March 21, 1933. W. P. VALENTINE 1,902,345

FLUID PRESSURE PUMP

Filed April 2, 1931 2 Sheets-Sheet 1

Fig. 1.

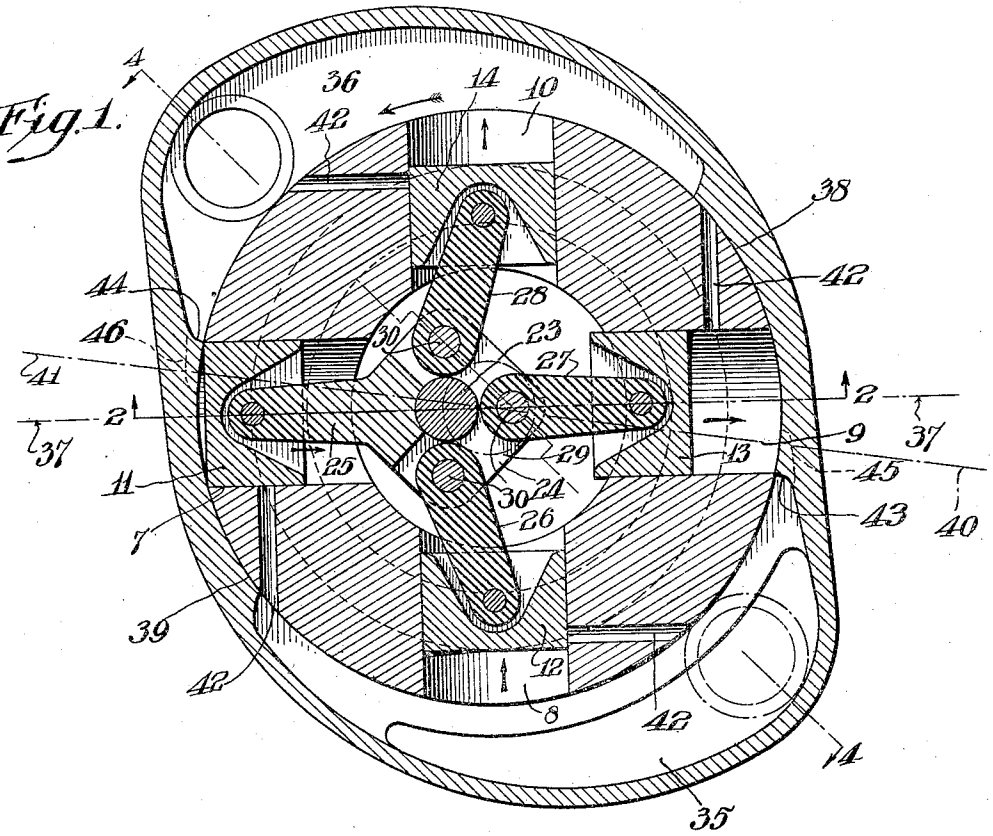
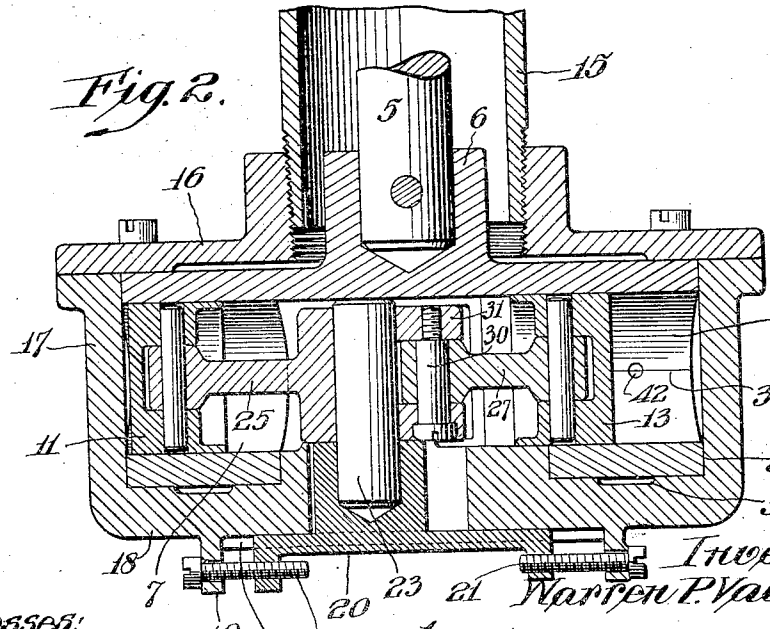


