Sept. 4, 1945. R. J. JAUCH ET AL 2,384,172

PUMP

Filed June 23, 1944 6 Sheets-Sheet 1

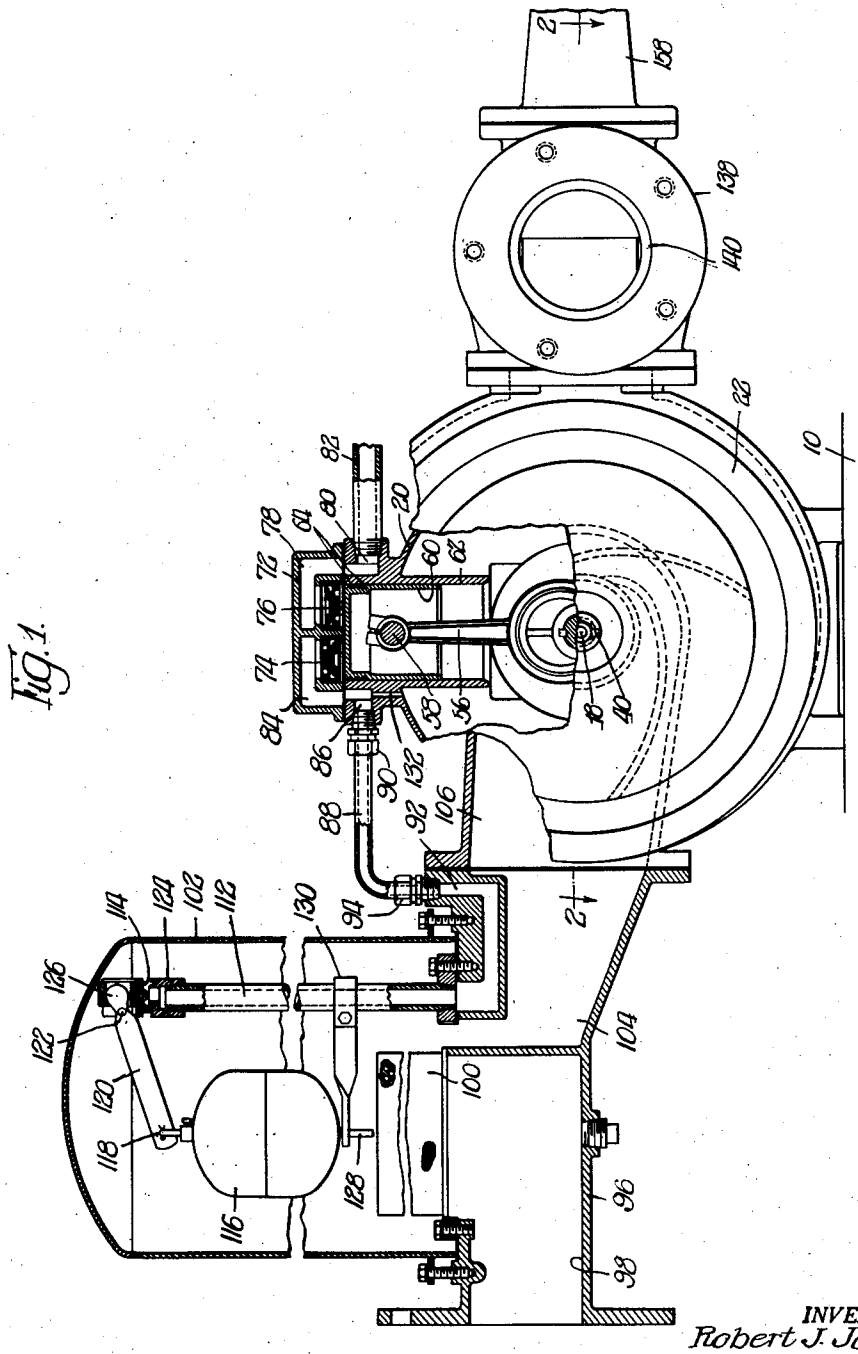


Fig. 1.

INVENTOR.
Robert J. Jauch,
Sherwood Hinds,

BY

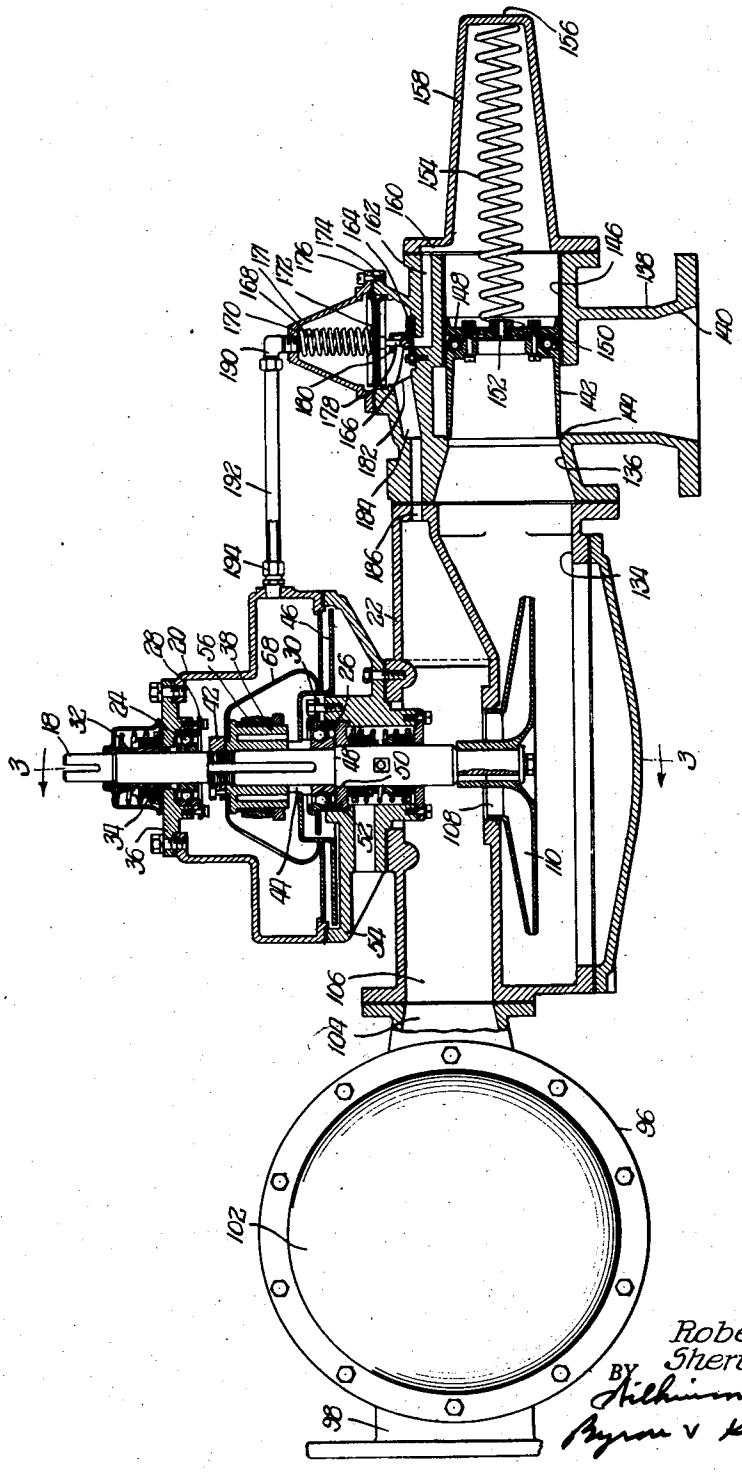
Wilkinson, Huxley, Byron & Knight
Attys

Sept. 4, 1945. R. J. JAUCH ET AL 2,384,172

PUMP

Filed June 23, 1944 6 Sheets-Sheet 2

Fig. 2.



