

Jan. 10, 1950

H. E. RITTENHOUSE ET AL

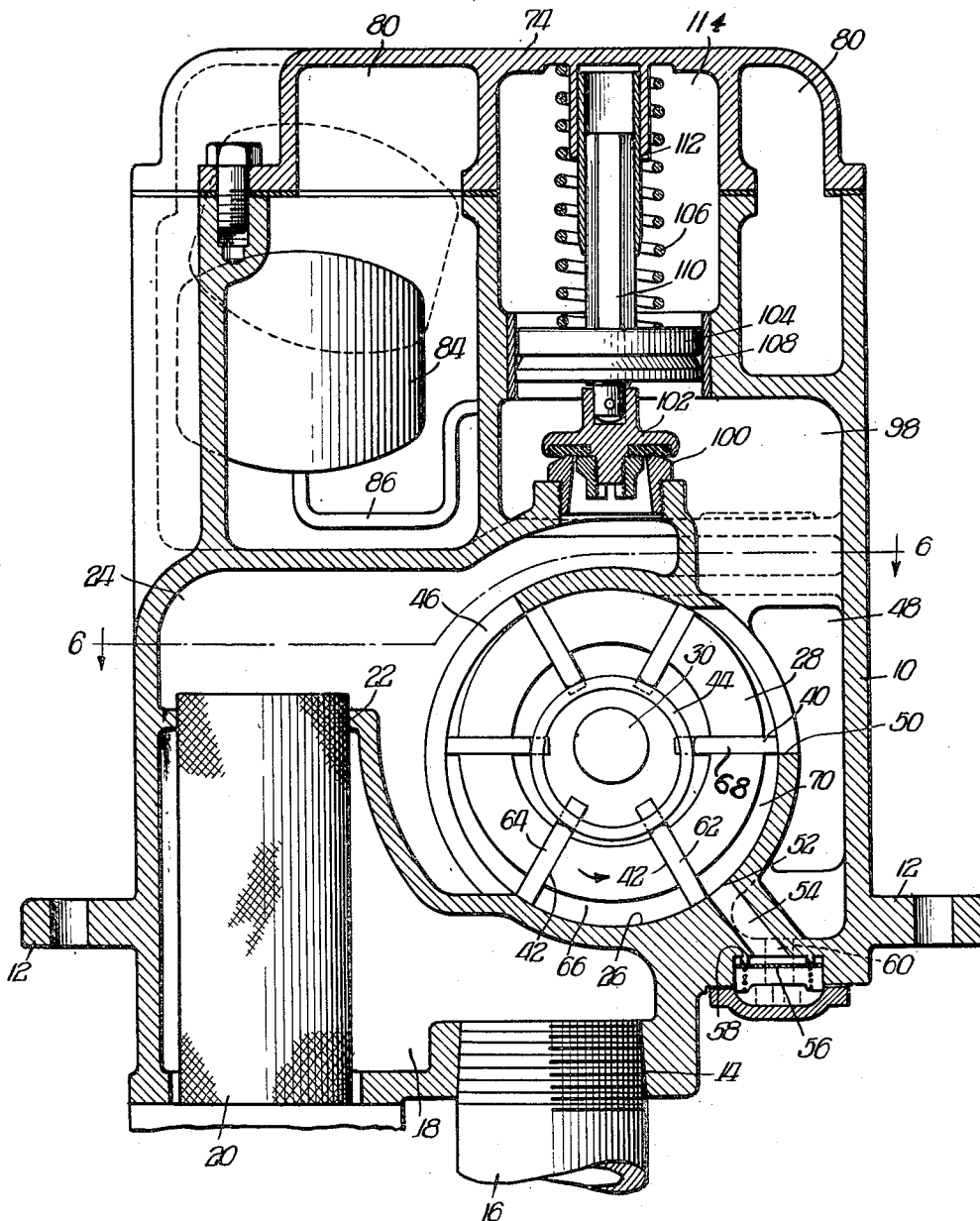
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5 Sheets-Sheet 1

Fig. 1.



