Dec. 29, 1942. H. E. ADAMS 2,306,841

PUMP ASSEMBLAGE

Filed Aug. 2, 1940 5 Sheets-Sheet 1

Fig. 2.

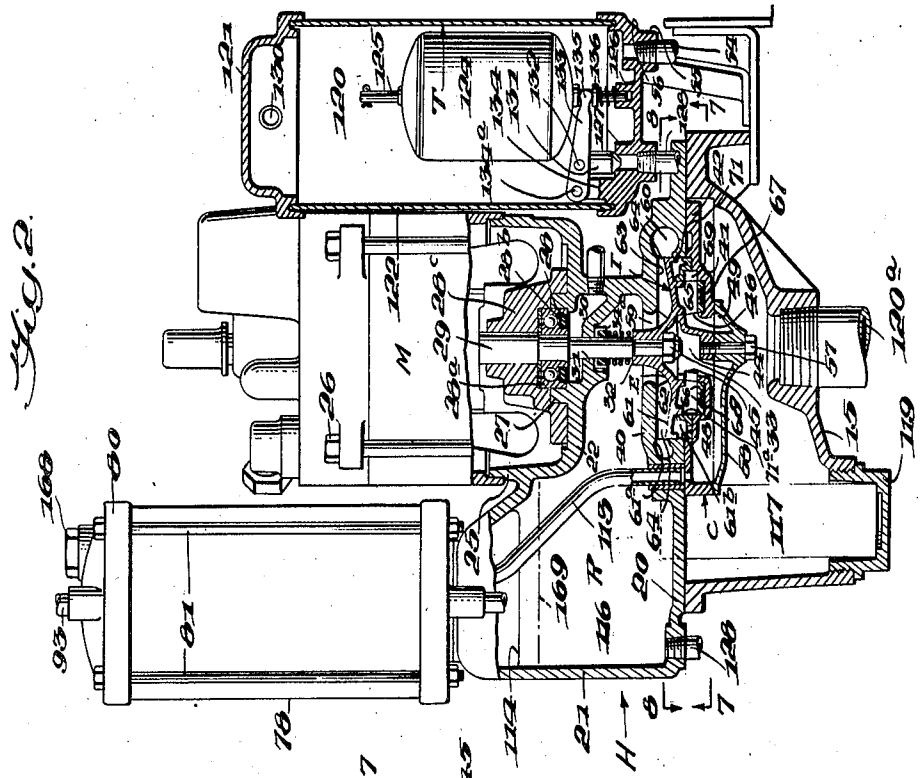
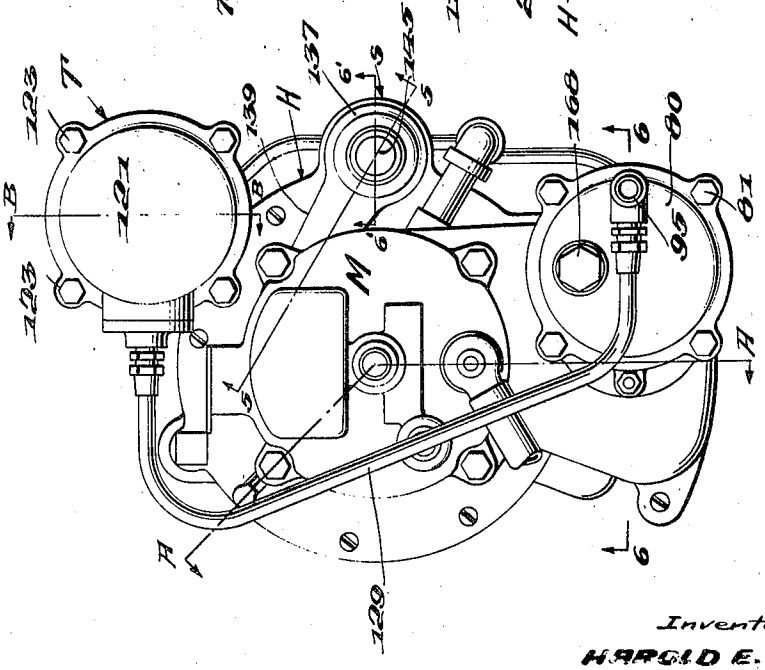


Fig. 1.



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Dec. 29, 1942. H. E. ADAMS 2,306,841

PUMP ASSEMBLAGE

Filed Aug. 2, 1940 5 Sheets-Sheet 2

Fig. 3.