INVENTOR.
Robert J. Jauch,
Sherwood Hinds,
BY Wilkinson, Huxley
Byron & Knight
Attys.

Sept. 4, 1945. R. J. JAUCH ET AL 2,384,172

PUMP

Filed June 23, 1944 6 Sheets-Sheet 3

Fig. 3

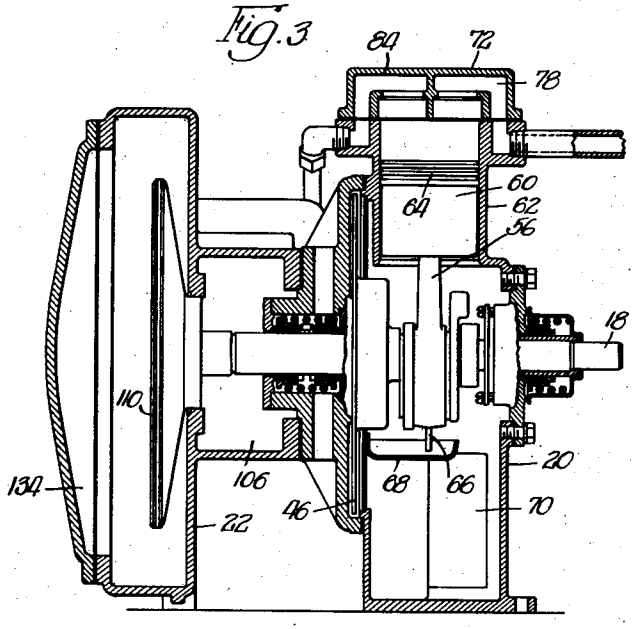
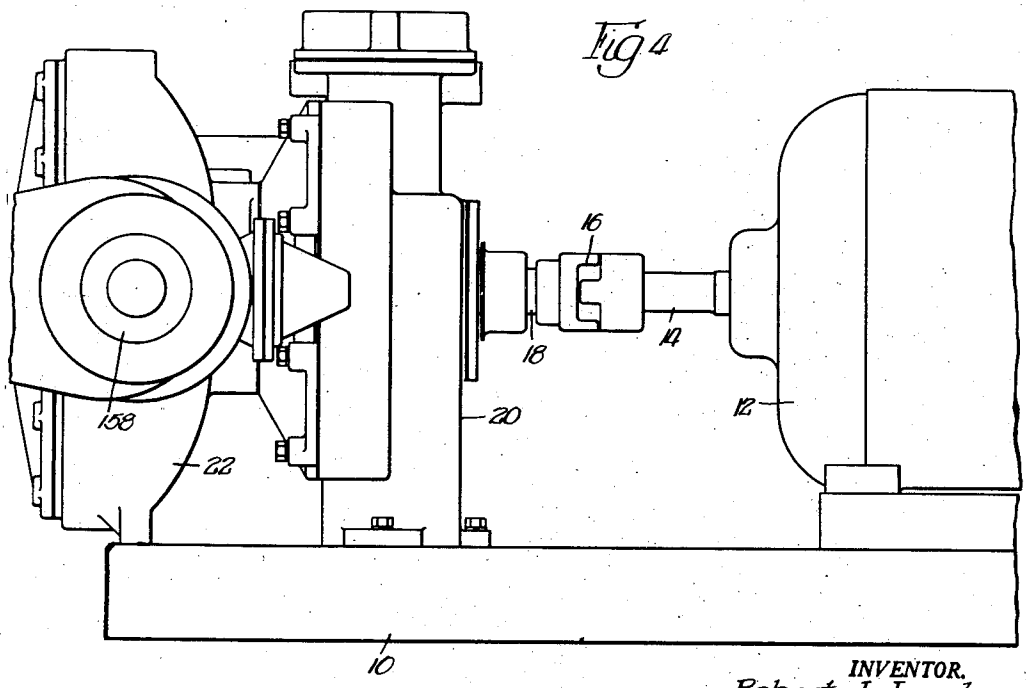


Fig 4



INVENTOR.
Robert J. Jauch,
BY Sherwood Hinds,
Wilkinson Huxley
Byron & King
attys.

Sept. 4, 1945. R. J. JAUCH ET AL 2,384,172

PUMP

Filed June 23, 1944 6 Sheets-Sheet 4

Fig. 5.