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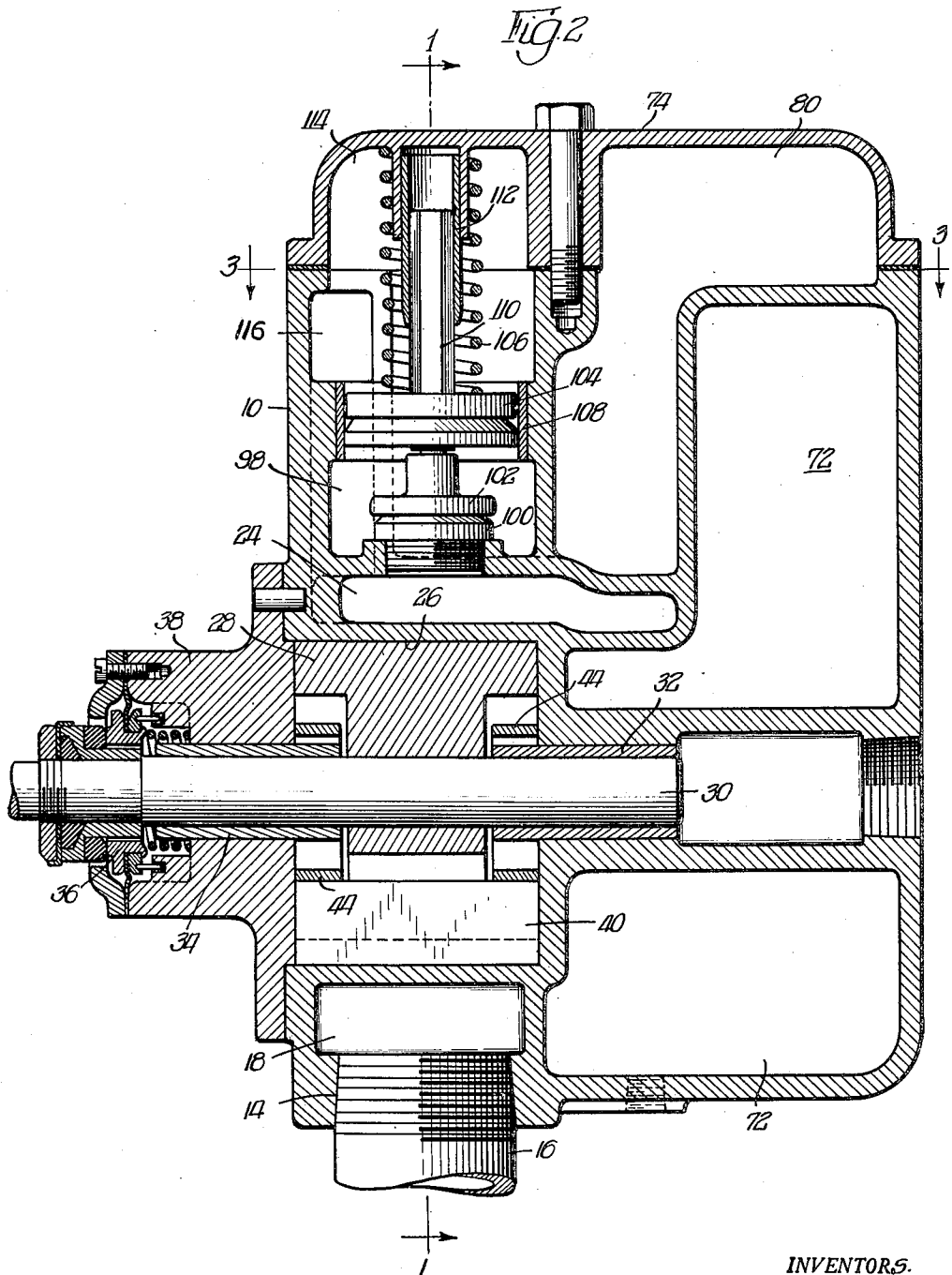
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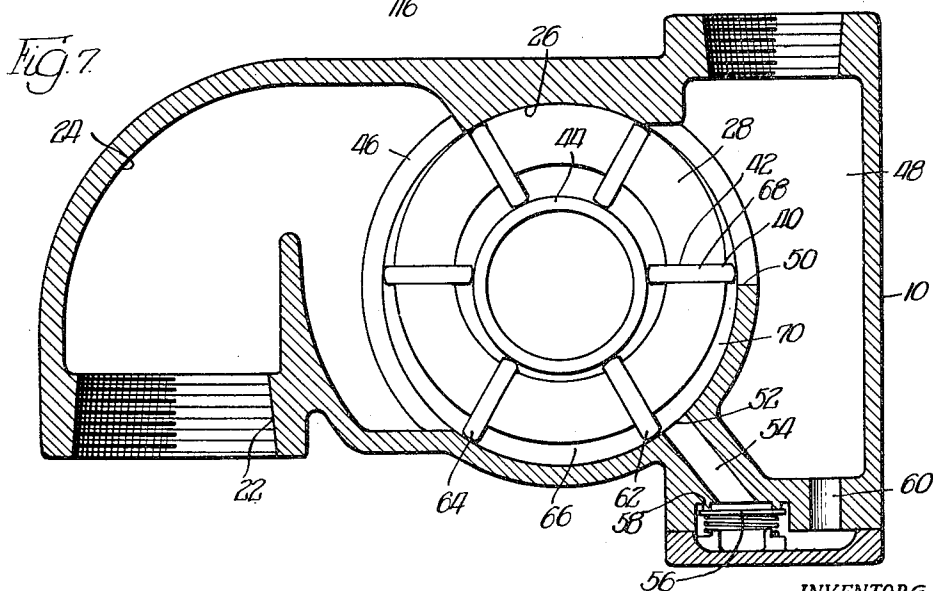
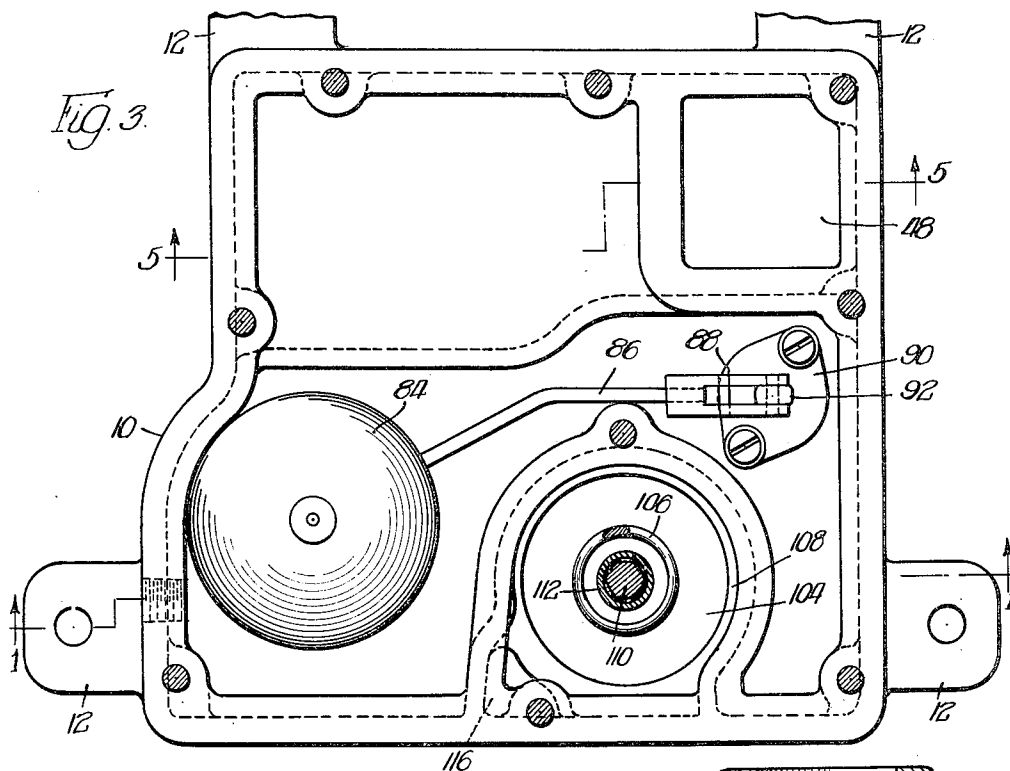
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5 Sheets-Sheet 3