Fig. 2.



Witnesses:
Chas. W. Hacker
Geo. L. Jepson

Inventor
Warren P. Valentine
by Dodge, Jackson and Sons
Attorneys.

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Fig. 3.

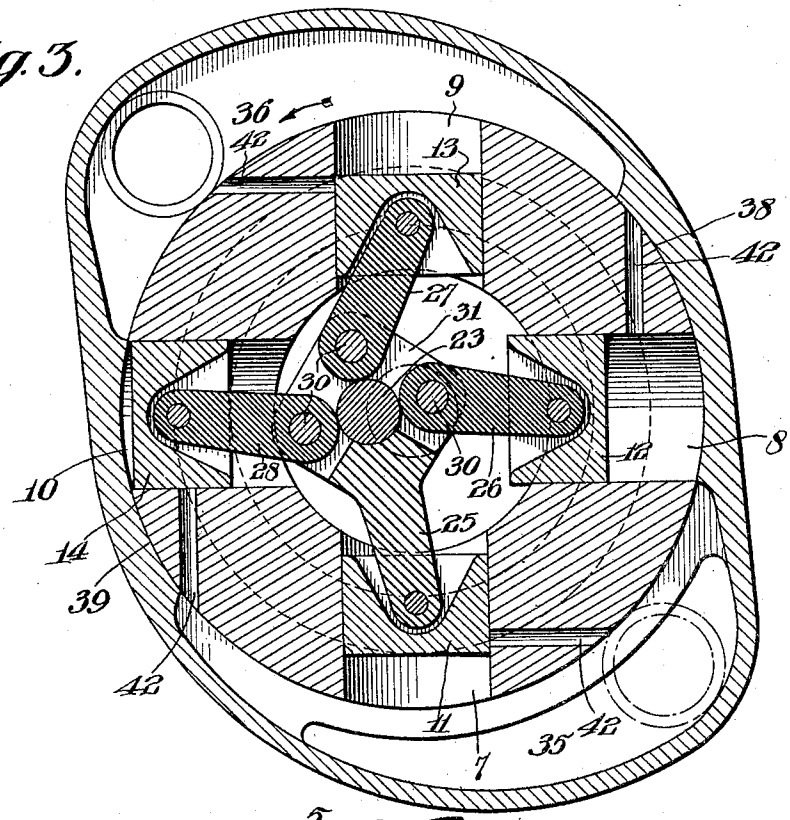
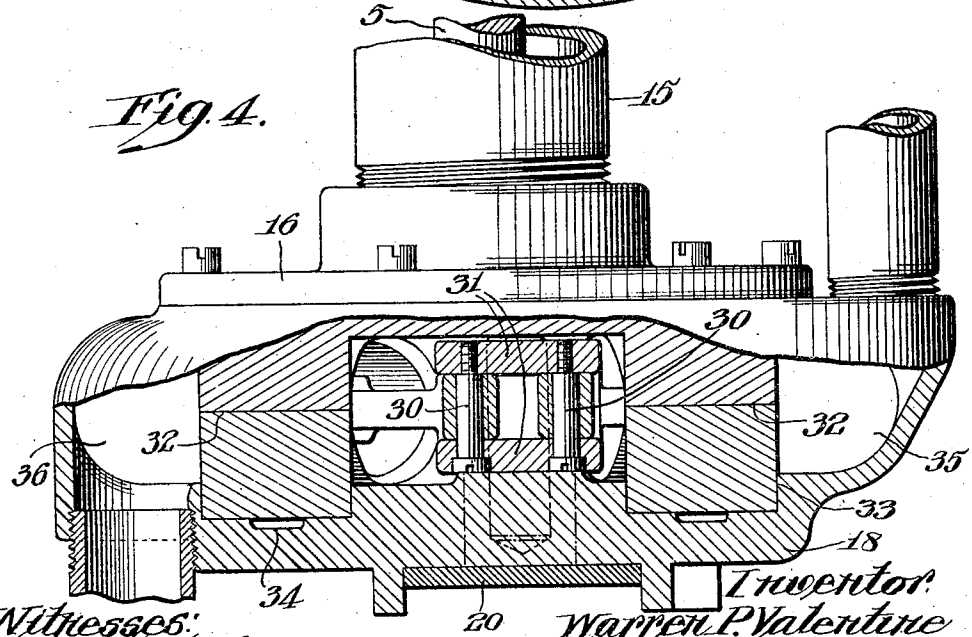