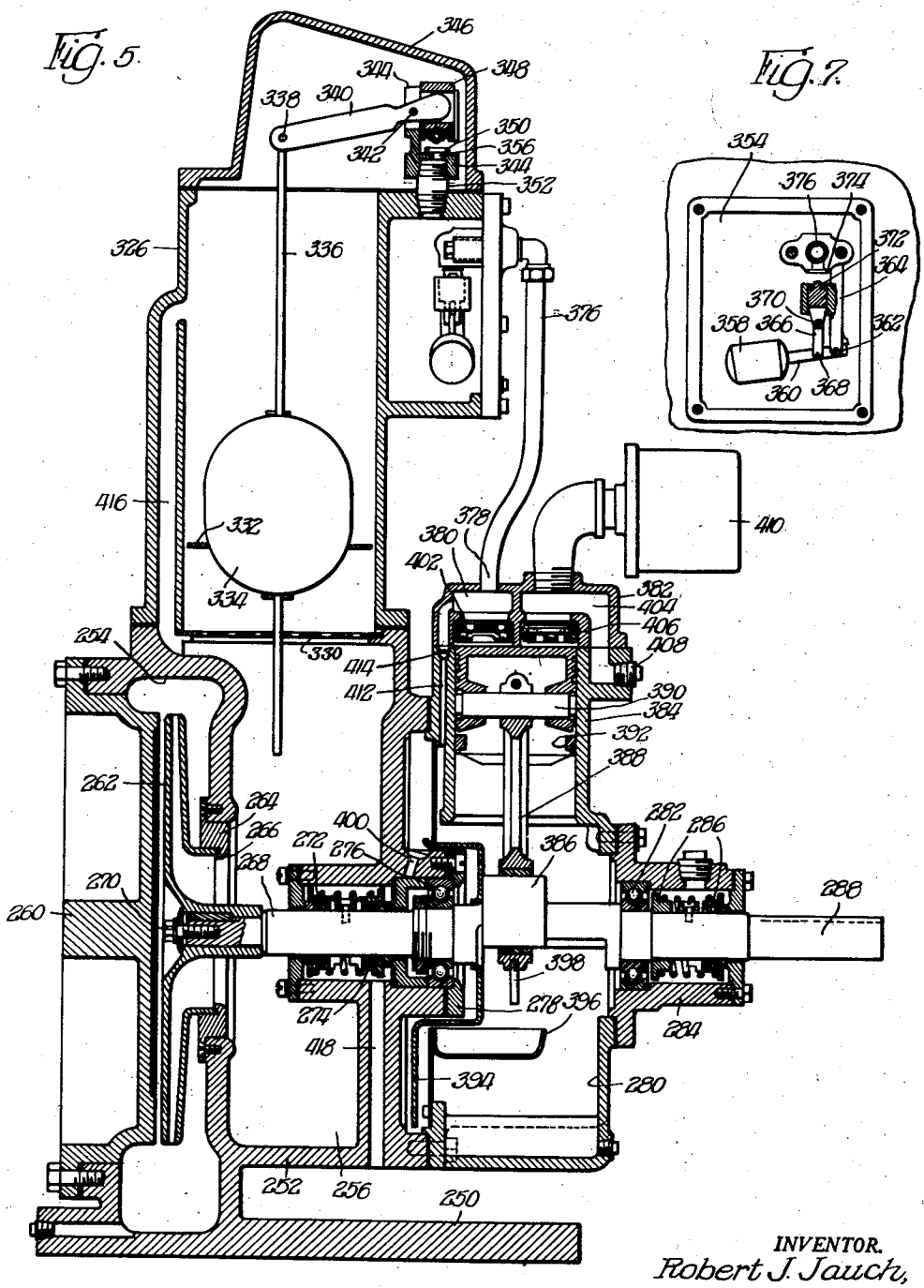


Fig. 7.

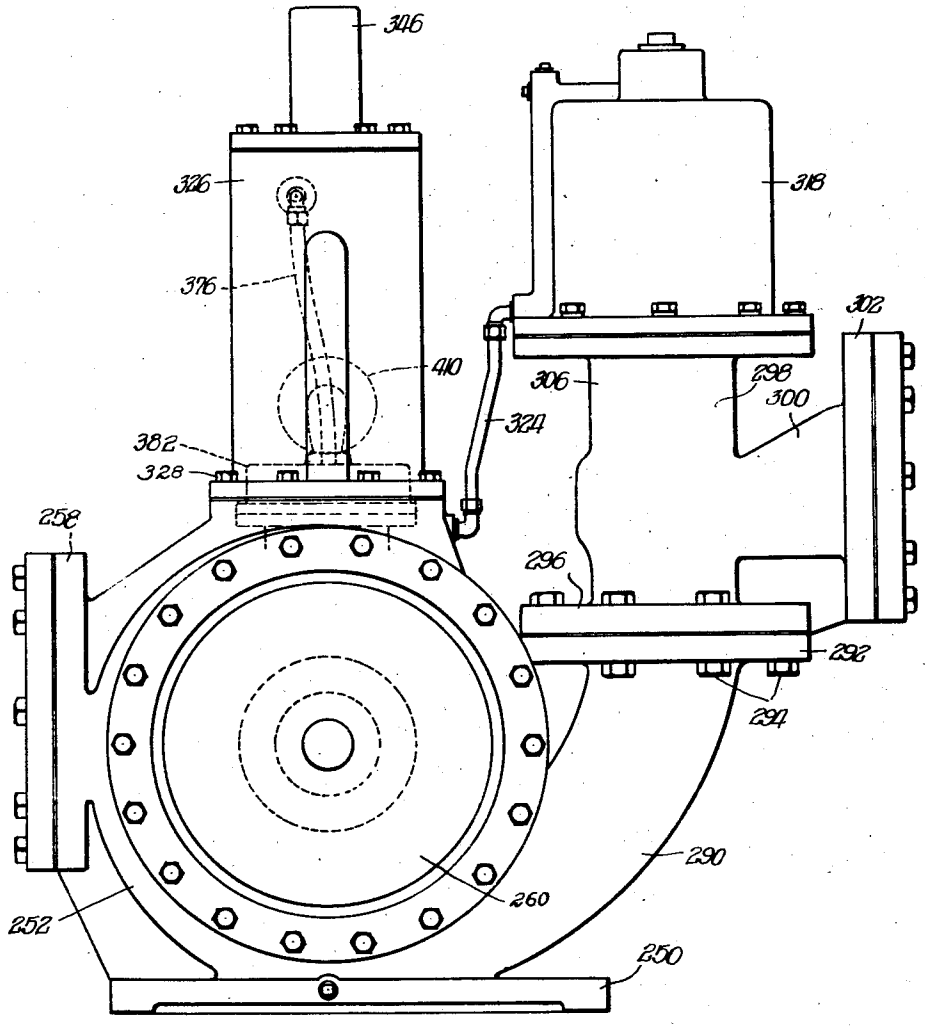
INVENTOR.
Robert J. Jauch,
BY Sherwood Hinds,
Wilkinson, Huxley
Byron & Knight
attys.

Sept. 4, 1945. R. J. JAUCH ET AL 2,384,172

PUMP

Filed June 23, 1944 6 Sheets-Sheet 5

Fig. 6.



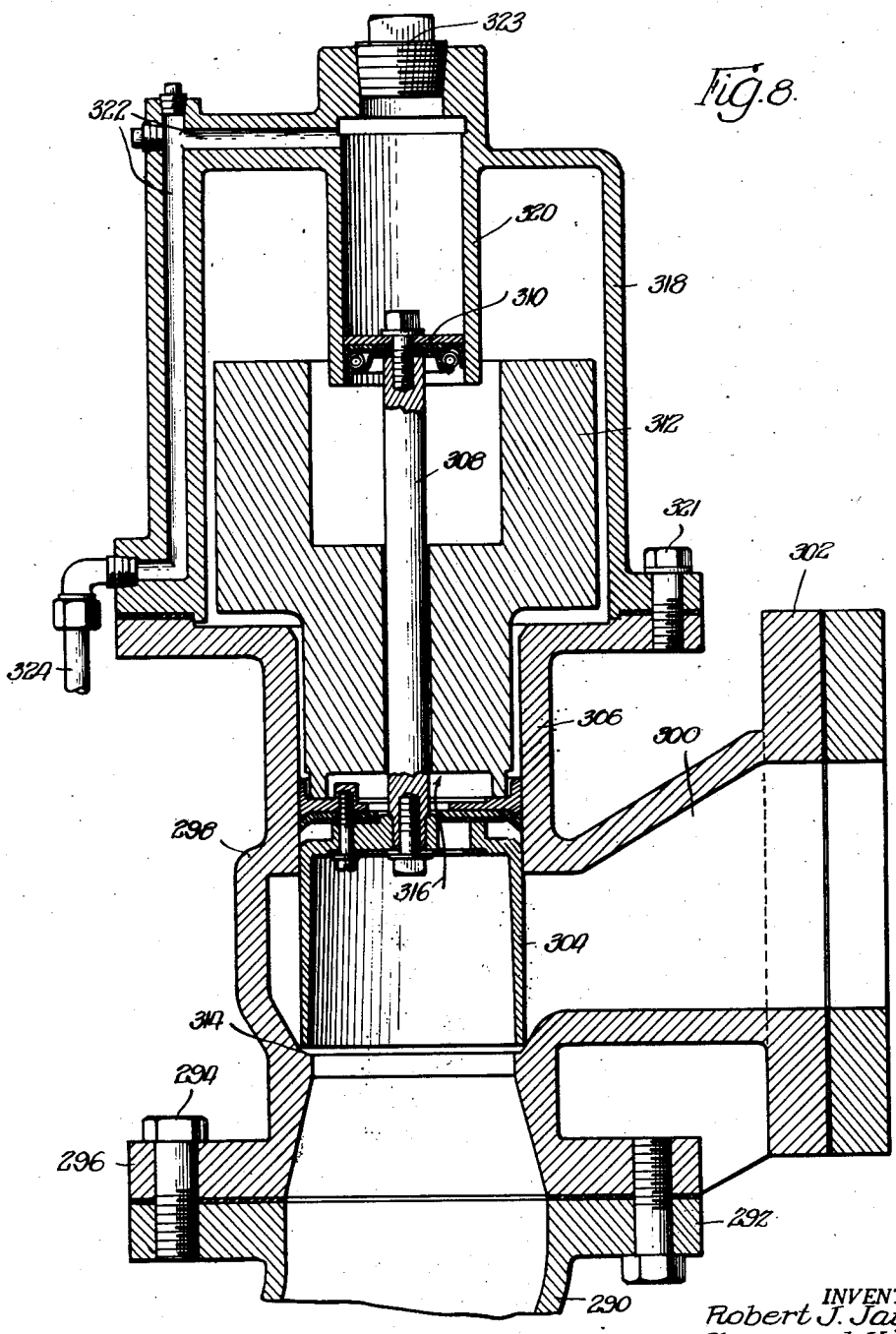
INVENTOR.
Robert J. Jauch,
BY Sherwood Hinds,
Atty.