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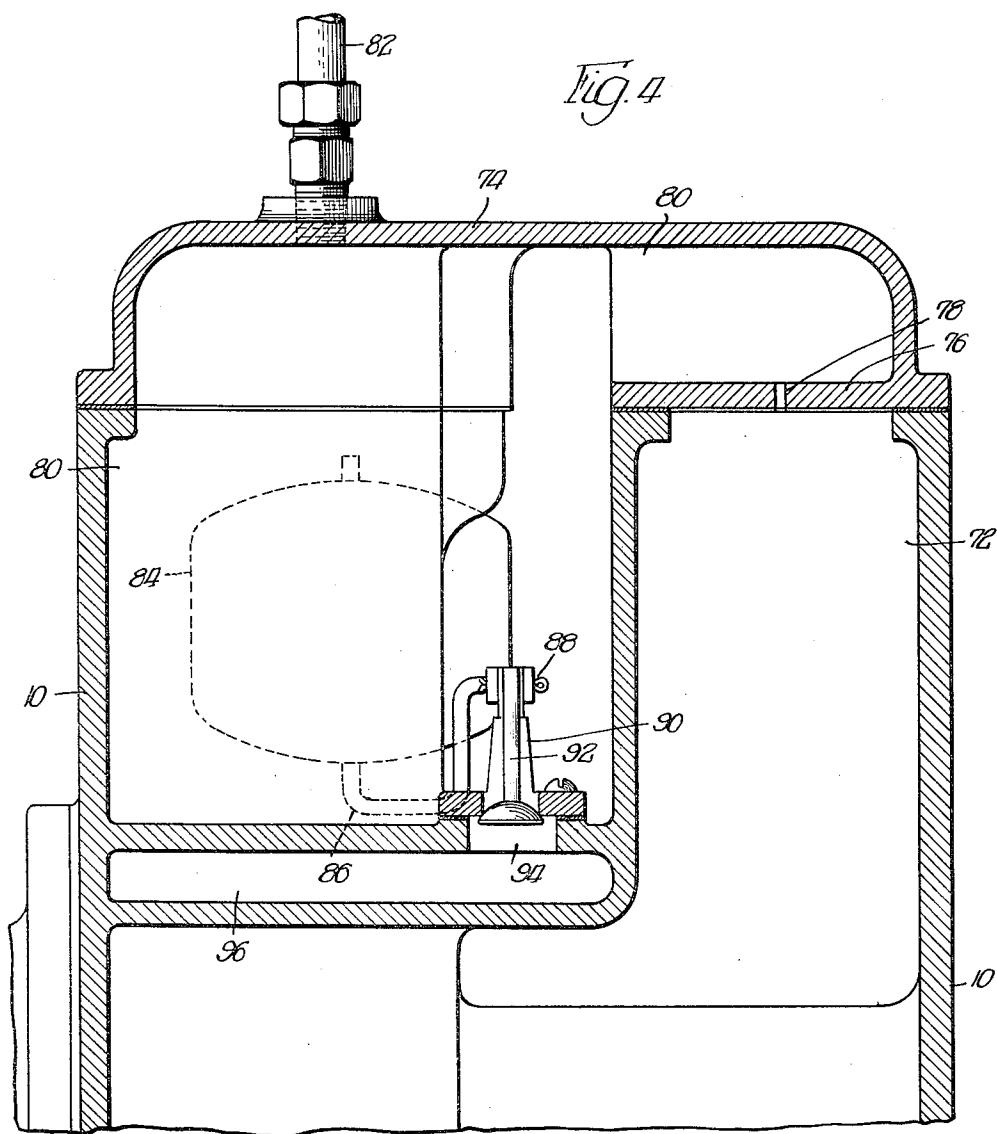
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Fig. 6

