F. H. RICHARDS.

FORCE PUMP.

APPLICATION FILED MAY 7, 1902.

976,917. Patented Nov. 29, 1910.

3 SHEETS—SHEET 1.

Fig. 2.

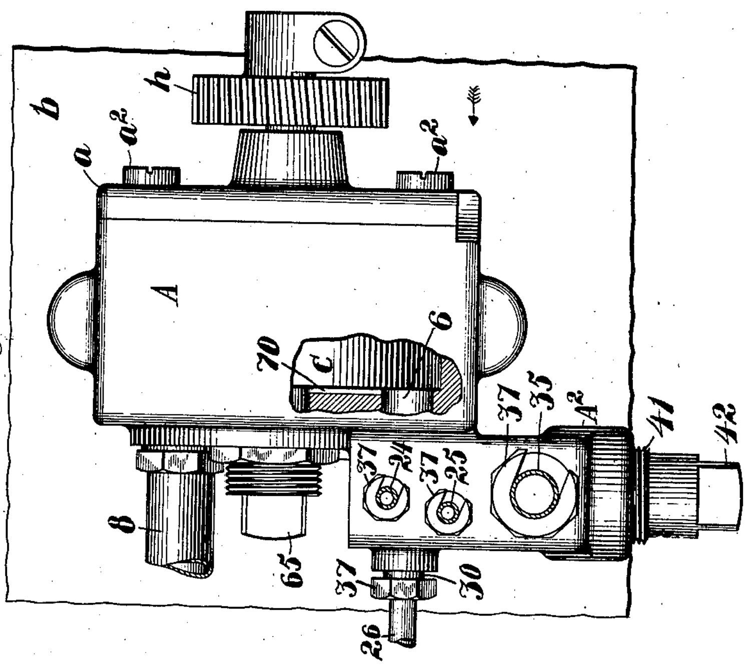
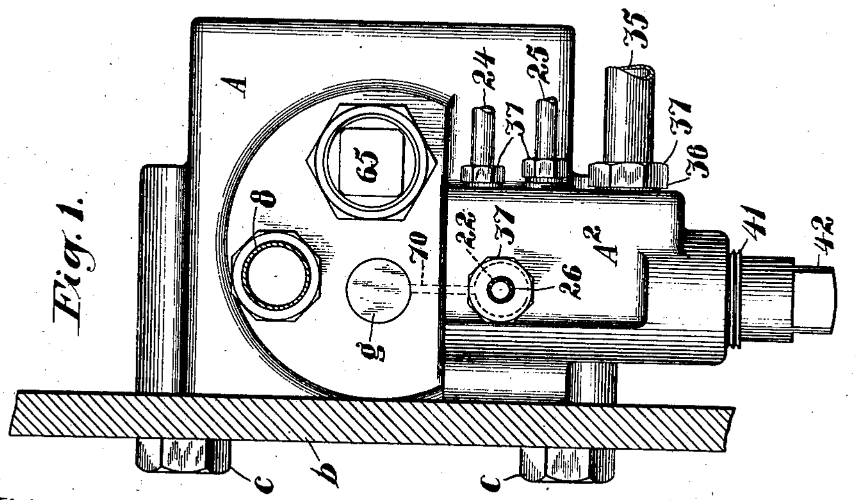


Fig. 1.



Witnesses:

F. C. Fliedner

H. Jacobs.

Inventor

F. H. Richards.

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3 SHEETS—SHEET 2.