Sept. 4, 1945. R. J. JAUCH ET AL 2,384,172

PUMP

Filed June 23, 1944 6 Sheets-Sheet 6

Fig. 8.



INVENTOR.
Robert J. Jauch,
Sherwood Hinds,
BY
Atty's.

Patented Sept. 4, 1945 2,384,172

UNITED STATES PATENT OFFICE

2,384,172

PUMP

Robert J. Jauch, Fort Wayne, and Sherwood Hinds, Columbia City, Ind., assignors to The Wayne Pump Company, Fort Wayne, Ind., a corporation of Maryland

Application June 23, 1944, Serial No. 541,766

8 Claims. (Cl. 103—113)

This invention pertains to pumping units and more particularly pumping units adapted particularly to handle volatile liquids such as gasoline, benzene, naphtha and the like.

Some liquid pumps are adapted particularly to handle liquids such as water, where there is substantially no problem involved in handling air or vapor in connection with the dispensing of the liquid, and where it is not necessary to deliver solid liquid for metering. However, there are various conditions which require the delivery of solid liquid, as where certain liquid is to be sold, in which case the liquid must be metered accurately, yet in these cases it is desirable that the liquid be delivered quickly and positively and under varying conditions. These conditions may involve handling the liquid at high temperatures, or handling the liquid under adverse conditions, such as a high lift, long or restricted suction lines, and frequently under these conditions the pump must be set in operation with the pump in substantially dry condition and wherein there is little opportunity to conveniently prime the pump by means external of the pump.

Further, it is desired that the dispensing means in the pump operate under the most favorable conditions, that is, a condition of flooded suction even though the actual source of supply from which the pump is drawing is at a lower level than the actual pumping unit.

Additionally, where airplanes and other vehicles are being fueled, it is highly desirable and frequently necessary that the fuel be supplied, vapor-free, at a high rate.

In the case of positive displacement pumps now being used, there is a substantially metal-to-metal engagement between the operating parts. These pumps, which include the gear type of pump, can be counted upon to produce a substantially high vacuum (26" to 28" of mercury, depending on the locality), when wet or primed. The gear type of pump, however, cannot be successfully used with tolerances close enough to produce a high vacuum when dry when dispensing non-lubricating liquid such as gasoline, as the wear is excessive. This also applies to the other positive displacement type of pumps such as the bucket, bladed type, and the like. There is an additional difficulty with these pumps in that when it is attempted to prime them dry or when the liquid becomes vaporized, or when they run dry in operation, an often disastrous wear takes place due to the lack of the lubrication provided by the liquid being pumped.

The centrifugal type of pump usually of one or more stages, is simple in construction having a rapidly whirling wheel or impeller that in itself is incapable of producing high vacuum, but can dispense liquid efficiently if the liquid is brought to the inlet or eye of the impeller. As in the case of positive displacement pumps, centrifugal pumps can likewise be broken down into a number of types. Generally they fall into three classifications, the conventional centrifugal which operates on flooded suction, employed for dispensing only. The centrifugal, to which has been added some means for effecting a prime, placing it in the classification of a self-priming centrifugal. Still a third employs means for establishing prime and the continuous elimination of air or vapor which may be referred to as a self-priming, air-eliminating centrifugal unit. This latter type is shown and described in Patent No. 2,124,681 to Jauch et al. granted July 26, 1938.

A piston type pump is a very efficient type of pump to create a vacuum, but has been found to be very inefficient to pump liquid, and additionally cannot operate at high speed and will not deliver a steady stream of liquid.

It is thus desirable to provide a pump which will handle successfully a large amount of vapor, a large amount of air and dispense only solid liquid successfully under severe installation conditions, as well as extreme temperature conditions.

It is, therefore, an object of this invention to provide a pump which will deliver solid liquid at a high rate, eliminating all air and vapor.

Another object is to provide a pump which is self-priming and wherein liquid is dispensed only after a predetermined pressure is built up.

Another object is to provide a pump wherein a centrifugal pump is used for dispensing liquid, but wherein the pump is primed and air eliminated by a piston type pump.

Another object is to provide a pump wherein a centrifugal pump is used to dispense solid liquid and wherein air and vapor is eliminated on the suction side of the centrifugal pump.

Another object is to provide a liquid dispensing apparatus operable to dispense liquid after a predetermined pressure is built up.

Another object is to provide a pumping unit operable after a predetermined vacuum is attained, but capable of throttling in the event of leakage in the suction or reduction of vacuum.

Another object is to provide a pumping unit capable of delivery under the most favorable simulated conditions, i. e., flooded suction, regardless of the disposition of the source of supply.

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 side elevation, partly in section, of one form of pump embodying the invention, the section being taken through the inlet, suction tank and piston pump;

Figure 2 is a top plan view, partly in section, of the pump illustrated in Figure 1, the section being taken substantially in the plane as indicated by the line 2—2 of Figure 1;

Figure 3 is a transverse sectional elevation taken substantially in the plane as indicated by the line 3—3 of Figure 2;

Figure 4 is a side elevation of the pump illustrated in Figures 1 to 3, the same looking toward the left as viewed in Figure 2;

Figure 5 is an elevation, partly in section, of a modified form of pump embodying the invention;

Figure 6 is an elevation of the pump illustrated in Figure 5, the same looking toward the right as viewed in said figure;

Figure 7 is an enlarged fragmentary sectional elevation of a portion of the pump shown in Figure 5, the same showing an auxiliary valve for the float chamber; and

Figure 8 is an enlarged fragmentary sectional elevation of the pump discharge valve.