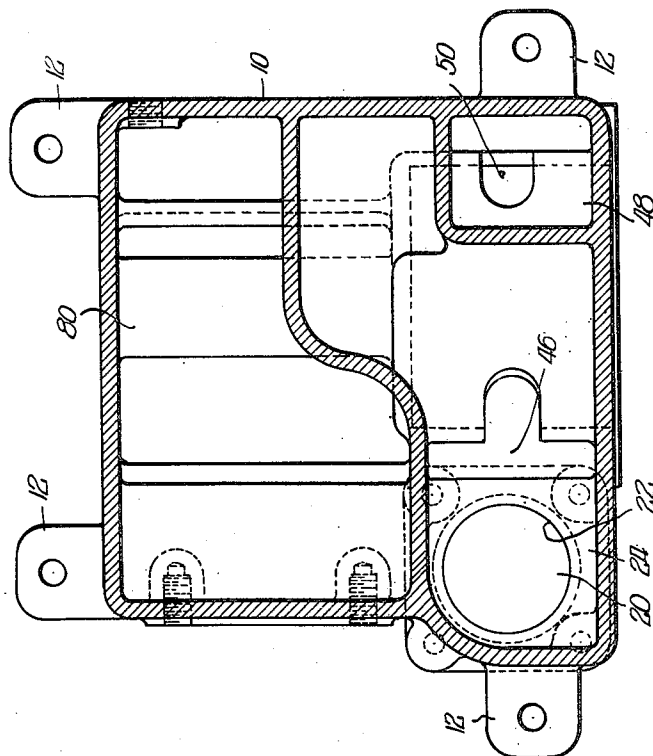
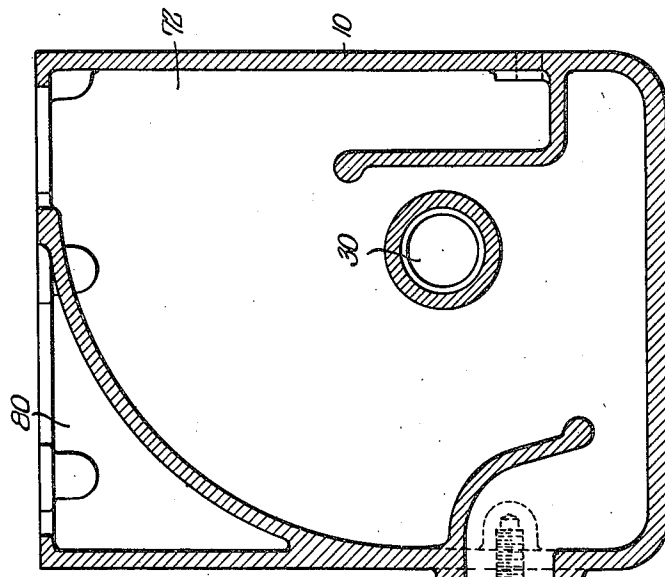


Fig. 5



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UNITED STATES PATENT OFFICE

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Application August 26, 1944, Serial No. 551,280

7 Claims. (Cl. 103—42)

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This invention pertains to a positive displacement pump.

It is an object of this invention to provide a positive displacement pump which is quiet and efficient in action and wherein a high vacuum is maintained.

Another object of the invention is to provide a positive displacement pump provided with an outlet port adapted to open at the time the relief valve closes so that any pressure built up can be relieved until the pressures in the outlet and rotor chambers are equalized as nearly as possible.

Another object of the invention is to provide a positive displacement pump wherein hydraulic shock is eliminated inasmuch as there is no communication between the liquid in the outlet chamber and that still under vacuum.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation as will be more fully described and particularly pointed out in the specification, drawings and claims appended hereto.