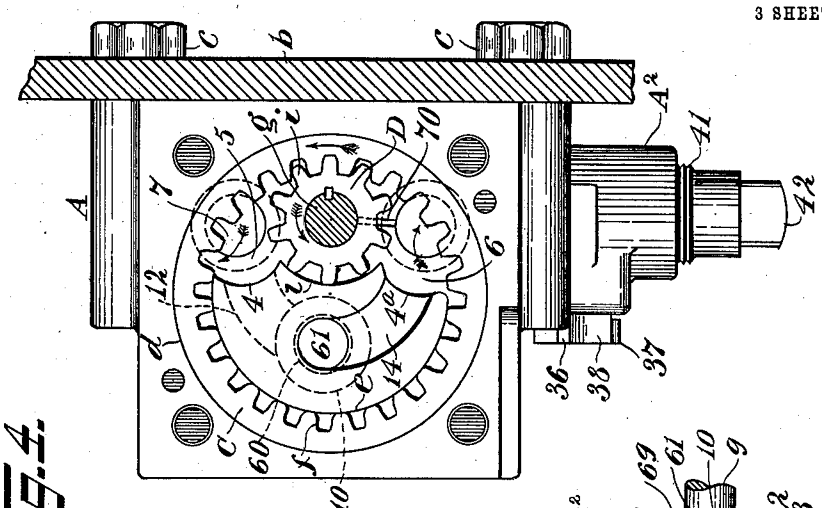

FIG. 4.

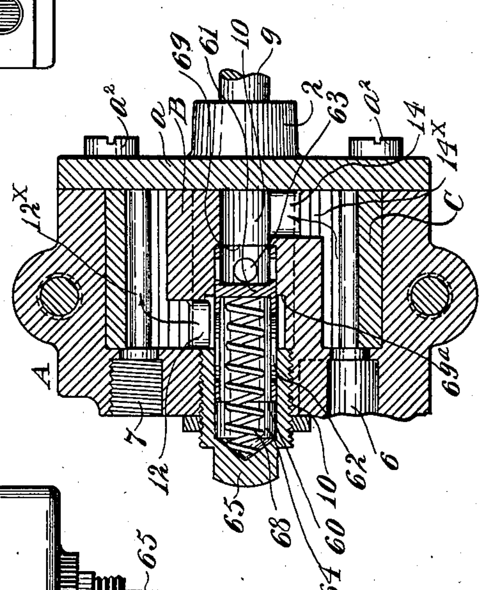

FIG. 12.

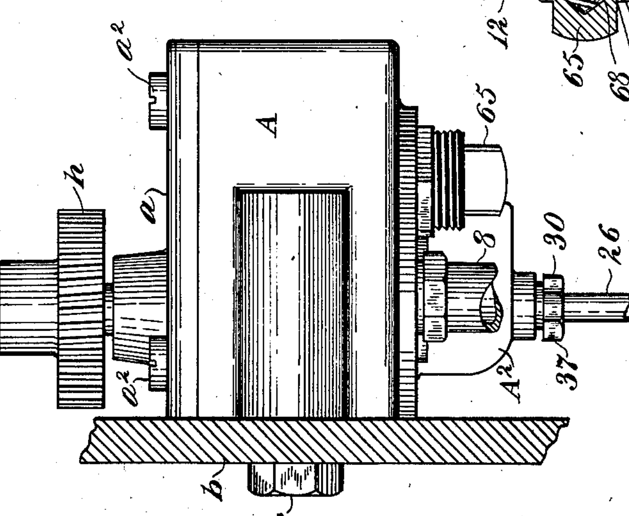

FIG. 3.

Witnesses:

L. C. Badeau.

H. D. Penney

Inventor:

F. H. Richards.

F. H. RICHARDS.

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3 SHEETS—SHEET 3.

Fig. 5.

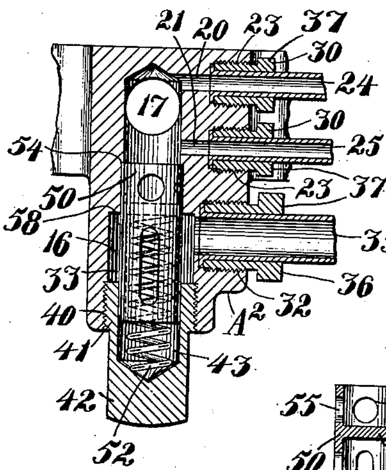


Fig. 6

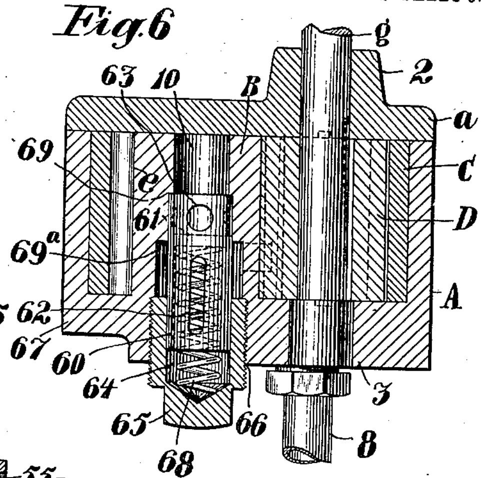


Fig. 7.

