of fluid in the pump regardless of the position in which the pump is stopped, cannot occur, the pump thus becoming locked against undesirable flow.

In the continued operation of the pump the original sharp-cornered edges of the outer ends of the pistons 21 and 22 are apt to wear, requiring that the pistons 21 and 22 and ports 18 and 19 be relatively adjusted. This is provided for in the pump as shown by providing these ports in the block 14 which is lineally adjustable in the casing 10, the desired position of adjustment being maintained by interposing shim means 36 between the flange 15a of the block 15 and the adjacent end face of the casing 10.

While I have illustrated and described a particular construction of pump embodying my invention, I do not wish to be understood as intending to limit my invention thereto, as the same may be variously modified and altered without departing from the spirit of my invention.

What I claim as new, and desire to secure by Letters Patent, is:

1. A pump having a pumping cylinder and a plurality of valve cylinders, ports connecting said valve cylinders with said pumping cylinder and serving alternatively as inlet and outlet openings from said valve cylinders, an alternative outlet or inlet opening for each of said valve cylinders, a supply of fluid to be pumped, a port through which said supply communicates with said pumping cylinder, a pumping piston in said pumping cylinder and controlling said last-referred-to port, pistons in said valve cylinders cooperating with said first-referred-to ports to control communication between said pumping cylinder and said valve cylinders, and reversible means for reciprocating said pistons in said cylinders, said ports being so positioned relative to the limits of the strokes of said pistons in their reciprocations that at no time will said valve cylinders be in communication with each other or with said second-named port in the operation of said means in either direction.

2. A pump having a pumping cylinder and a plurality of valve cylinders, ports connecting said valve cylinders with said pumping cylinder and serving alternatively as inlet and outlet openings from said valve cylinders, an alternative outlet or inlet opening for each of said valve cylinders, a supply of fluid to be pumped, a port through which said supply communicates with said pumping cylinder, a pumping piston in said pumping

cylinder and controlling said last-referred-to port, pistons in said valve cylinders cooperating with said first-referred-to ports to control communication between said pumping cylinder and said valve cylinders, and reversible means for reciprocating said pistons in said cylinders, comprising a rotary reversible element having eccentric devices disposed about said element approximately 120° apart and operatively engaging said pistons for reciprocating them, said ports being so positioned relative to the limits of the strokes of said pistons in their reciprocations that at no time will said valve cylinders be in communication with each other or with said second-named port in the operation of said means in either direction.

3. A pump having a pumping cylinder and a plurality of valve cylinders, ports connecting said valve cylinders with said pumping cylinder and serving alternatively as inlet and outlet openings from said valve cylinders, an alternative outlet or inlet opening for each of said valve cylinders, a supply of fluid to be pumped, a port through which said supply communicates with said pumping cylinder, a pumping piston in said pumping cylinder and controlling said last-referred-to port, pistons in said valve cylinders cooperating with said first-referred-to ports to control communication between said pumping cylinder and said valve cylinders, and reversible means for reciprocating said pistons in said cylinders, said ports being so positioned relative to the limits of the strokes of said pistons in their reciprocations that said ports open in succession, with a time interval between the opening of each of said ports and the closing of the preceding port, in the operation of said means in either direction.

4. A pump having a pumping cylinder and a plurality of valve cylinders, ports connecting said valve cylinders with said pumping cylinder and serving alternatively as inlet and outlet openings for said valve cylinders, an alternative outlet or inlet opening for each of said valve cylinders, a pumping piston in said pumping cylinder, pistons in said valve cylinders cooperating with the said ports, control communication between said pumping cylinder and said valve cylinders, and reversible means for reciprocating said pistons in said cylinders, said ports being so positioned relative to the limits of the strokes of said pistons in their reciprocations that the valve cylinders are at no time in communication with each other and that in at least one stage of a reciprocation cycle both ports are closed for a substantial portion of the cycle.

DOUGLAS N. EVANS.