In the drawings, which illustrate embodiments of the device and wherein like reference characters are used to designate like parts—

Figure 1 is a sectional elevation of a positive displacement pump embodying the invention, the same being taken substantially in the plane as indicated by the line 1—1 of Figures 2 and 3;

Figure 2 is a longitudinal sectional elevation taken substantially in the plane of the rotor shaft;

Figure 3 is a top plan view taken substantially in the plane as indicated by the line 3—3 of Figure 2;

Figure 4 is a fragmentary sectional elevation showing the pressure and atmosphere chambers of the pump illustrated in Figure 1;

Figure 5 is a sectional elevation taken substantially in the plane as indicated by the line 5—5 of Figure 3;

Figure 6 is a sectional plan view taken substantially in the plane as indicated by the line 6—6 of Figure 1; and

Figure 7 is a developed view of the pump rotor and relief valve, the air separator being omitted.

In the pump illustrated, the pump casing 10 having securing supports 12, is provided with the inlet port 14 adapted to be connected to the suction pipe 16, the port 14 communicating with the strainer chamber 18 provided with a strainer 20. The chamber 18 communicates through port 22 with the suction chamber 24 which in turn communicates with the rotor chamber 26 within

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which the rotor 28 is rotatably mounted. The rotor 28 is provided with the rotor shaft 30 journaled in the casing as at 32 and 34, a suitable seal 36 being provided in the closure 38 of the rotor chamber at the point where the shaft 30 extends through the closure, and the end of the shaft 30 is provided with suitable drive means for rotation of the shaft and rotor.

The rotor 28 is provided with suitable blades 40 spaced equidistantly and slidably disposed in suitable slots 42 in the rotor. Rings 44 are disposed adjacent each end of the rotor in engagement with the inner edges of the blades whereby the blades are always positively urged into engagement with the core defining the chamber 26. The chamber 26 is in communication with the inlet chamber 24 through the inlet port 46 and the chamber 26 is in communication with the outlet chamber 48 through the outlet port 50.

A relief port 52 is provided in communication with the chamber 26, the port communicating with passage 54 normally closed by the spring-pressed valve 56 seated on the seat 58. When the valve 56 is in open position, passage 54 communicates with passage 60 (Figures 1 and 7) which in turn is connected to the outlet chamber 48. In order to properly locate the ports 46, 52 and 50 so that the proper capacity of pump is provided as well as eliminating noise, such as hydraulic shock, the relief port 52 must be separated from the inlet port 46 by a blade, and when blade 62 is in position wherein it is just about to open port 52, the following blade 64 must have closed the inlet port whereby the blade chamber 66 is provided which maintains its highest vacuum.

The preceding blade 68 (to blade 62) must start to open the port 50 at substantially the time the relief port 52 starts to close so that any pressure built up in chamber 70 can be relieved whereby the pressures in the outlet chamber 48 and chamber 70 are equalized as nearly as possible. Further, the liquid in the outlet chamber 48 must not be in communication with the liquid in chamber 66, that is, the liquid in the chamber which is still under vacuum, as this would cause a condition of hydraulic shock. The inlet port 46 must be large enough so that a maximum amount of liquid will be trapped or supplied to chamber 66. Theoretically, cavitation ceases under the conditions of highest lift at the time discharge port 50 begins to open and, therefore, the relief valve 56 would be inoperative, that is, it would remain closed under these conditions. However, under low lift conditions, the chamber 66 in the position illustrated in Figure 1, that is, before the

chamber 66 starts to decrease in volume, may be substantially filled with liquid so that as the chamber 66 decreases in volume, pressure is built up in the chamber and as liquid is substantially incompressible, more power would be required to rotate the rotor shaft and the liquid would seek to escape past the blades. This pressure is relieved by opening of the valve 56 which bypasses a small amount of liquid through passages 54 and 60 to the discharge chamber 48.

In the form of pump illustrated, a six-bladed rotor is shown and where a six-bladed rotor is used it has been found that the entrance of the port 50, considering the rotor to be rotating in a counter-clockwise direction, is substantially in a horizontal plane passing through the center line of shaft 30. The entrance to the relief port 52 is spaced from the entrance to the exhaust port 50 by the arc of the rotor recess measured between adjacent faces of adjacent blades. The exit of the inlet port 46 is spaced from the entrance to the discharge port measured along the arc of the rotor recess by the distance between adjacent faces of two consecutive blades plus the thickness of one blade. Theoretically, of course, it would be sufficient that the difference between the exit from the inlet port 46 and the entrance to the relief port 52 is such that blades 62 and 64 completely close the chamber 66 just prior to opening port 52 by blade 62 and just after blade 64 has left port 46. The thickness of the blades is merely added to the length of the chamber 66 to insure that the chamber will be closed. The entrance of the inlet port is spaced from the exit of the outlet port 50 preferably by a distance which insures sealing between chambers 48 and 24, thus this distance is preferably chosen so that there will be a maximum two-blade seal.

The outlet chamber 48 communicates with the pressure chamber 72 of the air separator portion of the pump and a head 74 is provided having a wall 76 closing the chamber 72 but being provided with a relatively small vent passage 78 permitting very restricted communication between chamber 72 and the float or atmosphere chamber 80. The atmosphere chamber is in communication with the atmosphere through the vent pipe 82 and the float 84 is provided with the rod 86 pivoted as at 88 to the pedestal 90 and is provided with the valve 92 adapted to control the port 94 in communication with passage 96 which in turn communicates with the suction chamber 24.