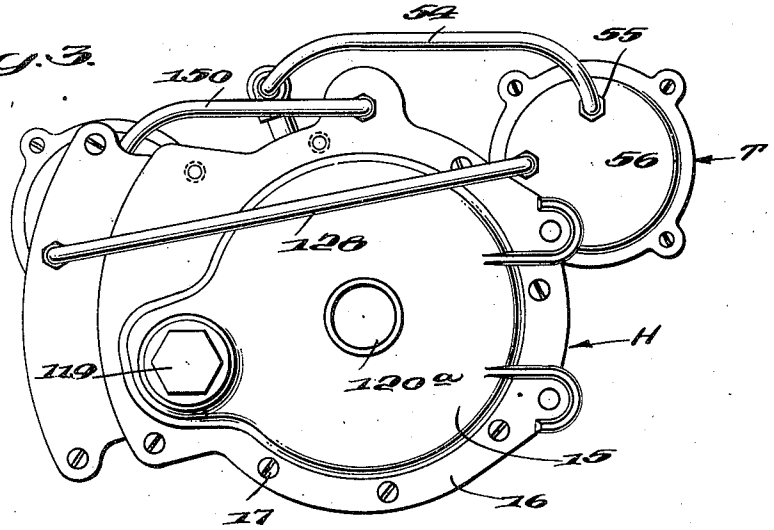
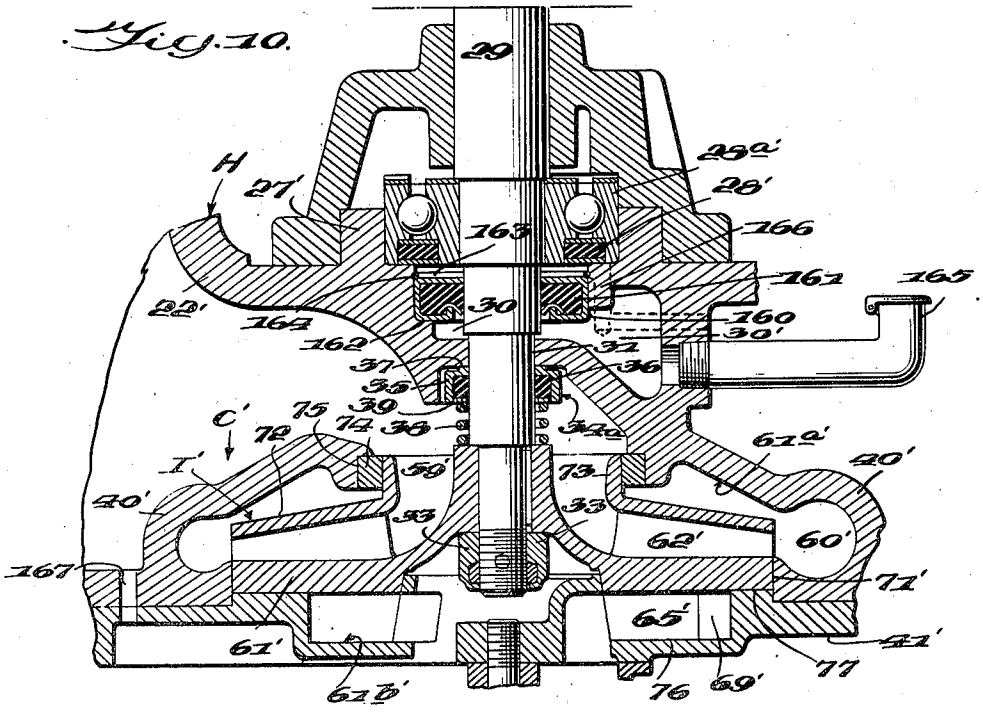


Fig. 10.



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Dec. 29, 1942. H. E. ADAMS 2,306,841

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Filed Aug. 2, 1940 5 Sheets-Sheet 3

Fig. 3.