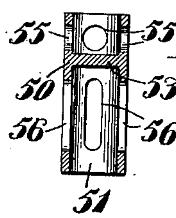


Fig. 8.

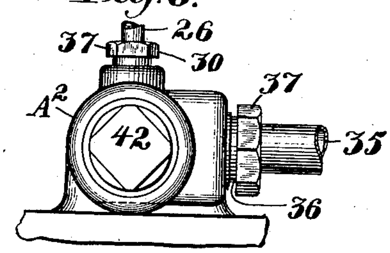


Fig. 10.

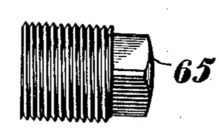


Fig. 9.

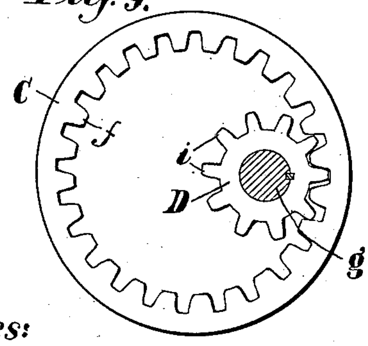
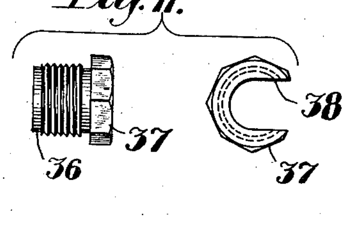


Fig. 11.



Witnesses:

F. C. Fliedner,

H. Jacobs.

Inventor;

F. H. Richards.

UNITED STATES PATENT OFFICE.

FRANCIS H. RICHARDS, OF HARTFORD, CONNECTICUT, ASSIGNOR, BY MESNE ASSIGNMENTS, OF ONE-HALF TO AMERICAN TYPOGRAPHIC CORPORATION, A CORPORATION OF ARIZONA TERRITORY.

FORCE-PUMP.

976,917. Specification of Letters Patent. Patented Nov. 29, 1910.

Application filed May 7, 1902. Serial No. 106,259.

To all whom it may concern:

Be it known that I, FRANCIS H. RICHARDS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Force-Pumps, of which the following is a specification.

This invention relates to pumps, and it consists substantially in the improvements hereinafter particularly described.

The invention has reference more especially to rotary pumps such as are employed for forcing liquid under pressure to a suitable place or places for utilization; and while my improved pump is well adapted for various applications in the different arts, the same possesses special advantages as a service pump for supplying oil to different mechanisms or parts of machinery for lubricating and other purposes.

My improved force pump may be driven directly from any suitable motive power, or else the same may constitute one of a plurality of mechanisms operated from a single source, in which latter case the uniform continuous operation of the pump is desirable in order that there may be no interruptions to the working of the other mechanisms, such for instance as might occur in any attempt to regulate the action of the pump in accordance with the discharge ratio thereof.

One of the principal objects of my invention, therefore, is to provide a rotary force pump with means whereby the continuous effective operation of the pump is maintained irrespective of variations of discharge therefrom; and also whereby the uniform rotary motions of the operative elements of the pump are unaffected notwithstanding the discharge from the pump may be entirely cut off.

A further object of the invention is to provide a rotary geared force pump having great capacity, and one also which operates with reliability and equal efficiency under varying conditions of use as well as under varying speeds at which the same may be driven.

A still further object is to provide a pump of the type or variety named which is exceedingly simple in construction and economical in the assemblage or organization of its parts; and one also which is subject to little or no strain due to back pressure or similar causes.