Fig. 4.



Witnesses:
Anna W. Hacker
Geo. C. Jepson

Inventor:
Warren P. Valentine
by C. A. Steele Jackson and Son
Attorney

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UNITED STATES PATENT OFFICE

WARREN P. VALENTINE, OF LINE LEXINGTON, PENNSYLVANIA, ASSIGNOR TO NATIONAL TRANSIT PUMP & MACHINE COMPANY, OF OIL CITY, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

FLUID PRESSURE PUMP

Application filed April 2, 1931. Serial No. 527,068.

My invention relates to rotary plunger pumps in which plungers reciprocate within radial cylinders of a hollow cylindrical cylinder block, usually a rotor, a crank pin carried by an end casing of the pump reciprocating the plungers once each revolution of the pump and the circumferential casing of the pump presenting circumferentially spaced inwardly open inlet and discharge passages angularly located to respectively register with the outer ends of the cylinders during the outward and inward movements of the plungers.

A purpose of my invention is to increase the length of the circumferential seal between the inlet and outlet passages of a pump of the character indicated in order to permit wear and erosion of the sealing surfaces without materially changing the effective operation of the pump, even when through long continued service, such wear and erosion has materially lessened the lengths of seal and would have rendered inoperative the pumps of the prior art.

A further purpose is to allow for outward movements of the plungers of pumps of the character indicated during the passage of the outer ends of the plunger cylinders across a relatively long end seal by providing forwardly extending pressure relief passages.

A further purpose is to provide each cylinder of a pump of the character indicated with a relief passage extending through the cylinder block forward of the cylinder in the direction of relative movement of the cylinder block and casing.

A further purpose is to provide a pump of the character indicated, which has a link connection between the crank and one of the plungers and which is enlarged to form a wrist plate about the crank to operate the remaining plungers, with novel construction that reduces the requisite distance between the crank and the plungers and thereby the requisite diametral size to the rotor.

A further purpose is to provide an advantageous and novel pump structure which operates effectively on viscous oils and stiff greases and is easily and inexpensively manufactured and well suited to the needs of service.

A further purpose is to construct a rotary pump well suited to use as a gauge.

Further purposes will appear in the specification and in the claims.

I have elected to show one main form only of my invention, selecting a form that is practical and efficient in operation and which well illustrates the principles involved.

Figure 1 is a transverse section through cylinder block and casing structure that embodies one form of my invention.

Figure 2 is a section of Figure 1 taken upon the line 2—2 thereof.

Figure 3 is a view corresponding generally to Figure 1, except that the parts are further advanced, the cylinder block in Figure 3 being advanced 90° beyond its position in Figure 1.

Figure 4 is an elevation, in part section upon the line 4—4 of Figure 1.

Like numerals refer to like parts in all figures.