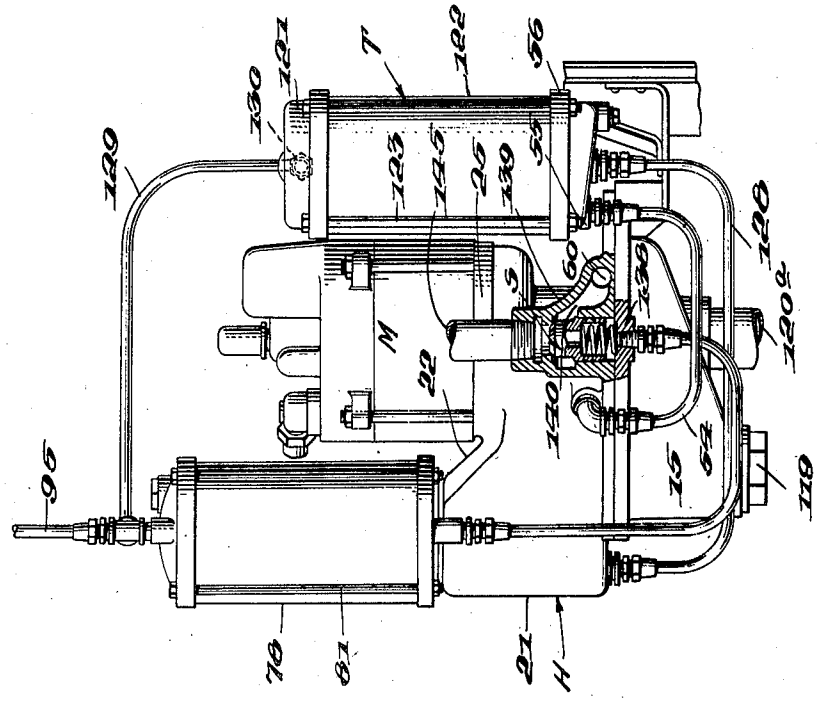
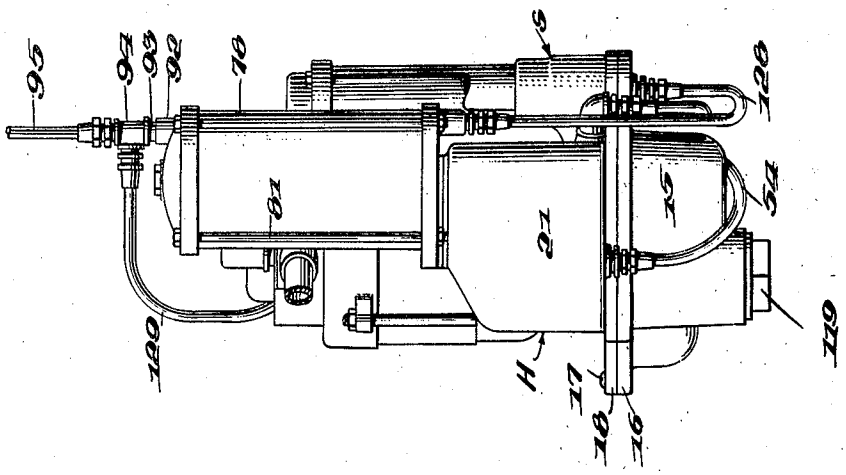


Fig. 4.



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Dec. 29, 1942. H. E. ADAMS 2,306,841

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Filed Aug. 2, 1940 5 Sheets-Sheet 4

Fig. 9.

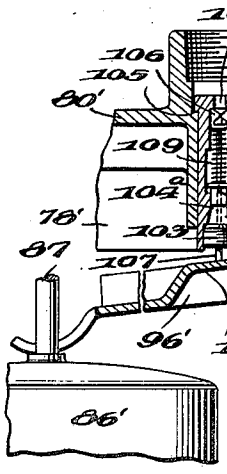
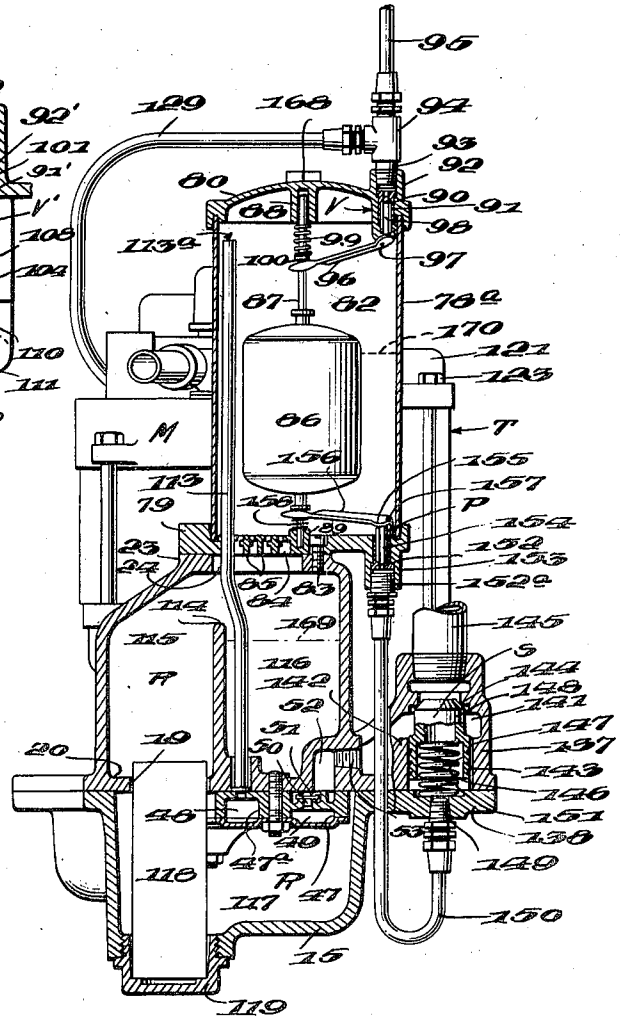


Fig. 6.



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Dec. 29, 1942. H. E. ADAMS 2,306,841

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Filed Aug. 2, 1940 5 Sheets-Sheet 5

Fig. 6.