When the liquid level in the atmosphere chamber has been raised to a predetermined amount the float, of course, raises to open the valve 92 to permit the liquid to flow back to the suction side of the pump. The chamber 48 is in communication with the valve chamber 98 provided with the valve seat 100 adapted to be closed by means of the valve 102. The valve 102 is provided with the piston 104 urged downwardly to valve closed position by means of the spring 106, the piston 104 being slidably mounted in the cylinder 108. The piston is provided with a hex piston rod 110 guided in cylindrical guide 112 secured in head 74.

The piston is of a larger area than the valve 102 so that there will be a differential in area whereby a predetermined pressure on the piston 104 will tend to open the valve 102. This is aided by the chamber 114 above the piston, being in communication through the passage 116 with the suction side of the pump whereby the pressure and suction tend to open the valve 102 so that, in the case of a liquid dispensing apparatus, if the dispensing nozzle is closed, the pump will

readily by-pass liquid from the chamber 48 to chamber 98 past the valve seat 100 to the suction chamber 24.

It is to be understood that this application is not to be limited by the exact embodiments of the device shown, which are merely by way of illustration and not limitation, as various and other forms of the device will, of course, be apparent to those skilled in the art without departure from the spirit of the invention or the scope of the claims.

We claim:

1. A pump for pumping liquid, comprising a pump housing having an inlet chamber adapted to be connected to a source of liquid supply, a rotor chamber, and an outlet chamber, said rotor chamber having an inlet connecting the inlet and rotor chambers and having an outlet connecting said rotor and outlet chambers, a bladed rotor eccentrically and rotatably mounted in said rotor chamber for moving liquid from said inlet chamber to said outlet chamber, said inlet and outlet each having an entrance and an exit, the blades of the rotor moving from the entrance to the exit of each of said inlet and outlet upon rotation of the rotor, the rotor being so disposed that it is spaced from the walls of the rotor chamber between the entrance of the inlet and the exit of the outlet and closely engaging the walls of the rotor chamber between the exit of the outlet and the entrance to the inlet, means for causing the edges of the rotor blades to engage the walls of the rotor housing, said housing having a valve chamber connecting said outlet and inlet chambers, a valve in said valve chamber controlling flow between said inlet and outlet chambers, said valve closing toward said inlet chamber, said housing having a cylinder adjacent said valve, said cylinder having a closed end and an open end, said open end communicating with said valve chamber, a piston slidably mounted in said cylinder and connected to said valve whereby movement of said piston moves said valve, and resilient means urging said valve toward valve closing position, the side of said piston toward the open end of the cylinder being subjected to pressure in said valve chamber whereby said piston urges the valve to valve open position, said housing having a passage connecting said inlet chamber with the closed end of said cylinder whereby suction from said inlet chamber acts on the side of the piston opposite to that upon which the pressure in the valve chamber acts so that suction and pressure act to control said valve, said housing having a pressure chamber connected to said outlet chamber and an atmosphere chamber connected to atmosphere and connected through a restricted vent opening to said pressure chamber, said atmosphere chamber being connected to said suction chamber, and a float controlled valve in said atmosphere chamber for controlling flow from said atmosphere chamber to said suction chamber.

2. A pump for pumping liquid, comprising a pump housing having an inlet chamber adapted to be connected to a source of liquid supply, a rotor chamber, and an outlet chamber, said rotor chamber having an inlet connecting the inlet and rotor chambers and having an outlet connecting said rotor and outlet chambers, a bladed rotor eccentrically and rotatably mounted in said rotor chamber for moving liquid from said inlet chamber to said outlet chamber, said inlet and outlet each having an entrance and an exit, the blades of the rotor moving from the entrance to

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the exit of each of said inlet and outlet upon rotation of the rotor, the rotor being so disposed that it is spaced from the walls of the rotor chamber between the entrance of the inlet and the exit of the outlet and closely engaging the walls of the rotor chamber between the exit of the outlet and the entrance to the inlet, means for causing the edges of the rotor blades to engage the walls of the rotor housing, said housing having a valve chamber connecting said outlet and inlet chambers, a valve in said valve chamber controlling flow between said inlet and outlet chambers, said valve closing toward said inlet chamber, said housing having a cylinder adjacent said valve, said cylinder having a closed end and an open end, said open end communicating with said valve chamber, a piston slidably mounted in said cylinder and connected to said valve whereby movement of said piston moves said valve, and resilient means urging said valve toward valve closing position, the side of said piston toward the open end of the cylinder being subjected to pressure in said valve chamber whereby said piston urges the valve to valve open position, said housing having a passage connecting said inlet chamber with the closed end of said cylinder whereby suction from said inlet chamber acts on the side of the piston opposite to that upon which the pressure in the valve chamber acts so that suction and pressure act to control said valve, said housing having a pressure chamber connected to said outlet chamber and an atmosphere chamber connected to atmosphere and connected through a restricted vent opening to said pressure chamber, said atmosphere chamber being connected to said suction chamber, and a float controlled valve in said atmosphere chamber for controlling flow from said atmosphere chamber to said suction chamber, said rotor chamber having a relief port between said inlet and outlet connecting the rotor chamber with said outlet chamber, a valve normally closing said port, and resilient means urging said valve toward closed position.