The above and additional objects are attained by means substantially such as are illustrated in the accompanying drawings wherein:—

Figure 1 is a side view, in part section, of a rotary geared force pump embodying my present improvements; and Fig. 2 is a front elevation thereof, also in part section, and partly broken away to indicate interior construction. Fig. 3, is a top plan view of my improved pump, the support for the pump being in section. Fig. 4, is a side elevation of Fig. 2 looking in the direction of the arrow and with the face plate of the casing of the pump detached or removed, certain parts of the mechanism being in section. Fig. 5, is a sectional view in detail to more clearly indicate the construction and organization of the elements constituting the safety or relief device located externally of the pump. Fig. 6, is a horizontal sectional plan view illustrating the interior construction of the pump more clearly, as well as the construction and mode of operation of the relief device located within the pump. Fig. 7, is a sectional view in detail showing the construction preferably employed for each of the relief devices. Fig. 8, is a view in elevation looking at Fig. 5 from the lower end thereof. Fig. 9, is a view in detail showing the general construction and organization of the working elements or pistons of the pumps; and Fig. 10 is a detail view showing the adjustable hollow plug employed as a seat for the spring of each of the relief valves of the pump. Fig. 11 is a detail view showing the construction of the device employed for effecting connection with the pump structure of the several pipes or tubes employed. Fig. 12, is a sectional view taken in the line 12—12 of Fig. 4.

Before proceeding with a more detailed description it may be stated that I employ a suitable casing in which are operatively mounted the working elements or pistons of the pump, said elements being two in number and consisting of a ring fitting closely within the casing and formed with an internal gear, and a driving pinion engaging such gear, the said pinion being preferably of such relative size as to provide for the accommodation of a relief valve within the diameter of said gear, thereby economizing in space and deriving a much smoother action of the working elements with less accuracy of fit of the gear teeth thereof. Intermediate the said working elements or pistons of the pump is a stationary member having curved surfaces upon or against which the gear teeth of the elements move in the delivery of liquid to the outlet of the pump; and the construction and organization of the several parts are such as to also include within the diameter of the ring an inlet chamber and an outlet chamber for a liquid, said chambers, respectively, being provided with an inlet port and an outlet port. Though one of the working elements or pistons of the pump is a driver for the other, I obtain a delivery to the outlet of the pump of an equal volume of liquid for each of said elements, and thus is the capacity of the pump greatly increased, as will appear.

I connect in any suitable manner with the outlet of the pump, one or more delivery pipes through which the liquid is expelled from the pump to the place or places of utilization thereof; and I also employ a relief valve externally of the pump and which is practically a safety device in that it becomes operative only on back pressure of the liquid, such as takes place on retardation of flow of the liquid at the delivery end of said distributing pipe or pipes. On such retardation the said external relief valve or safety device is operated to open communication between the pump outlet and an additional or reserve distributing pipe, and thus overcome such back pressure; and on complete cutting off or stoppage of flow at the delivery ends of the distributing pipes the relief valve within the pump is operated to establish a short circuit of the liquid from the discharge side of the pump back to the receiving side thereof, and in this way no strain is exerted to the parts of the pump, while at the same time the movements of the working elements or pistons thereof are unaffected by any of the causes leading to the establishment of such short circuit in the manner and by the means hereinafter specifically described. Inasmuch as the first mentioned relief valve is the first to be affected or operated under the conditions mentioned I shall hereinafter refer to the same either as the primary relief valve or safety device, while the relief valve last above mentioned I shall refer to as the secondary valve. It will be understood of course that the primary relief valve requires less pressure to operate the same than does the said secondary relief valve, and also that said primary valve will operate for all the purposes of a safety device (in predetermined limits) without in any manner affecting the secondary valve, and in which case there will be no short circuiting of the liquid within the pump, but at the same time there will be such relief of back pressure within the pump as to prevent any fluctuation in the motions of the working elements thereof. I have emphasized this particular feature of the operation of my improved force pump for the reason that it is of the utmost importance in the use of the pump in connection with other mechanisms operated from the same source of motion. The operative parts of the pump are so organized as to minimize the quantity of liquid which would be required when the pump is used for furnishing liquid to some working mechanism through discharge or distributing pipes, or when the fluid is required intermittently or in quantities subject to considerable variation.