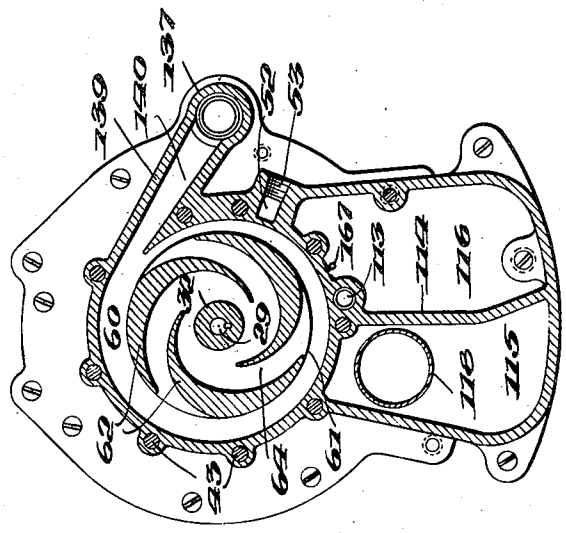
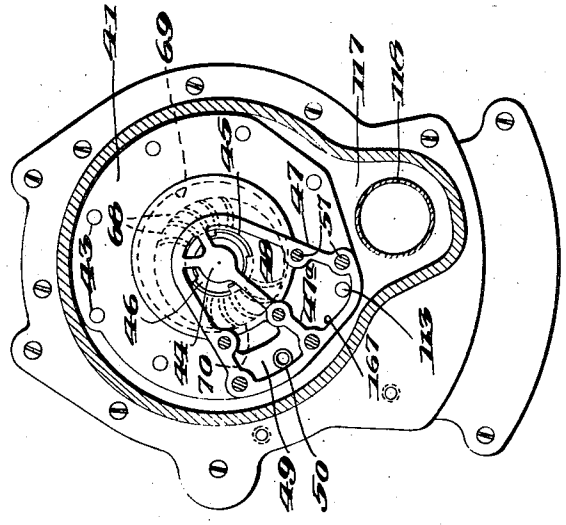


Fig. 7.



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Patented Dec. 29, 1942

2,306,841

UNITED STATES PATENT OFFICE

2,306,841

PUMP ASSEMBLAGE

Harold E. Adams, South Norwalk, Conn., assignor to Nash Engineering Company, South Norwalk, Conn., a corporation of Connecticut

Application August 2, 1940, Serial No. 349,954

11 Claims. (Cl. 103—113)

This invention relates to pumps and more particularly to a pump assemblage especially adapted to handle both liquids and gases.

The particular embodiment of the invention herein described, revolves about certain improvements to gasoline dispenser pumps for use in pumping gasoline from an underground storage tank through appropriate meter equipment and a flexible discharge nozzle to automobiles. Because of the highly volatile nature of the gasoline being pumped and because of inward air leakage in the suction line caused by the necessary suction lift, it has been most common to apply positive rotary displacement pumps suitable to withdraw the air and vapors from the suction line, so that the gasoline may in turn be lifted and delivered.

Because of the expense of these positive rotary displacement pumps, the necessity for belt or gear drive, the more expensive motor required to take care of the high starting torque, and furthermore, because of other complications involved in the by-passing and air separating arrangements typical of such units, attempts have been made to apply a centrifugal pump with suitable priming means instead of the positive rotary displacement pump, and its accessories.

Many of these centrifugal pump units have met with uncertain success because of the sensitiveness of the centrifugal pump to the presence of air or vapor in the liquid being pumped, together with inadequate air and vapor removal capacity coupled with insufficient separation of these gases and vapors from the liquid being pumped. It is to this latter class of equipment that this invention specifically relates but there are principles involved in the construction of the present invention that may be applied to other pumping problems, such as sump pumps, return line vacuum heating pumps, etc., and it is not intended to limit the invention to this narrow field of gasoline dispensing pumps.

Specifically the pump unit employed is a combination centrifugal and liquid ring or fluid piston unit having a common impeller, one side of the unit being effective to handle liquids and the other side being in the nature of a vacuum pump effective to keep the centrifugal side primed.

Among the objects of the invention is an arrangement of the casings for combination impeller-rotor pump mechanisms disclosed in my copending application, Serial No. 349,953 filed August 2, 1940, in a compact unit so as to furnish the maximum sealing capacity for the pump elements.

Another object is to provide various chambers in the liquid reservoir of the pump effective to thoroughly de-aerate the liquid received by the pump, and transfer such liquid to a point of delivery in de-aerated condition.

A further object of the invention is to provide a pump construction that insures the complete priming of the pump before any liquid may be discharged at the delivery point.

Still another object contemplates a construction that acts as an unloader for the vacuum pump to prevent liquid in the pump reservoir from being carried over into the suction line of the vacuum pump.