3. A pump for pumping liquid, comprising a pump housing having an inlet chamber adapted to be connected to a source of liquid supply, a rotor chamber, and an outlet chamber, said rotor chamber having an inlet connecting the inlet and rotor chambers and having an outlet connecting said rotor and outlet chambers, a bladed rotor eccentrically and rotatably mounted in said rotor chamber for moving liquid from said inlet chamber to said outlet chamber, said inlet and outlet each having an entrance and an exit, the blades of the rotor moving from the entrance to the exit of each of said inlet and outlet upon rotation of the rotor, the rotor being so disposed that it is spaced from the walls of the rotor chamber between the entrance of the inlet and the exit of the outlet and closely engaging the walls of the rotor chamber between the exit of the outlet and the entrance to the inlet, means for causing the edges of the rotor blades to engage the walls of the rotor housing, said housing having a valve chamber connecting said outlet and inlet chambers, a valve in said valve chamber controlling flow between said inlet and outlet chambers, said valve closing toward said inlet chamber, said housing having a cylinder adjacent said valve, said cylinder having a closed end and an open end, said open end communicating with said valve chamber, a piston slidably mounted in said cylinder and connected to said valve whereby move-

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ment of said piston moves said valve, and resilient means urging said valve toward valve closing position, the side of said piston toward the open end of the cylinder being subjected to pressure in said valve chamber whereby said piston urges the valve to valve open position, said housing having a passage connecting said inlet chamber with the closed end of said cylinder whereby suction from said inlet chamber acts on the side of the piston opposite to that upon which the pressure in the valve chamber acts so that suction and pressure act to control said valve, said rotor chamber having a relief port between said inlet and outlet connecting the rotor chamber with said outlet chamber, a valve normally closing said port, and resilient means urging said valve toward closed position.

4. A pump for pumping liquid, comprising a pump housing having an inlet chamber adapted to be connected to a source of liquid supply, a rotor chamber, and an outlet chamber, said rotor chamber having an inlet connecting the inlet and rotor chambers and having an outlet connecting said rotor and inlet chambers, a bladed rotor eccentrically and rotatably mounted in said rotor chamber for moving liquid from said inlet chamber to said outlet chamber, said inlet and outlet each having an entrance and an exit, the blades of the rotor moving from the entrance to the exit of each of said inlet and outlet upon rotation of the rotor, the rotor being so disposed that it is spaced from the walls of the rotor chamber between the entrance of the inlet and the exit of the outlet and closely engaging the walls of the rotor chamber between the exit of the outlet and the entrance to the inlet, means for causing the edges of the rotor blades to engage the walls of the rotor housing, said rotor chamber having a relief port between said inlet and outlet connecting the rotor chamber with said outlet chamber, a valve normally closing said port, and resilient means urging said valve toward closed position, said housing having a pressure chamber connected to said outlet chamber and an atmosphere chamber connected to atmosphere and connected through a restricted vent opening to said pressure chamber, said atmosphere chamber being connected to said suction chamber, and a float controlled valve in said atmosphere chamber for controlling flow from said atmosphere chamber to said suction chamber.

5. A pump for pumping liquid, comprising a pump housing having an inlet chamber adapted to be connected to a source of liquid supply, a rotor chamber, and an outlet chamber, said rotor chamber having an inlet connecting the inlet and rotor chambers and having an outlet connecting said rotor and inlet chambers, a bladed rotor eccentrically and rotatably mounted in said rotor chamber for moving liquid from said inlet chamber to said outlet chamber, said inlet and outlet each having an entrance and an exit, the blades of the rotor moving from the entrance to the exit of each of said inlet and outlet upon rotation of the rotor, the rotor being so disposed that it is spaced from the walls of the rotor chamber between the entrance of the inlet and the exit of the outlet and closely engaging the walls of the rotor chamber between the exit of the outlet and the entrance to the inlet, means for causing the edges of the rotor blades to engage the walls of the rotor housing, said rotor chamber having a relief port between said inlet and outlet connecting the rotor chamber with said outlet chamber, a valve normally closing said port, and resilient

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means urging said valve toward closed position, the relief port having an entrance and exit, the entrance to the relief port being between the exit of the inlet and the exit to the relief port, the distance between the exit of the inlet and the entrance of the relief port being such that adjacent blades of the rotor close the chamber defined by said adjacent blades and the wall of the rotor chamber and the rotor between said blades, prior to the time the leading of said blades opens said relief port, the distance between the exit of the outlet and the entrance of the inlet being such that two adjacent blades of the rotor act as seals between the inlet and outlet chambers by the edges of said last named blades engaging the wall of the rotor chamber, and the distance between the entrance of the outlet and the entrance of the relief port being the space between the adjacent faces of adjacent blades measured on the arc of the rotor chamber.