The pump illustrated in Figures 1 to 4 inclusive, comprises the base 10, on which the motor 12 is mounted, said motor being provided with motor shaft 14, coupled as at 16 to the pump shaft 18. The pump shaft 18 extends through the crank case housing 20, and into the pump housing 22. The shaft 18 is provided with the anti-friction bearings 24 and 26, the bearings 24 being retained in place as at 28, while the bearings 26 are retained in place as at 30.

Shaft 18 is provided with the sleeve 32, pressed or otherwise tightly fitted to said shaft, and the seal 34 is disposed to prevent leakage through the end plate 36 of the housing 20 adjacent the sleeve 32.

The shaft 18 is provided with the eccentric 38 (or crank), said eccentric being keyed as at 40 to said shaft and being positioned by means of the nut 42, threaded to the crank shaft. The opposite end of the eccentric 38 bears against and is positioned by the sleeve 44 on which the oiling disc 46 is non-rotatably mounted.

Bearing 26 is mounted on a diminished portion of the sleeve 44 and the inner race ring abuts a shoulder 48 of the shaft, and the outer race ring abuts against a seal 50, disposed in the recess 52, provided in the inner crank case cover 54 of the crank case 20, said cover 54 being suitably secured to the pump housing 22.

The piston or connecting rod 56 is rotatably mounted on the eccentric 38 and the upper end of said piston rod is pivotally connected through the wrist pin 58, to the piston 60, slidably mounted in the cylinder 62, the piston 60 being provided with suitable rings 64. The connecting rod is provided with the pin 66, adapted to dip into oil contained in the oil pan 68, whereby lubrication is had by the splashing of the oil by the pin. Constant level is maintained in the pan 68 by means of the disc 46, which constantly dips into the sump 70 of the crank case below the pan 68. This causes the oil to be taken from the sump and thrown by centrifugal force around the wall of the crank case where it drains back into the pan 68. The oiling means just described and the valves to be described are more particularly shown in Patent No. 2,267,479, Sturm et al., granted December 23, 1941.

The cylinder 62 is closed by means of the cylinder head 72, said cylinder head being provided with the inlet valve 74 and the outlet or exhaust valve 76, the outlet valve communicating with the passage 78 in the cylinder head, which in turn communicates with passage 80 provided in the crank case housing, said passage 80 being in communication with the atmosphere through the pipe 82, which may be provided with a suitable muffler, not shown. The inlet valve 74 communicates with the passage 84, which in turn communicates with the passage 86 provided in the crank case housing, said passage 86 being connected to pipe 88 through coupling 90, and communicating with passage 92 through coupling 94. Passage 92 is disposed in the suction inlet casting 96, which is suitably secured to the impeller pump housing 22.

The casting 96 is provided with the inlet 98 which communicates through screen 100 with the suction tank 102 and said casting is provided with the passage 104 which communicates with the passage 106 of the impeller pump housing 22, the passage 106 communicating with the eye 108 of the impeller 110, said impeller being fixed to the shaft 18.

The suction tank 102 is provided with the riser tube 112, communicating with the passage 92 and extending to a point adjacent the top of the suction tank 102. The upper end of the riser tube 112 is provided with the valve 114, controlled by the float 116. The float 116 is pivoted as at 118 to the lever 120, said lever being pivoted as at 122 to a support on the valve seat 124 and the opposite end of the lever being loosely connected to the valve as at 126. The float is provided with the guide stem 128, slidably mounted in the guide 130 carried by the tube 112.

In order to prevent the piston 60 from pumping oil the pressures on the opposite sides of the piston are substantially balanced by the passage 132 which connects the passage 86 with the inside of the crank case housing 20.

The impeller 110 is adapted to rotate in the impeller discharge housing 134, said discharge housing communicating with the passage 136 provided in the outlet valve housing 138. The housing 138 is provided with the outlet passage 140, adapted to be closed from the passage 136 by means of the sleeve valve 142, said sleeve valve being adapted to close communication between said passages when it is seated on the valve seat 144. The sleeve valve is adapted to slide in the cylinder 146 provided in the housing 138, the valve being provided with a suitable piston 148 which is made substantially liquid tight by means of suitable spring pressed leathers 150 or other suitable means.

The valve and piston are provided with the balancing orifice 152 which provides communication between opposite sides of the piston, and a suitable spring 154 is provided seated at one end on the piston and at other end in the spring seat 156 in the housing 158, said spring urging the valve toward closed position.

The cylinder 46 on the side of the valve op-

posite to the passage 136, communicates through passages 160 and 162 with the seat 164, said seat being provided with the valve 166 urged towards closed position by means of the spring 168. The spring 168 seats at one end on the spring seat 170 of housing 171 and at the other end on the flexible diaphragm 172, said diaphragm being secured between the flanges 174 and 176 of housings 138 and 171. The diaphragm is provided with the plunger 178 extending through the guide 180 and engaging the valve 166 for controlling said valve by the spring 168 and the diaphragm 172. The valve chamber 182 communicates through the passages 184 and 186 with the impeller suction chamber 106. The housing 171 for the spring 168 communicates through coupling 190, pipe 192 and coupling 194 with the inside of the crank case housing 20.

While the tube 192 is shown as connected to the crank case housing (being vacuumized through the passage 132), it is of course understood that this tube could be connected to the suction side of the piston pump, that is, it might be connected to the passage 84, pipe 88 or passage 92. It has been found, however, that by connecting it to the vacuumized crank case housing that a lighter spring 168 can be provided and there is less fluttering effect of the diaphragm 172.

Let it be assumed that the pumping unit described is connected through the inlet 98 with a source of supply at a lower level than the inlet 98, and that the pumping unit is dry and has absolutely no priming liquid in any part of the unit, and that it is desired to draw the liquid from the source of supply and deliver it to a container as through a meter. In the pumping of some liquid, such as gasoline, a true measure must be had of the liquid to be dispensed, thus no air can be delivered through the outlet 140 to meter. Operation of the motor 12 or other source of power supply causes rotation of the shaft 18, which in turn rotates the impeller 110 and causes reciprocation of the piston 60. The pump being dry, the valve 142 will be closed, that is, will be in the position as illustrated in Figure 2 and the valve 166 will also be closed. The valve 114 in the suction tank will be open.

Rotation of the shaft 118 causes the piston pump to vacuumize the suction tank 102 through valve 114, pipe 112, passage 92, pipe 88, passage 84 and inlet valve 74. During operation of the piston pump it will be noted that the chamber of the crank case is also vacuumized through the passage 132 so that there is no tendency for the piston to pump oil and there will be a proper lubrication, without loss of lubricant.

The pin 66 will dip into the oil in the pan 68 causing the oil to splash to the rotating parts in the crank case housing and rotation of the disc 46 will cause oil to be thrown by centrifugal force to the sides of the crank case housing, where it will drain into the pan 68, maintaining the proper level, all as described in said Patent No. 2,267,479.

When the piston pump is vacuumizing the suction tank, it also is vacuumizing the impeller pump housing, the passage 136 and the cylinder 146, whereby there is a balanced condition of the valve so that under this condition the spring 154 is the only means of maintaining the valve 142 in seated position.