It is also an important object of the invention to provide an air and liquid seal for the drive shaft bearing that will minimize leakage into vital parts of the pump.

With the foregoing and other objects in view, the invention consists of a novel combination, construction, and arrangement of parts, as will appear more clearly in the following specification considered in connection with the accompanying drawings, but it is to be understood that variations and modifications may be resorted to without departing from the spirit of the invention in the claims hereunto appended.

In the drawings wherein like reference characters indicate like parts throughout the several views:

Fig. 1 is a top plan view of a liquid dispensing device embodying the principles of the invention;

Fig. 2 is a front elevation thereof, partly in section taken substantially on lines A—A and B—B of Fig. 1;

Fig. 3 is a bottom plan view thereof;

Fig. 4 is a side elevation thereof;

Fig. 5 is a front elevation thereof, with the valve shell broken away and in section taken substantially on the plane of line 5—5 in Fig. 1;

Fig. 6 is a side elevation thereof, with a part broken away and in section taken substantially on the plane of line 6—6, and with the valve shell at the lower right hand portion of the figure, broken away substantially on the plane of line 6'—6', both of which section lines are disclosed on Fig. 1 of the drawings;

Fig. 7 is a horizontal section thereof, taken substantially on the plane of line 7—7 of Fig. 2;

Fig. 8 is a horizontal section thereof, taken substantially on the plane of line 8—8 of Fig. 2;

Fig. 9 is an enlarged fragmentary sectional

view through the float chamber of the reservoir showing a modification of the vent valve; and

Fig. 10 is an enlarged fragmentary vertical sectional view of the housing showing modifications of the combination rotor-impeller, and also the seal for the bearing on the drive shaft.

The main features of the invention include a pump body, or housing H, enclosing an irregularly shaped liquid reservoir R from communication with the atmosphere except for venting valves as will presently appear. So as to obtain the maximum efficiency and insure against atmospheric leakage into the pump casing C, this casing C is positioned almost entirely in the reservoir in order that the vital parts of the pump members may be submerged in the liquid. A spring loaded valve S, which controls the discharge of liquid from the liquid pump, is influenced by a pilot valve P which will insure the discharge of the liquid at the dispensing nozzle (not shown) only under conditions that will not impair the efficiency of the pump.

The housing H is preferably made of an upright bowl 15 having a flange 16 around the edge of its open end, bolted as at 17, to a flange 18 on the bottom of a hollow head. This head, except for the strainer opening 19 and the eye or inlet port of the centrifugal liquid pump, hereinafter described, is closed by a bottom wall 20 which, together with the pump casing C, divides the reservoir R horizontally, in cases where the installation permits the pumping members to operate on a vertical axis. The side wall of the head is substantially straight, as at 21, around a part of its perimeter, and the straight part merges with the horizontal portion 22 of the motor end shield which forms the remainder of the side wall. Both the straight and the irregularly inclined parts of the side wall merge at the top in a round hollow rim 23 surrounding the open throat 24 that forms the upper portion of the reservoir R.

Part way up on the outside of the irregular wall 22, is an annular portion 25 of the motor end shield to which the prime mover is bolted at 26, and in this instance, the prime mover is an electric motor M. In the face of the flange is a stepped collar 27 which supports a ball bearing 28*a* for a part of the armature shaft 29 from the motor M. In the lower face of the ball bearing is a circular groove 28*b* which receives a mechanical resilient ring seal 28 that prevents leakage, and which may be made of rubber. A bearing bonnet 28*c* fits over the ball bearing 28*a* and the collar 27 and rests on the upper face of flange 25. Between the collar 27 and the wall 22 is an oil chamber 30 to receive the oil that forms a liquid seal for shaft 29, as will appear later. Shaft 29 extends through the chamber in a vertical direction, then through an opening 31 in wall 22, and terminates in the pump compartment E of pump casing C, where it is keyed to the conical hub 32 of the combination impeller-rotor I to which it is locked by means of the nut 33.

Between the hub 32 and the confronting face of wall 22 is a mechanical seal 34*a*. This seal consists of a cap member 35 fixed to and rotatable with the shaft 29 by a flexible ring bushing 36 which fits snugly inside the cap and grips it firmly. The ring 36 is preferably made of rubber-like substance. The ring bushing 36 also grips the shaft snugly. Around the opening in the crown of the cap 35 is a raised shoulder with a smooth face which bears against a corresponding smooth stationary face 37 around the bearing opening 31 in wall 22. The cap is urged into bearing or wiping engagement with face 37 to take up wear by means of a spring 38 encircling the shaft 29, one end of which bears against the hub 32 and the other end against a washer 39 that fits against the bushing 36.