Specific reference being had to the accompanying drawings by the designating characters marked thereon, A, represents a suitable casing for my improved rotary geared force pump, the same being of proper dimensions and provided at one end thereof with a face plate a, held in place by bolts a^2, said casing being herein illustrated as secured to a support b, by means of fastening bolts c, or in any other suitable way, it being apparent, of course, that these small details are of no special significance and may be varied at pleasure. On the interior thereof the casing of the pump is constructed from end to end on a complete circle d, as shown in Fig. 4, and located within such circle, also practically from end to end of the casing, is a stationary member B, approximately crescent-shaped in transverse section, the outer or convex surface e of which member is struck on a circle of smaller diameter than the circle d, and concentric therewith, thus forming a space between said curved surface e, and the adjacent curved portion of the casing, in which is closely fitted a movable ring C, constituting one of the working elements or pistons of the pump, said ring being constructed with continuous internal gear teeth f, as shown, and being also of substantially the same thickness or width as the distance from end to end of both the interior of the casing and the said stationary crescent-shaped member B.

Mounted in suitable bearings 2, and 3, therefor in the end portions of the casing A, is a shaft g which projects somewhat beyond the casing at one end and is provided with a driving gear wheel h, by which connection may be made with suitable driving mechanism for the shaft, said bearings being properly alined to bring the shaft within the inner diameter of the ring to one side of the axis of motion thereof. Said shaft is provided with a pinion D, of relatively small diameter which engages with the internal gear teeth f, of ring C, and constitutes the other working element or piston of the pump, said pinion being of equal thickness or width with the said ring B, and the teeth i, thereof moving over or upon the inner or concave surface l of the crescent-shaped stationary member B, as shown in Fig. 4. The said member B is cut off at the ends thereof, as indicated at 4, and 4^a, so as to form an inlet chamber 5, and an outlet chamber 6, said inlet-chamber having a suitable inlet-port 7, for communication with an inlet pipe 8, leading from a suitable supply tank (not shown) for oil or other liquid; and said outlet chamber being provided with an outlet port which may be connected with one or more distributing pipes substantially in the manner and for the purpose hereinafter specifically explained. Said inlet and outlet chambers are on opposite sides of the axes of the working elements or pistons of the pump, and it will be observed that the convex and concave surface portions e and l of the said crescent-shaped stationary member B, serve to keep a certain number of the interdental spaces of both the ring C, and pinion D, closed, and thus in the rotation of said ring and pinion within the casing quantities of liquid are continuously gathered or taken up into the spaces between the teeth of both sets and successively conveyed by such teeth from the inlet chamber to the outlet chamber of the pump, this being the only means of communication between said chambers except on operation of the secondary relief valve, as presently described. During the operation of the pump the said inlet and outlet chambers are of course filled with liquid, it being understood that the liquid discharged from the pump may be utilized for any desired purpose; and, being constantly crowded into the outlet chamber by the working elements or pistons of the pump the liquid is forced out of the outlet port under pressure proportionate to the speed at which said elements or pistons are driven.

The crescent-shaped stationary member B. is formed with a chamber or conduit 10, extending from end to end thereof, and said member is formed at one end with a curved channel 12, (dotted lines Fig. 4) forming a means of communication between said chamber 10, and the inlet-chamber 5, of the pump, while at the other end the said member is formed with a similar but reversely curved channel 14, for establishing communication between said chamber 10, and the outlet-chamber 6, of the pump, said chamber 10, and the channels 12, and 14 being always practically filled with or at least containing a percentage of the liquid in virtue of the described relation thereof with the said inlet and outlet chambers.