The vacuum induced in the suction tank 102 causes liquid to be drawn from the source of supply through the passage 98 into the suction tank 102, through the screen 100. It will then be drawn through the passage 104, the impeller suction housing 106 and will be introduced to the eye 108 of the impeller 110. The liquid will then be delivered by the impeller through the impeller discharge housing 134 to the passage 136, a portion of said liquid passing through the orifice 152 to maintain the balanced condition of the valve. This liquid delivered through orifice 152 is not at sufficient pressure to open the valve 166. Liquid will continue to be supplied to the suction tank 102 with the valve 142 closed until a predetermined liquid level is reached, at which time the float 116 will close the valve 114.

Closing the valve 114 will cause a high vacuum through passages 84, 132, crank case housing 20, pipe 192 and housing 171, thus causing a high vacuum on the diaphragm 172. The float and valve are so arranged that the valve 114 will close long prior to the approach of the liquid level to the valve so that no liquid can ever get into the piston pump . In other words an air chamber is always insured at the top of the tank 102. This high vacuum will cause the diaphragm to move upwardly as viewed in Figure 2 against the spring 168, raising the pin 178 from the valve 166, permitting the valve to open, thus permitting liquid to flow through passages 184—186 to the impeller suction housing 106. The orifice 152 being smaller than the opening controlled by the valve 166 will cause a reduction of pressure in the cylinder 146 on the side of the valve opposite to the seat 144. This condition will permit the increased pressure on the side of the valve adjacent the seat 144 to open the valve 142, permitting discharge through the outlet 140.

It will be understood that the valve 142 will only open in the event there is solid liquid at the valve; in other words, if there is air or a mixture of air and liquid at the valve 142, said valve will not open even though the valve 166 opens. The valve 166 opening prior to the opening of the valve 142 permits the air or mixture of air and liquid at the valve 142 to pass through the orifice 152, passage 162, passages 184 and 186 to the impeller suction chamber 106. The air then will work its way back into the suction tank 102 where it will seek a high level and will evacuate whenever the valve 114 opens. When there is solid liquid at the valve 142, said valve will open as already described and thereafter should air be introduced into the suction line between the pump and the source of supply, said air will enter the suction tank 102, causing a drop in the liquid level within the tank which in turn causes the float 116 to drop, opening the valve 114.

As soon as the valve 114 opens the air in the suction tank will be drawn through the riser tube 112, passage 92, pipe 88, and through the piston pump to the atmosphere through the pipe 82. As soon as air is discharged, the liquid level in the suction tank will rise, causing the valve 114 to close, which in turn causes the valve 166 to open as in the manner already described, thus permitting valve 142 to open and the dispensing operation to continue. Should there be continuous leaking, that is, to a point where the valve 114 is alternately opening or closing, the pump will still continue to discharge liquid at a reduced quantity, though the valve 142 will throttle, and the pump will continue to deliver liquid until the amount of air introduced into the suction tank exceeds the displacement of the piston pump, at which time the pressures on opposite sides of the diaphragm 172 will equalize, causing the valve

166 to close and consequently causing the valve 142 to close.

Referring now more particularly to the form of pump illustrated in Figures 5 to 7 inclusive, said pump comprises a base 250 having an impeller housing 252 provided with an impeller chamber 254 and a suction or inlet chamber 256 communicating with a suitable inlet 258. The impeller housing 254 is closed by means of the cover plate 260, and the impeller 262 is rotatably mounted in said impeller housing. The outer periphery of the eye of the impeller rotates in the fixed wearing ring 264 and the clearances between the outer periphery of the impeller eye and the ring are such that no wear takes place between these parts. The wear ring is provided with the reentrant flange portion 266 directed into the eye of the impeller so that should any liquid pass between the impeller and the ring 264 it will be directed into the eye of the impeller rather than against the liquid normally entering the eye.

The impeller is rotated by means of the shaft 268 secured thereto as at 270 and said shaft passes through a gasoline seal 272 and oil seal 274 and is supported on bearing 276 retained by the ring 278. The shaft extends into the vacuum pump crank case 280 and is rotatably mounted on bearing 282 provided in the housing 284 in which is disposed the seal 286. The shaft extends outwardly of housing 284 and provides a portion 288 for coupling to suitable drive means such as an electric motor, gasoline motor or the like. The impeller chamber 254 is provided with a voluted outlet passage 290 and is provided with the flange 292 fastened as at 294 to the flange 296 of the outlet valve housing 298.

The outlet valve housing is provided with the outlet 300 provided with the flange 302 adapted to be secured to suitable discharge means. A sleeve valve 304 is adapted to close the outlet 300 and is adapted to be moved vertically upwardly from the position illustrated in the Figure 8 to open the outlet. The sleeve valve 304 is adapted to reciprocate in the cylinder 306 and is provided with the valve rod 308 extending upwardly and having the piston 310 secured thereto. A suitable weight 312 continually urges the valve 304 toward closed position on its seat 314. There is, however, a passage through the sleeve valve as indicated by the arrow 316 and there is clearance between the weight 312 and the rod 308, and the weight 312 and the cylinder 306 and housing 318 whereby liquid under pressure can pass upwardly to act on the piston 310 slidably mounted in the cylinder 320. Housing 318 is secured as at 321 to the housing 298, and cylinder 320 is part of housing 318 being closed by the plug 323. The cylinder 320 above the piston 310 has access through passage 322 and connection 324 with the suction chamber 256.

The float chamber housing 326 is secured as at 328 to the pump housing 252, and surge ring 330 is interposed between said housings to prevent a sudden surge of the liquid upwardly into the housing 326, and within the housing 326 there is also provided a baffle surge ring 332 fixed to the float 334 so that should there be a surge of liquid the float and surge ring would be urged upwardly by the force of the liquid as well as the buoyancy of the liquid. The float 334 is provided with the guiding and lifting rod 336 pivoted adjacent the upper end as of 338 to the lever 340, the lever being pivoted as at 342 to the pedestal 344.

The cap 346 closes the upper end of the housing 326 and is suitably secured thereto. The other end of the lever 340 engages the slide valve 348, said valve being adapted in closed position to be seated on the seat 350 provided on the pedestal 344, the pedestal being supported on the pipe 352 permitting ingress to the auxiliary float chamber 354. A restrictive opening 356 permits communication between the chamber 326 and pipe 352 for the purpose to be later described.

Within the auxiliary float chamber 354 there is provided a float 358, said float being provided with a supporting rod 360 pivoted at 362 to the support 364, and rod 366 is pivoted as at 368 to the rod 360 and is pivoted as at 370 to the slide valve 372. Upward movement of the float causes the valve 372 to move upwardly and be seated in closed position on the seat 374. The seat 374 communicates with the pipe 376, the other end of said pipe being connected as at 378 to the suction valve chamber 380 provided in the piston head 382 of the vacuum pump.