As the description proceeds, it will be obvious that the pump casing C, together with the bottom wall 20 of the head of the body, or housing H, separates one portion of the reservoir R from another. In units having the pump members operating on a vertical axis, these aforesaid parts separate the upper portions of the reservoir R from the lower portions, so that when the dispensing device of the present invention is initially primed and operating thereafter, all of the elements of the pumps that might be influenced by the leakage of gas are submerged in liquid. Since both a gas or vacuum pump and a liquid pump are utilized in the present invention, there is created in the pump casing C and housing H, a large enough pump compartment E to accommodate both pumps, and permit arrangement of the inlet and outlet ports for each pump to conform to the arrangement of pump chambers for the individual pumps.

The invention contemplates a novel manner of utilizing a combination impeller-rotor I, so as to divide the pump compartment E into pump chambers in a manner to seal the chambers one from the other. This feature is described and claimed in my co-pending application, above mentioned, and only so much of this structure will be recited herein, as is necessary to a clear understanding of the instant invention.

With the foregoing in mind the volute part 40 of the pump casing C is preferably made integral with the bottom wall 20, although obviously this volute part may be made as a separate piece and attached to the bottom wall 20. The volute part 40 of casing C, has bolted to it, the bottom wall 41 of the casing, and this bottom wall has a peripheral rim 42, which may be bolted at 43, or otherwise secured to the periphery of the volute part 40. Formed on the center of the bottom wall is an upstanding hollow spindle or hub 44 around which the combination impeller-rotor rotates, which in the form of rotor illustrated in connection with this invention using ports, is cut away to form the inlet port 45, and the outlet port 46. For a more detailed description of examples of various port arrangements, which may be used, reference may be made to the patents to Nash, No. 953,222, and Jennings 1,718,294. It is also feasible to utilize side ports, if desired.

The bottom wall 41 is cut away substantially in a sector, and around this cut away part is a depending sector-shaped ridge 47. Between the radial parts of the ridge is a radial partition ridge 47*a* which divides the opening into an inlet passage 48 and the outlet passage 49, and the outlet passage communicates with an upwardly extending opening 50 having a valve seat for the spring pressed check valve 51. The opening 50 communicates past the valve 51, with a lateral cavity 52 in the volute part 40 that has a threaded opening 53 to which the conductor pipe 54 (Fig. 5) is connected at one end, while the other end of the pipe 54 is connected to a threaded nipple 55 on the bottom wall 56 of the stripping tank T. The radial parts of the sector-shaped ridge 47, and the partition ridge 47*a* merge at the apex in the spindle or hub 44. Over the ridges 47 and 47*a*, and the spindle 44 is bolted, as at 57, the

port plate or hood 58, which closes the inlet and outlet passages 48 and 49 respectively, and with the wall 41, and volute wall 40, entirely separates the upper from the lower portion of the reservoir R.

In the center of the volute part 40 is the eye or inlet port 59, which enters the pump compartment E at the top, and in the margin of the volute part is the volute passage 60. The combination impeller-rotor I is disposed in the pump compartment E. The member I may be made in many forms but all of them are made with a disc 61 that merges with the hub 32. In both of the forms shown in Figures 2 and 10, on the upper face of the disc are mounted pump elements which constitute a centrifugal liquid pump, while on the lower face are mounted the pump elements that perform the function of a liquid ring gas pump or compressor. It being the purpose of the present invention to create a self-priming liquid pump, the liquid ring gas pump is utilized for creating a vacuum, and the centrifugal pump for pumping the liquid from the reservoir R. In both of the forms of the invention shown in Figures 2 and 10, the disc 61 divides the pump compartment E into the upper centrifugal pump chamber 61*a* and the lower liquid ring pump chamber 61*b*, the disc forming a rotating partition wall for said respective chambers, and at the same time serving to carry the pump elements for the centrifugal pump and the liquid ring pump.

In the form of the invention shown in Fig. 2, impeller blades 62 are formed on the top face of disc 61 and have a close clearance with the inner face of the volute part 40, as at 63. The blades form the impeller passages 64 between the face of the disc 61 and the confronting face at 63, whereby liquid is drawn from the reservoir R through port 59 and discharged into volute passage 60 by centrifugal force well known in centrifugal pumps.

The vanes 65 of the liquid ring pump are located on the lower face of disc 61, and have a shroud or cover plate 66, riveted at 67, to their free edges thereby forming the liquid ring buckets or displacement chambers 68, between the vanes and between the bottom face of the disc and the shroud. The inner and outer peripheries of the shroud or cover plate 66 are disposed against mating surfaces of the recess in the inner face of bottom wall 41, with a close clearance. As is well known in the art from the teachings of the U. S. patents to Nash 953,222, March 29, 1910; 1,091,529, March 31, 1914; and Jennings 1,297,692, March 18, 1929, a gas is efficiently pumped by the action of a liquid in the outer portion of the buckets 68, when the liquid moves, by centrifugal force, in and out of the buckets against the lobe 69 and the lands 70 (Fig. 7), respectively. A depending lip 71 is formed on the edge of the disc 61, and this lip 71 has close clearance with the confronting peripheral wall adjacent volute passage 60 and forms a seal between the pump chambers 61*a* and 61*b*. Another seal 71*a* is made between the wall 41 and a depending annular ring on disc 61.