Fitted to or formed with the casing A, of the pump is an auxiliary casing A^2, formed internally with a chamber 16, having an opening 17, for communicating with the outlet port of the pump, said auxiliary casing being formed with lateral openings 20, 21, and 22, (latter shown dotted in Fig. 1) leading to said chamber 16, and the sides or walls of each of which are counterbored and threaded at 23 for the reception of the flanged ends of liquid distributing pipes 24, 25, 26, as well as the threaded portions of the nuts 30, by which said pipes are securely held in place within said openings. The auxiliary casing A^2, is also formed with an enlarged lateral opening 32, leading to the somewhat enlarged lower part 33, of curely held in place within said openings. 32, being also counterbored and threaded a suitable distance from without for the reception of the flanged end of an additional or reserve distributing pipe 35, said latter pipe being also preferably enlarged and likewise secured in place by means of the nut 36. The said nuts 30 and 36, are alike in construction, each having a head 37, and formed entirely open at one side, as indicated at 38, thus enabling the nut to be readily applied to the pipe laterally and both the nut and end of the pipe to be fitted in the opening therefor in the auxiliary casing, as shown. By this means the ends of the distributing pipes of the pump may be quickly connected to or detached from said auxiliary casing, which is very desirable in many instances of use of the pump. Besides, the construction of fastening thus afforded for the ends of said pipes is very simple and thoroughly liquid tight.

The lower end of the chamber 16, of the auxiliary casing A^2 is open, and the sides of said chamber are internally threaded at 40, to receive the threaded portion 41, of a plug 42, screwing into the chamber, the said plug being recessed or hollowed out at 43, from its inner end to receive and permit the working therein of the lower portion of the safety device or primary relief valve 50, (hereinbefore mentioned) said valve being also hollow at 51, and receiving a part of a spiral spring 52, the lower end of which is seated upon the bottom of the recess, and the upper end of which supports the valve by means of a head or portion 53, formed in the latter nearest the upper end thereof. The upper part of said safety device or primary relief valve 50, closely fits the sides of the chamber 16, in which the valve partially works, and the upward movement of the valve is limited by a shoulder 54 in the chamber, the valve being of a length sufficient to extend across the enlarged space 33, of the chamber and having ample working bearings against the walls or sides of both the said chamber and the said recess in the plug. The said primary relief valve 50 is formed with lateral ports 55, at points thereof above the head or partition 53, while below such head the valve is slotted laterally, as shown at 56, which slots permit of displacement of any liquid contained in the plug or lower part of chamber 16, and which is essential to the descent of the valve against the force or tension of the spring 52, whenever the valve is actuated by return or excess of pressure on the upper surface of the said head or partition 53 thereof, it being understood that the lower part of chamber 16 becomes filled with liquid each time the valve is operated to carry the edges of its ports past the shoulder 58, in said chamber. The said primary relief valve, as will be understood, controls the discharge of liquid to the additional or reserve distributing pipe 35, and which pipe remains closed to communication with the pump outlet until the pressure within the outlet chamber 6, exceeds a predetermined point, such as may occur on varying the outflow from the delivery ends of the distributing pipes 24, 25, and 26, or on completely checking or cutting off such outflow. It is of course apparent that instead of employing a plurality of distributing pipes in communication with the pump outlet I may use a single pipe only; and it will also be understood that if desired the said primary relief valve may be employed as a controlling device for preventing discharge of liquid from the pump except at a predetermined pressure, such discharge being automatically cut off by closing of the valve on reduction of such pressure from any cause. In such connection, the said relief valve would be a safety device in a stricter sense than before, and the working thereof in such capacity will be clearly apparent. In the operation of the pump, it may be assumed that liquid is being supplied to the distributing pipes 24, 25, and 26, simultaneously at a certain pressure, and which liquid is discharged at the delivery ends of such pipes for utilization for various purposes. Now, if the pressure in the outlet chamber of the pump is increased from any cause, such for instance by retarding or cutting off the outflow from one or more of said pipes, then the said relief valve 50 is forced open and the excess of liquid allowed to be conducted away by the extra or reserve distributing pipe 35, which latter may also deliver or discharge its liquid at any point or place, as is apparent. As soon as the excess of pressure is removed from the outlet chamber of the pump the valve of course closes again automatically, and the original volume of delivery to the distributing pipes is restored.