Describing in illustration and not in limitation and referring to the drawings:—

In rotary pumps of this character, in which a cylinder block having radial cylinders equipped with radially reciprocating plungers moves with respect to a casing, the question as to whether the casing is stationary and the cylinder block turns or the cylinder block is stationary and the casing turns is of relatively little importance, since in any case there will be relative rotation of the cylinder block with respect to the casing. In the form illustrated, the cylinder block is intended to turn, and therefore to be a rotor, is merely my preferred construction.

The rotor includes a shaft 5 rotated in any suitable way not shown, and a hollow cylinder block 6 carried upon the shaft, the cylinder block being radially bored to form cylinders at 7, 8, 9 and 10 and the block interior providing space for mechanism reciprocating the plungers 11, 12, 13 and 14 in the respective cylinder bores.

The stator structure includes a supporting pipe 15 that carries threaded upon its for-

ward end a flange 16 forming the inner end casing of the cylinder block and supporting the circumferential casing 17 and forward or outer end casing 18.

On the end casing 18, supporting lugs 19 adjustably position a sliding plate 20 by means of adjusting screws 21. The plate 20 is movable longitudinally in a guideway 22. The plate 20 carries an inwardly directed crank pin 23 that is parallel to the shaft of the rotor and laterally spaced therefrom at a distance selected to give the desired range of movement to the plungers 11, 12, 13 and 14.

The crank pin 23 is desirably adjustable in its distance from the axis of the shaft 5, as through shifting the settings of the adjusting screws 21. Obviously changing the position of the plate 20 adjustably changes the throw of the plungers and thereby changes delivery of the pump when operated at a given speed.

A wrist plate 24 pivotally mounted on the crank pin 23 has operative connections with the individual plungers, one of these connections 25 comprising an arm pivoted at its outer end to the plunger 11 and at its inner end desirably integral with the wrist plate.

The other connections include links 26, 27 and 28 which are pivoted to the wrist plate at one end and to the plungers 12, 13 and 14 respectively at the other end.

The wrist plate is recessed at 29 to receive the inner ends of the links 26, 27 and 28, these ends being connected by the screw pivots 30 to the spaced plate portions 31 of the wrist plate.

For ease of assembly and manufacture, the cylinder block is transversely divided at 32 in a plane which longitudinally bisects the radial cylinders 7, 8, 9 and 10 carrying the plungers. The end casing 18 is annularly recessed at 33 to fit the outer end of the cylinder block, the annular recess being shown deepened somewhat at 34 throughout its length to provide an oil groove.

The circumferential casing 17 presents inwardly open inlet and discharge passages 35 and 36 respectively to circumferential portions of the cylinder block, these passages being located on opposite sides of a diametral line 37 through the cylinder block and crank axes, with arcuate circumferential sealing portions 38 and 39 intermediate and adjacent ends of the passages.

It will be understood that the open ends of the cylinders 7, 8, 9 and 10 successively register with the inlet passage 35 during the periods of radial inward plunger travel and register with the outlet passage during the periods of radial outward plunger travel. For counterclockwise cylinder block rotation as contemplated in the form shown, the plungers pass from inward to outward travel somewhere along the seal 38 and from outward to inward travel somewhere along the seal 39.

Theoretically the extreme outward and extreme inward positions of the plungers 11 and 13 are at the instants of angular registry of the common axes of the longitudinal bores 7 and 9 with the line 37, the plungers having their extreme outward positions at the seal 39 and their extreme inward positions at the seal 38.

But for the fact that the wrist plate arm 25 itself is angularly changing position and thus changing the angular setting of the wrist plate supports for the links, the pistons 12 and 14 when in the position of Figure 3 would have their maximum inner and outer strokes in angular positions corresponding with the line 37. Because of the angular displacement (as guided by the arm 25) this is altered, so that the angular positions of maximum inward and outward movements are changed to correspond with some such lines as 40 and 41.