The head 382 is supported on the cylinder block 384 which is preferably integral with the crank case 280 and is suitably secured to the pump casing 252 whereby a unitary structure is provided. The shaft 268 is provided with the crank shaft portion 386 to which the piston rod 388 is rotatably secured. The upper end of the piston rod is secured through the pin 390 to the reciprocating piston 392. The crank shaft 386 is provided with the oiling disc 394 offset to act as a counterbalance for the piston, and being adapted to dip into the lubricant in the crank case to throw it outwardly whereupon it can be trapped within the pan 396 and any excess may overflow and spill into the crank case. The piston rod 388 is provided with the splash pin 398 adapted to dip into the liquid. The pan 396 for lubricating purposes, has already been described and the lubricating passage 400 is provided for conducting lubricant to the bearing 276.

The head 382 is provided with the suction valve chamber 380 closed by the suction valve 402 and is provided with the outlet valve chamber 404 closed by the outlet valve 406. The chamber 404 is provided with the plug 408 which may be removed for connecting the chamber to a suitable remote vent such as where the connection is carried back to the supply tank and vented therethrough. A muffler 410 is also secured to the head 382 and in communication with the chamber 404 and is used unless the remote vent is used. A passage 412 forms a communication between the suction valve chamber 380 and the crank case 280 for equalizing the pressures therebetween whereby there is no tendency for oil pumping. Should, however, there be a change in vacuum in the chamber 380 this would be immediately felt in the crank case 280 and to delay this change from taking place in the crank case the check valve 414 is provided. A passage 416 is provided for effecting communication between the inlet chamber 256 and the float chamber housing 326 at a suitably high point in the housing 326 whereby should there be an influx of air into the inlet chamber this air will quickly find its way above the float and can thus be quickly exhausted through the vacuum pump without having to seek its way through the liquid contained in the float chamber housing.

Assuming that the inlet 258 is secured to a suitable source of supply and assuming that the outlet 302 is secured to a suitable dispensing means and that the centrifugal pump is dry and it is desired to dispense liquid, the operating means

causes rotation of the shaft 288 thus rotating the impeller 282 and the crank shaft 386 reciprocating the piston 392. The valve 304 will be closed and therefore no fluid can be drawn from the outlet through passage 322 and pipe 324 to the suction chamber 256. Reciprocation of the piston causes a vacuum to be produced through chamber 388, pipe 376, chamber 354, housing 326 and inlet chamber 256. The air will be withdrawn through the connections just named and expelled as through the vent or muffler 418, or connection at 408 whichever is used. Liquid will finally be drawn into the inlet chamber 256 and will rise into the float chamber housing 326 to a point where the float 334 is raised to close the valve 348.

Liquid then will be moved through the volute 280 by the impeller to the valve 304 and liquid under pressure will pass through the valve upwardly and will act on the underside of the piston 310. At the same time, suction from the inlet chamber 256 will be applied to the top of the piston 310 through pipe 324 and passage 322. Upward opening movement of the valve 304 will thus be caused to permit dispensing operation after the predetermined pressure necessary to raise the weight 312 has been created. The weight 312 is determined so that a predetermined back pressure will be set up to insure venting of all air trapped, from time to time, in the casing 252 so that the impeller will always pump solid liquid. It is to be noted that should any air be introduced into the housing 256 it will immediately cause the valve 304 to be closed or throttled as the vacuum above the piston 310 will be reduced thus permitting the weight 312 to immediately become effective to close or throttle the valve.

The valve is necessary where it is desired that air elimination take place where a sufficient head on the outlet side is not provided to insure that the air be raised above the impeller housing so that it can readily be discharged through the vacuum pump. If a meter is not to be used in connection with the pump, of course, no automatic valve is necessary and a hand operated valve may be used. Should the float 334 fail and should liquid rise a sufficient height in the housing 326 to flow into the auxiliary housing 354, the float 358 will close the valve 372 and prevent liquid from flowing into the inlet chamber 388. Should, however, both floats fail, the restricted opening 356 is so determined that only an amount of liquid will be supplied to the vacuum pump that can be readily discharged. Should leakage occur past the seal 274, it would be an oil leakage and the oil would pass through the tell-tale 418 and when detected would indicate that the seal 274 leaked. Should, however, gasoline or the pumped fluid pass through the tell-tale 418, it would indicate that the seal 272 was leaking.

It is to be understood that we do not wish to be limited by the exact embodiment of the device shown, which is 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 departing from the spirit of the invention or the scope of the claims.

We claim:

1. In a pumping unit, the combination of a centrifugal pump casing having an impeller chamber and a suction chamber, said suction chamber having an inlet and said impeller chamber having an outlet, an impeller rotatably mounted in said impeller chamber, the eye of said impeller communicating with the suction chamber for receiving liquid therefrom, a housing comprising a float chamber communicating with said suction chamber adjacent the bottom of said float chamber, a passage communicating with said suction chamber and extending upwardly and communicating with said float chamber adjacent a high point thereof, an outlet adjacent a high point in said float chamber, a float and valve for controlling said outlet in accordance with the liquid level in said float chamber, means for exhausting air and vapor from said float chamber, said means comprising a piston pump having a crank case and a cylinder thereabove, a crank shaft in said crank case, said crank shaft extending into said centrifugal pump casing and providing a shaft for said impeller, a piston reciprocally mounted in said cylinder and connected by means of a connecting rod to said crank shaft, a cylinder head on said cylinder having a suction chamber and an exhaust chamber, valves between said chambers and the upper part of said cylinder above the piston, a connection between said float chamber and said piston pump suction chamber, a connection between said piston pump suction chamber and said crank case, a discharge valve connected to the impeller chamber outlet, means urging said valve to closed position, a housing having a cylinder adjacent said valve connected to said crank case whereby suction from said crank case is imparted to said last named cylinder, a piston in said last named cylinder connected to said last named valve whereby suction in said last named cylinder urges said last named valve to open position, said last named valve being opened when said suction and the liquid delivery pressure on said valve reaches a predetermined amount.

2. In a pumping unit, the combination of a centrifugal pump casing having an impeller chamber and a suction chamber, said suction chamber having an inlet and said impeller chamber having an outlet, an impeller rotatably mounted in said impeller chamber, the eye of said impeller communicating with the suction chamber for receiving liquid therefrom, a housing comprising a float chamber communicating with said suction chamber adjacent the bottom of said float chamber, an outlet adjacent a high point in said float chamber, a float and valve for controlling said outlet in accordance with the liquid level in said float chamber, means for exhausting air and vapor from said float chamber, said means comprising a piston pump having a crank case and a cylinder thereabove, a crank shaft in said crank case, said crank shaft extending into said centrifugal pump casing and providing a shaft for said impeller, a piston reciprocally mounted in said cylinder and connected by means of a connecting rod to said crank shaft, a cylinder head on said cylinder having a suction chamber and an exhaust chamber, valves between said chambers and the upper part of said cylinder above the piston, a connection between said float chamber and said piston pump suction chamber, a connection between said piston pump suction chamber and said crank case, a discharge valve connected to the impeller chamber outlet, means urging said valve to closed position, a housing having a cylinder adjacent said valve connected to said crank case whereby suction from said crank case is imparted to said last named cylinder, a piston in said last named cylinder connected to said last named valve whereby suction in

said last named cylinder urges said last named valve to open position, said last named valve being opened when said suction and the liquid delivery pressure on said valve reaches a predetermined amount.