In order to prevent disaster to the pump elements from excessive pressure within the pump, and also to enable the motions of such elements to be continuously maintained irrespective of increase of such pressure from any cause, I also employ the secondary relief valve hereinbefore referred to, and which is indicated at 60. Said secondary relief valve is preferably similar in construction to the primary relief valve 50, the same being cylindric in form and hollow, and provided with the head or partition 61, on the longer side of which are formed the slots 62, and on the shorter side of which are formed the ports or openings 63. The inner end or portion of said secondary relief valve closely fits and works within the chamber or conduit 10 in the stationary crescent-shaped member B, of the pump casing, while the outer end or portion thereof closely fits and works within a recess 64, formed in a plug 65, having an externally threaded portion screwing into an opening 66, formed in the corresponding wall 67 of the pump casing. The said secondary relief valve operates against the tension of a spring 68, the inner end of which bears upon the outer side of the head or partition of the valve, and the outer end of which bears upon the end wall of the recess in the plug, the greater part of said spring being inclosed by the valve, and said valve being limited in its inward movement by the shoulder 69, formed in the said chamber or conduit 10, the valve extending across the curved channel 12 in the adjacent end of the said member B. Inasmuch as the said channel 12, and corresponding channel 14 are open to the inlet chamber and outlet chamber of the pump, respectively, it follows that the chamber or conduit 10, is usually filled with liquid on the outlet side of the valve 60, while the interior of said valve, as well as the recess 64, of adjusting plug 65, is also usually filled with liquid on the inlet side of said valve, hence when the latter is operated to cause the edges of the ports therein to be carried past the shoulder 69^a, the liquid within said recess is displaced and passes out through the slots in the valve and thus permits said valve to be moved. This movement or opening of the said secondary relief valve takes place whenever the pressure in the pump is greater than is provided for by the primary relief valve 50, and it will be noted that as soon as edges of the ports of said secondary relief valve are opened to the inlet side of the pump a short circuit of liquid is established from the outlet port to the inlet port via the curved channel 14, chamber or conduit 10, valve 60, and curved channel 12, thence to the inlet chamber, this movement is indicated by the arrows 12^x and 14^x see Fig. 12. In this way, liquid will be continued to be supplied to the delivery pipes to the fullest capacity thereof, while such volume or quantities of the liquid as there may be in excess of the discharge capacity of the pump will be conveyed back to the inlet of the pump in an obvious manner. These operations take place with no perceptible changes or fluctuations in the motions or operative movements of the working elements or pistons of the pump, and which, as hereinbefore stated, is an important feature of my present invention. As is apparent, the said secondary relief valve 60, may be adjusted or set to different pressures by simply turning the plug 65, to alter the tension or power of the spring 68; said secondary valve always being set to require a greater pressure to open the same than is required to open the primary relief valve.

In order to overcome any tendency to vacuum formation within the pump, and consequent drawing in of air with the oil or other liquid, (which is objectionable for several reasons) I provide a suitable channel 70 (see Figs. 2 and 4) leading from some point of the interior of the pump to the outlet or pressure chamber 6, and thus the oil or other liquid may be forced through and out of the pump entirely free or devoid of air bubbles. Preferably, said channel 70, is herein shown as leading to said outlet chamber 6, from one of the bearings of the pump shaft, as shown, and which has been found entirely effective in practice.

It will of course be understood that I am not limited to the details of construction and organization of the several parts herein illustrated, since variations therefrom may be made and still be within the scope of my invention. It will be understood also that my improved force pump is adapted to any of the purposes for which such pumps are usually employed. By simple changes in the organization of the parts the working elements or pistons may be operated in other than vertical planes, if desired, in which case the positions of the inlet and outlet ports may also be altered, according to the particular use to which the pump may be applied.

From the embodiment of the invention herein illustrated it will be noted that only the minimum amount of liquid required to be delivered to and through the delivery pipes is discharged from the pump at any time.

It should be added that the means for establishing the short circuit of liquid between the outlet and inlet ports of the pump are not in any manner dependent for their operation upon the primary relief or safety device, nor conversely, although there is cooperative action between the two; hence said means and said device may each be employed independently for the performance of its particular function.