Disregarding the modified form of the bearing seal in Fig. 10 which will be considered later, it will be seen, in Fig. 10, that the disc 61', similar to disc 61, has a close clearance, at 71', with the confronting part of the volute wall 40' adjacent the volute passage 60' to form a liquid seal between the centrifugal pump chamber 61*a*' and the liquid ring pump chamber 61*b*'. In this figure the impeller blades 62' have a shroud 72 riveted to their edges like the shroud 66 is riveted to blades 65 in Fig. 2 and this shroud 72 has an upstanding neck 73 near the center, the opening of which registers with the inlet port 59'. In this construction a renewable, mechanical seal ring 74, is seated in a step 75 about the inlet port 59', and forms a snug fit with the outside of the neck 73. In the structure shown in Fig. 10, the rotor blades 65' have no shroud covering them, but instead have a close clearance 76 with the adjacent wall 41' of the pump casing C'. Another seal 77 is formed between the lower surface of disc 61' and the bottom casing wall 41', which when considered with seal 71' forms a right angled seal. In all other respects, save for the modified bearing seal, the parts are similar to the structure shown in Fig. 2. The purpose of the seals at 71 and 71*a* in Fig. 2, and seals 77, 71' in Fig. 10, is to permit some liquid from the volute passage 60 and 60' to flow into the gas pump lobes 69 and 69', respectively, all of which promotes efficiency in operation.

The flow from the volute passage 60 or 60' to the lobe 69 and 69' respectively, is provided by making the centrifugal impeller of higher pressure capacity, in this case, than the liquid ring pump rotor, but the present invention is not to be restricted in the relationship of these two capacities, as the control of the interchange of liquid being pumped by the centrifugal impeller and the liquid seal for the liquid ring pump rotor can be obtained through other appropriate means as hereinafter explained.

The reservoir R further includes a drum 78 having a round upstanding side wall 78*a* (Fig. 6), the edges of which are clamped in grooves between the heads 79, 80. Long bolts 81 clamp the heads 79, 80 together. The drum 78 forms the float chamber 82 of the reservoir R. The bottom head 79 is bolted to rim 23, as at 83, and is eccentric with respect to the rim having an overhanging portion that carries the pilot valve P. A portion of the head 79 has an opening 84 communicating with the reservoir R and in this opening is a baffle 85 in the form of a grid or grille similar to that shown in my U. S. Patent 1,929,232. A float 86 slides upon an upright rod 87 in chamber 82, and the rod is supported at one end in a thimble 88 on head 80 and at the other end in a thimble 89 on bottom wall 79. At the top, the chamber 82 is vented through the vent valve V, which consists of a valve seat 90 formed in the vent passage 91 of the sleeve 92 made integral with the top head 80. The sleeve has a pipe connection 93 with the passage 91 which pipe opens into the atmosphere through the union 94 and pipe 95. A lever 96 is pivoted at 97 to rock on the inner end of the sleeve 92, and has wiping engagement with the projecting end of the valve pin 98 which slides in the valve passage 91. The inner end of the valve pin 98 bears on the seat 90 and closes the passage 91, and in the position shown in Fig. 6, the valve is closed.

A fork on the other end of the lever 96, straddles the float rod 87 in the path of the float 86 and the lever is held in valve closing position by a spring 99 encircling the rod 87. One end of the spring is fixed in the thimble 88, and its other end is fixed to a washer 100 which slides on the rod and bears against the lever 96. Another type of vent valve V' is shown in Fig. 9, which is of a type similar to those used in pneumatic tires. In this type, a bored bushing 101 is in-

serted in the passage 91' in the sleeve 92' on the head 80', and the bushing has a passage 102 throughout its length. The passage is threaded at 103 at one end, and the barrel 104 is screwed into the threaded part. At the opposite end, the passage 102 has a shoulder 105 in which an open cage member 106 is seated. A valve stem 107 extends through a bore 104a in the barrel 104, and through the passage 102, and is slidably received in the cage 106. A disc valve 108 is fixed to the stem 107, and closes the bore in the barrel, being normally urged to that position by a spring 109 encircling the stem 107. One end of the spring bears against the cage 106, and the other against the disc valve 108. It is to be understood that the cage 106 is open so as to permit air to be vented through the passage 102. Depending from the head 80' of the tank 78' are a pair of spaced ears 110, between which is pivoted at 111, the inner end of the lever 96', said lever having a flange 112. The flange 112 wipes against the projecting end of valve stem 107, and the forked end of the lever 96' straddles the float rod 87'. In the position shown in Fig. 9, the valve and other parts including the float 86' are in the normal closed position. Further movement upward by the float 86' on the float rod 87' will press valve stem 107 inwardly, unseat the valve 108, and vent the float chamber 82' to the atmosphere.