While the pistons are angularly close to the dead center lines, their actual longitudinal movements are relatively small, and an important feature of the present invention incudes the provision of long seals at 38 and 39, extending a considerable distance beyond the dead center lines with forwardly extending relief ports 42 in the different cylinders positioned to permit small outward movements of the plungers while the outer ends of the cylinders carrying the plungers are passing the long seal 38.

The relief ports 42 do not function at the seal 39, since the plungers are there in their outermost positions, and subsequently will move inwardly.

The widest application of the invention is thought to be in pumping greases and heavy liquids, both of which are incompressible and therefore readily block any substantial outward movements of the plungers if sealed within the spaces ahead of the plungers, and because of this fact, inventors and others have in the past provided seals at 38 that are relatively quite short as compared with the length of seal used by the applicant.

Small inward movements of the plungers when passing the seal 39 result in a suction resistance to the rotor movement that is of merely minor importance since it is relatively low, being limited to that needed to overcome atmospheric pressure.

In the past the sealing surfaces between the inlet and discharge passages 35 and 36 of pumps of the type under consideration have become worn or eroded in use to such an extent as to destroy the effectiveness of the pump long before any accompanying deterioration of the mechanism has become material. Wear has been most pronounced in pumping heavy liquids, such as cup

grease and other lubricants of high viscosity.

The erosion and wear usually take place from the rearwardly directed surfaces 43 and 44, for example, as indicated by the dotted lines 45 and 46, and the long sealing surfaces of the present invention permit wear without loss of seal between the inlet and outlet passages.

The pressure relief passages 42, extending forward perpendicular to the cylinder axes from intermediate points of the cylinders 7, 8, 9 and 10 to the outside circumference of the cylinder block permit the rather small outward movements of the plungers when passing the long seal 38, since without these relief passages the incompressible fluid filling the cylinders while the cylinders are closed by the seal 38 would block the plungers from moving outward.

As a result of the relief passages 42, the plungers can thus move outwardly while the outer ends of the cylinders are sealed, because the outward displacements of the plungers is accommodated by corresponding discharge of the grease or other fluid within the cylinders through the relief passages 42 to the discharge passage 36.

The corresponding inward movements of the plungers while passing the seal 39 meets a mere suction resistance that cannot exceed a relatively small value, too small to give material trouble.

Another important feature of the invention is directed to the novel wrist plate structure operatively connecting the crank and the cylinders, the bifurcation of the wrist plate permitting a very close connection between the inner ends of the links 26, 27 and 28 and the crank pin 23 that is particularly advantageous.

I bring the link pivots on the wrist plate as close to the crank as is permitted by the diameter of the crank and of the link bearings, in this way greatly reducing the differences in the radial distances of the pistons from the crank when the pistons respectively reach the same position. By using a yoke form of wrist plate, I am enabled to support both ends of the link pins, thus distributing the load between the ends of the pins.

My form of pump is particularly well suited for use as a gauge, since its discharges measured quantities from the cylinders and is not subject to inaccuracy due to destruction of the circumferential seal by wear. When the pump is employed as a gauge I will drive either the cylinder block or the casing, and not rely on the liquid to operate the rotor.

In view of my invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such in so far as they fall within the reasonable spirit and scope of my invention.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. A pump of the character indicated comprising a cylindrical rotor having a hollow recess extending rearwardly from its forward end and having circumferentially spaced radial bores intersecting said recess, a plunger in each bore, a stationary eccentric pin, an operating connection between said pin and said plungers whereby rotation of the rotor reciprocates the plungers in their respective bores, an external casing presenting a surface toward the rotor recessed outwardly to provide inlet and outlet passages respectively registering with the ends of the bores during major portions of the inward and outward movements respectively of the plungers within the bores and seals comprising casing portions making arcuate sealing engagements with the outside of the rotor intermediate the passages at positions to respectively register the seals with the bores when the plungers therein are at their innermost and outermost positions, and the seal in position to register with the bores while the plungers thereof are at their innermost positions having an arcuate forward sealing extension sealing the open ends of the bores during early portions of the outward movements of the plungers within the bores, said rotor having a perforation extending forwardly from an intermediate point only of each bore to a point on the circumference of the rotor such that the bore is connected to the discharge passage through the perforation while the open end of the bore is closed by the sealing extension and the perforation is sealed when the piston extends outwardly beyond the intermediate point.