Having described my invention I claim:

1. A force pump comprising a casing having an inlet and an outlet port and provided with an opening, a movable ring in the casing having internal gear teeth, a pinion engaging such teeth, a stationary member having curved surfaces against which the teeth of the ring and of the pinion move in the operation of said elements, said member having therethrough a conduit in line with the said opening of the casing, and provided with channels leading from the ends of said conduit to the said inlet and outlet ports respectively, a recessed plug fitting said opening, a valve normally closing the channel to the inlet port and reciprocatory in the said conduit and in the said recess of the plug, said valve being hollow and formed with slots and ports and divided by a partition intermediate said slots and ports, and a spring for closing the valve.

2. A force pump, comprising a cylinder having inlet and outlet ports, a pair of rotating pistons therein, and having their juncture of operation between said inlet and outlet ports, an intermediary member between said pistons, and provided with channels also communicating with said inlet and outlet ports, a relief valve communicating with said channels, and an additional relief valve communicating with one of said ports.

3. A force pump, comprising a cylinder having inlet and outlet ports, a pair of pistons rotating therein and in opposite directions, and adapted to communicate from one port to the other port, an intermediary member located between said oppositely rotating pistons, and provided with channels which communicate with said ports, a relief valve communicating with said channels and an additional relief valve communicating with one of said ports.

4. A force pump, comprising a fixed member having inlet and outlet ports, a driving member within said fixed member, a driven member between said driving member and fixed member, a gear construction between said driving and driven member, an intermediary member between said driving and driven member, and provided with a means of short circuit from the inlet and outlet ports of the pump, a relief valve situated in said short circuit, and a second relief valve operatively connected with one of the ports.

5. A force pump, comprising a fixed member, a driving member within said fixed member, a driven member between said driving member and fixed member, a gear construction between said driving and driven member, an intermediary member between said driving and driven member, and provided with a means of short circuit from the inlet and outlet ports of the pump, a relief valve situated in said short circuit, a second relief valve operatively connected with one of the ports, and devices for adjusting said relief valves.

6. A force pump, comprising a fixed member having inlet and outlet ports, two oppo-

sitely rotating pistons therein and communicating with said ports, an intermediary member located between the oppositely rotating pistons, and provided with a short circuit channel to each of said ports, a relief valve in said short circuit, and a second relief valve communicating with one of said ports.

7. A force pump, comprising a fixed member having inlet and outlet ports, two oppositely rotating pistons therein and having working engagement between said ports, an intermediary member located between the oppositely rotating pistons, and provided with a short circuit channel to each of said ports, a relief valve in said short circuit, and a second relief valve communicating with one of said ports.

8. A force pump, comprising a fixed member having inlet and outlet ports, two oppositely rotating pistons therein, and communicating with said ports, an intermediary member located between the oppositely rotating pistons, and provided with a short circuit channel to each of said ports, a relief valve in said short circuit, a second relief valve communicating with one of said ports, and means of adjustment for each of said relief valves.

9. A force pump, comprising a fixed member having inlet and outlet ports, two oppositely rotating geared pistons therein having working engagement between said ports, an intermediary member located between the oppositely rotating pistons, and provided with a short circuit channel to each of said ports, a relief valve in said short circuit, a second relief valve communicating with one of said ports, and means of adjustment for each of said relief valves.

10. A force pump, comprising a fixed member provided with inlet and outlet ports, a hollow piston therein, a driving member provided with a piston located within said hollow piston, a gear construction between said pistons, an intermediary member also between said pistons and provided with a short circuit channel communicating with said ports, a relief valve in said short circuit, and an additional relief valve communicating with one of the ports.

11. A force pump, comprising a cylinder provided with inlet and outlet ports, a pair of oppositely movable pistons located therein, one piston operating as a driver for the other, an intermediary member situated between said pistons and provided with a short circuit channel to said ports, and means to relieve the pressure at one of said ports and also in said channel.

FRANCIS H. RICHARDS.

Witnesses:
JOHN I. SEIFERT,
FRED. J. DOLE.