6. A pump for pumping liquid, comprising a pump housing having an inlet chamber adapted to be connected to a source of liquid supply, a rotor chamber, and an outlet chamber, said rotor chamber having an inlet connecting the inlet and rotor chambers and having an outlet connecting said rotor and inlet chambers, a bladed rotor eccentrically and rotatably mounted in said rotor chamber for moving liquid from said inlet chamber to said outlet chamber, said inlet and outlet each having an entrance and an exit, the blades of the rotor moving from the entrance to the exit of each of said inlet and outlet upon rotation of the rotor, the rotor being so disposed that it is spaced from the walls of the rotor chamber between the entrance of the inlet and the exit of the outlet and closely engaging the walls of the rotor chamber between the exit of the outlet and the entrance to the inlet, means for causing the edges of the rotor blades to engage the walls of the rotor housing, said rotor chamber having a relief port between said inlet and outlet connecting the rotor chamber with said outlet chamber, a valve normally closing said port, and resilient means urging said valve toward closed position, the relief port having an entrance and exit, the entrance to the relief port being between the exit of the inlet and the exit to the relief port, the distance between the exit of the inlet and the entrance of the relief port being such that adjacent blades of the rotor close the chamber defined by said adjacent blades and the wall of the rotor chamber and the rotor between said blades, prior to the time the leading of said blades opens said relief port, the distance between the exit of the outlet and the entrance of the inlet being such that two adjacent blades of the rotor act as seals between the inlet and outlet chambers by the edges of said last named blades engaging the wall of the rotor chamber, and the distance between the entrance of the outlet and the entrance of the relief port being the space between the adjacent faces of adjacent blades measured on the arc of the rotor chamber, said housing having a valve chamber connecting said outlet and inlet chambers, a valve in said valve chamber controlling flow between said inlet and outlet chambers, said valve closing toward said inlet chamber, said housing having a cylinder adjacent said valve, said cylinder having a closed end and an open end, said open end communicating with said valve chamber, a piston slidably mounted in said cylinder and connected to said valve whereby movement of said piston moves said valve, and resilient means urging said valve toward

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valve closing position, the side of said piston toward the open end of the cylinder being subjected to pressure in said valve chamber whereby said piston urges the valve to valve open position, said housing having a passage connecting said inlet chamber with the closed end of said cylinder whereby suction from said inlet chamber acts on the side of the piston opposite to that upon which the pressure in the valve chamber acts so that suction and pressure act to control said valve.

7. A pump for pumping liquid, comprising a pump housing having an inlet chamber adapted to be connected to a source of liquid supply, a rotor chamber, and an outlet chamber, said rotor chamber having an inlet connecting the inlet and rotor chambers and having an outlet connecting said rotor and inlet chambers, a bladed rotor eccentrically and rotatably mounted in said rotor chamber for moving liquid from said inlet chamber to said outlet chamber, said inlet and outlet each having an entrance and an exit, the blades of the rotor moving from the entrance to the exit of each of said inlet and outlet upon rotation of the rotor, the rotor being so disposed that it is spaced from the walls of the rotor chamber between the entrance of the inlet and the exit of the outlet and closely engaging the walls of the rotor chamber between the exit of the outlet and the entrance to the inlet, means for causing the edges of the rotor blades to engage the walls of the rotor housing, said rotor chamber having a relief port between said inlet and outlet connecting the rotor chamber with said outlet chamber, a valve normally closing said port, and resilient means urging said valve toward closed position, the relief port having an entrance and exit, the entrance to the relief port being between the exit of the inlet and the exit to the relief port, the distance between the exit of the inlet and the entrance of the relief port being such that adjacent blades of the rotor close the chamber defined by said adjacent blades and the wall of the rotor chamber and the rotor between said blades, prior to the time the leading of said blades opens said relief port, the distance between the exit of the outlet and the entrance of the inlet being such that two adjacent blades of the rotor act as seals between the inlet and outlet chambers by the edges of said last named blades engaging the wall of the rotor chamber, and the distance between the entrance of the outlet and the entrance of the relief port being the space between the adjacent faces of adjacent blades measured on the arc of the rotor chamber, said housing having a valve chamber connecting said outlet and inlet chambers, a valve in said valve chamber controlling flow between said inlet and outlet chambers, said valve closing toward said inlet chamber, said housing having a cylinder adjacent said valve, said cylinder having a closed end and an open end, said open end communicating with said valve chamber, a piston slidably mounted in said cylinder and connected to said valve whereby movement of said piston moves said valve, and resilient means urging said valve toward valve closing position, the side of said piston toward the open end of the cylinder being subjected to pressure in said valve chamber whereby said piston urges the valve to valve open position, said housing having a passage connecting said inlet chamber with the closed end of said cylinder whereby suction from said inlet chamber acts on the side of the piston opposite to that upon which the pressure in the valve chamber acts so that suc-

tion and pressure act to control said valve, said housing having a pressure chamber connected to said outlet chamber and an atmosphere chamber connected to atmosphere and connected through a restricted vent opening to said pressure chamber, said atmosphere chamber being connected to said suction chamber, and a float controlled valve in said atmosphere chamber for controlling flow from said atmosphere chamber to said suction chamber.

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