2. A pump of the character indicated, comprising a cylindrical rotor having a hollow recess extending rearwardly from its forward end and having circumferentially spaced radial bores intersecting said recess, a plunger in each bore, a stationary eccentric pin, an operating connection between said pin and said plungers whereby rotation of the rotor reciprocates the plungers in their respective bores, an external casing presenting a surface toward the rotor recessed outwardly to provide inlet and outlet passages respectively registering with the ends of the bores during major portions of the inward and outward movements respectively of the plungers within the bores and seals comprising casing portions making arcuate sealing engagements with the outside of the rotor intermediate the passages at positions to re-

spectively register the seals with the bores when the plungers therein are at their innermost and outermost positions, and the seal in position to register with the bores while the plungers thereof are at their innermost positions having an arcuate forward sealing extension sealing the open ends of the bores during early portions of the outward movements of the plungers within the bores, and the rotor having perforations extending forwardly from intermediate points of the bores to the outside of the rotor sealed by the plungers when the plungers move to their radially outer position.

3. In a rotary pump of the character indicated, comprising a casing and a cylinder block containing pump cylinders with their relatively reciprocating plungers, inlet and outlet compartments with which the cylinders communicate and opposite sealing arcs of engagements separating the compartments, the art which consists in circumferentially extending the sealing engagements greatly in excess of the circumferential spans of the plungers and in by-passing the discharge from points short of the ends of the cylinders to permit outward movements of the plungers during parts of the successive sealing engagements and providing for sealing the discharges by the pistons in the outer parts of the piston movements.

4. In a rotary pump of the character indicated, comprising a casing and a cylinder block containing pump cylinders with their relatively reciprocating plungers, inlet and outlet compartments with which the cylinders communicate and opposite sealing arcs of engagements separating the compartments, the art which consists in discharging fluid from the cylinders in turn ahead of each of the pistons into the outlet compartment before the outer cylinder openings in their circumferential movement have reached the compartment and in sealing the discharge from the cylinders while the pistons are in the outer parts of their strokes.

5. A rotary pump of the character indicated, comprising an outer casing having inlet and outlet connections and compartments, a cylinder block therein relatively rotatable with respect to the casing, walls forming cylinders in the block in spaced positions about the block, sealed against the casing at opposite sides during movement over an angular distance greater than the circumferential spread of each cylinder, pistons in the cylinders, a crank revoluble with respect to the cylinder block, connections from the crank to the respective pistons and walls forming by-passes from intermediate points in the cylinders to the outlet compartment in advance of other connections of the cylinders therewith in the direction of relative block rotation, whereby the cylinders may discharge to the outlet compartment before the ends of the cylinders are connected with the outlet compartment and the by-passes are closed by the pistons in outer parts of the piston strokes.

6. A rotary pump of the character indicated, comprising an outer casing having inlet and outlet connections and compartments, a cylinder block therein relatively rotatable with respect to the casing, walls forming cylinders in the block in spaced positions about the block, sealed against the casing at opposite sides during movement over an angular distance greater than the circumferential spread of each cylinder, pistons in the cylinders, a crank revoluble with respect to the cylinder block, connections from the crank to the respective pistons, walls forming by-passes from intermediate points in the cylinders to the outlet compartment in advance, in the direction of relative block rotation, of cylinder connection therewith, each by-pass being sealed at all times by the piston of its cylinder during its connection with the inlet compartment except when its cylinder end is connected with said inlet compartment.

WARREN P. VALENTINE.