3. In a pumping unit, the combination of a centrifugal pump casing having an impeller chamber and a suction chamber, said suction chamber having an inlet and said impeller chamber having an outlet, an impeller rotatably mounted in said impeller chamber, the eye of said impeller communicating with the suction chamber for receiving liquid therefrom, a housing comprising a float chamber communicating with said suction chamber adjacent the bottom of said float chamber, a passage communicating with said suction chamber and extending upwardly and communicating with said float chamber adjacent a high point thereof, an outlet adjacent a high point in said float chamber, a float and valve for controlling said outlet in accordance with the liquid level in said float chamber, means for exhausting air and vapor from said float chamber, said means comprising a piston pump having a crank case and a cylinder thereabove, a crank shaft in said crank case, said crank shaft extending into said centrifugal pump casing and providing a shaft for said impeller, a piston reciprocally mounted in said cylinder and connected by means of a connecting rod to said crank shaft, a cylinder head on said cylinder having a suction chamber and an exhaust chamber, valves between said chambers and the upper part of said cylinder above the piston, a connection between said float chamber and said piston pump suction chamber, and a connection between said piston pump suction chamber and said crank case.

4. In a pumping unit, the combination of a centrifugal pump casing having an impeller chamber and a suction chamber, said suction chamber having an inlet and said impeller chamber having an outlet, an impeller rotatably mounted in said impeller chamber, the eye of said impeller communicating with the suction chamber for receiving liquid therefrom, a housing comprising a float chamber communicating with said suction chamber adjacent the bottom of said float chamber, an outlet adjacent a high point in said float chamber, a float and valve for controlling said outlet in accordance with the liquid level in said float chamber, means for exhausting air and vapor from said float chamber, said means comprising a piston pump having a crank case and a cylinder thereabove, a crank shaft in said crank case, said crank shaft extending into said centrifugal pump casing and providing a shaft for said impeller, a piston reciprocally mounted in said cylinder and connected by means of a connecting rod to said crank shaft, a cylinder head on said cylinder having a suction chamber and an exhaust chamber, valves between said chambers and the upper part of said cylinder above the piston, a connection between said float chamber and said piston pump suction chamber, and a connection between said piston pump suction chamber and said crank case.

5. In a pumping unit, the combination of a centrifugal pump casing having an impeller chamber and a suction chamber, said suction chamber having an inlet and said impeller chamber having an outlet, an impeller rotatably mounted in said impeller chamber, the eye of said impeller communicating with the suction chamber for receiving liquid therefrom, a housing comprising a float chamber communicating with said suction chamber adjacent the bottom of said float chamber, a passage communicating with said suction chamber and extending upwardly and communicating with said float chamber adjacent a high point thereof, an outlet adjacent a high point in said float chamber, a float and valve for controlling said outlet in accordance with the liquid level in said float chamber, means for exhausting air and vapor from said float chamber, said means comprising a piston pump having a crank case and a cylinder thereabove, a crank shaft in said crank case, said crank shaft extending into said centrifugal pump casing and providing a shaft for said impeller, a piston reciprocally mounted in said cylinder and connected by means of a connecting rod to said crank shaft, a cylinder head on said cylinder having a suction chamber and an exhaust chamber, valves between said chambers and the upper part of said cylinder above the piston, and a connection between said float chamber and said piston pump suction chamber.

6. In a pumping unit, the combination of a centrifugal pump casing having an impeller chamber and a suction chamber, said suction chamber having an inlet and said impeller chamber having an outlet, an impeller rotatably mounted in said impeller chamber, the eye of said impeller communicating with the suction chamber for receiving liquid therefrom, a housing comprising a float chamber communicating with said suction chamber adjacent the bottom of said float chamber, a passage communicating with said suction chamber and extending upwardly and communicating with said float chamber adjacent a high point thereof, an outlet adjacent a high point in said float chamber, a float and valve for controlling said outlet in accordance with the liquid level in said float chamber, means for exhausting air and vapor from said float chamber, said means comprising a piston pump having a crank case and a cylinder thereabove, a crank shaft in said crank case, said crank shaft extending into said centrifugal pump casing and providing a shaft for said impeller, a piston reciprocally mounted in said cylinder and connected by means of a connecting rod to said crank shaft, a cylinder head on said cylinder having a suction chamber and an exhaust chamber, valves between said chambers and the upper part of said cylinder above the piston, and a connection between said float chamber and said piston pump suction chamber, a discharge valve connected to the impeller chamber outlet, means urging said valve to closed position, a housing having a cylinder adjacent said valve connected to said piston pump suction chamber whereby suction from said chamber is imparted to said last named cylinder, a piston in said last named cylinder connected to said last named valve whereby suction in said last named cylinder urges said last named valve to open position, said last named valve being opened when said suction and the liquid delivery pressure on said valve reaches a predetermined amount.

7. In a pumping unit, the combination of a centrifugal pump casing having an impeller chamber and a suction chamber, said suction chamber having an inlet and said impeller chamber having an outlet, an impeller rotatably mounted in said impeller chamber, the eye of said impeller communicating with the suction chamber for receiving liquid therefrom, a housing comprising a float chamber communicating with said suction chamber adjacent the bottom

of said float chamber, an outlet adjacent a high point in said float chamber, a float and valve for controlling said outlet in accordance with the liquid level in said float chamber, means for exhausting air and vapor from said float chamber, said means comprising a piston pump having a crank case and a cylinder thereabove, a crank shaft in said crank case, said crank shaft extending into said centrifugal pump casing and providing a shaft for said impeller, a piston reciprocally mounted in said cylinder and connected by means of a connecting rod to said crank shaft, a cylinder head on said cylinder having a suction chamber and an exhaust chamber, valves between said chambers and the upper part of said cylinder above the piston, and a connection between said float chamber and said piston pump suction chamber.

8. In a pumping unit, the combination of a centrifugal pump casing having an impeller chamber and a suction chamber, said suction chamber having an inlet and said impeller chamber having an outlet, an impeller rotatably mounted in said impeller chamber, the eye of said impeller communicating with the suction chamber for receiving liquid therefrom, a housing comprising a float chamber communicating with said suction chamber adjacent the bottom of said float chamber, an outlet adjacent a high point in said float chamber, a float and valve for controlling said outlet in accordance with the liquid level in said float chamber, means for exhausting air and vapor from said float chamber, said means comprising a piston pump having a crank case and a cylinder thereabove, a crank shaft in said crank case, said crank shaft extending into said centrifugal pump casing and providing a shaft for said impeller, a piston reciprocally mounted in said cylinder and connected by means of a connecting rod to said crank shaft, a cylinder head on said cylinder having a suction chamber and an exhaust chamber, valves between said chambers and the upper part of said cylinder above the piston, and a connection between said float chamber and said piston pump suction chamber, a discharge valve connected to the impeller chamber outlet, means urging said valve to closed position, a housing having a cylinder adjacent said valve connected to said piston pump suction chamber whereby suction from said chamber is imparted to said last named cylinder, a piston in said last named cylinder connected to said last named valve whereby suction in said last named cylinder urges said last named valve to open position, said last named valve being opened when said suction and the liquid delivery pressure on said valve reaches a predetermined amount.

ROBERT J. JAUCH.
SHERWOOD HINDS.