Opening from a point 113a near the top of the float chamber 82, is a conductor pipe 113, which extends through the reservoir R, and terminates in an open end in the inlet passage 48 of the liquid ring vacuum pump. It will thus be seen that there is a direct connection, from a point above the liquid level limit where chamber 82 is vented to the atmosphere, to the inlet port 45 of the liquid ring gas pump. Extending from one part of the side wall 22 to the other part 21, is a baffle wall 114, preferably made integral with the head walls. The wall 114 extends from the bottom wall 20, of the head to a point near the top. This wall 114 divides the reservoir R into a de-aerating or separating chamber 115, and a liquid supply or suction chamber 116, the space above wall 114 permitting the liquid to pass from one to the other. The opening 24 in the top of the head casting, and the baffled opening 84 to the chamber 82 are offset with respect to the separating chamber 115. The bowl 15 forms the settling chamber 117 for the reservoir R, and communicates with the separating chamber 115 through a cylindrical screen 118, which is wedged in a cap 119 on the bowl 15. The upper end of the screen 118 extends through the opening 19. A lower level of bowl 15 is connected by the pipe 120a to an underground storage tank, not shown, and in the pipe is the usual foot valve to retain the head of liquid in the pipe, once the pump has been primed. It will then be seen that the reservoir R includes the settling chamber 117, the separating chamber 115, the supply chamber 116, and the chamber 82, the latter being referred to as the suction control chamber, or float chamber and is disposed above the former chambers, all of which are in communication.

The purpose of the stripping tank T is to form a chamber 120 to receive the air exhausted by the liquid ring gas pump, strip the heavy vapors and liquid from the air exhausted from the pump, allow the air to escape into the atmosphere, and return, or recirculate the liquid so stripped to the reservoir R. The tank T has a tubular side wall 122, the edges of which are clamped between two heads 121, 56 by the long bolts 123. In the chamber 120, a float 124 slides on a rod 125 secured at the one end in a nipple 126 on the bottom wall 56. A valve seat 127 is formed in the bottom wall 56, and a pipe 128 connects the passage in the valve seat with the liquid suction or supply chamber 116. The discharge pipe 129 is connected with a port 130 in the top wall 121 of the chamber 120, and this pipe connects with the pipe 95 which opens to the atmosphere. A fire repellant gauze may be placed in the pipe 129, or pipe 95 to reduce fire hazards. A float controlled valve 131 is pivoted on an intermediate portion, at 132, of a lever 133. One end of the lever is pivoted at 134a, to a lug 134 on bottom wall 56, and the other end is forked at 135. The ends of the fork fit in a collar 136 on the float 124 and as the float rises with the volume of stripped liquid in the chamber 120, the valve 131 will open from the closed position shown in Fig. 2, and permit the liquid in chamber 120 to be returned to the suction chamber 116.

The discharge control valve S consists of a dome or shell 137, fixed to a shelf 138 on the rim of the settling bowl 15. One side of the shell is formed with a hollow, laterally projecting neck 139 which merges with the volute part 40 of the pump casing H, and contains a passage 140 that registers with the volute passage 60. As shown, the valve shell 137 and neck 139, are made integral with the volute part 40 of the casing, but other ways of constructing these parts in separate pieces may be devised. The passage 140 also communicates with the valve chamber 141. In the valve chamber 141 is an open top cylinder 142 formed with a bore 143. Directly over the bore of the cylinder, the shell is formed with a valve seat 144, which communicates with the discharge pipe 145 that leads to the dispensing nozzle, not shown, where liquid is delivered as desired. The nozzle carries an electric switch, as is conventional, which controls the operation of the motor M.

The valve S is illustrated as of a piston type (although obviously other forms of differential pressure valves, e. g., diaphragm or bellows, might be used) and has an enlarged skirt 146 mounted for sliding movement in the bore 143, with a predetermined clearance, as shown at 147, which provides for a certain amount of flow of liquid around the valve. The skirt 146 of the valve merges with a reduced part 148 that is larger in diameter than the seat 144 against which the reduced part seats. The reduced part 148 of the valve is under the direct influence of liquid under pressure in the valve chamber 141, which latter is in communication with the volute passage 63 of the centrifugal pump. There is an opening 149 in the shelf 138 which communicates with the bore 143, and a pipe 150 threaded in this opening is connected to the pilot valve P. A helical spring 151 has one end seated against the shelf 138 in the bore 143, and its outer end bears against a shoulder on the inside of the skirt 146, normally urging the valve to closed position, as shown in Figures 5 and 6.

The pilot valve P is formed of a valve seat 152 secured in a small sleeve 153 that is made integral with, and extends downwardly from the overhanging part of the head 79 of suction control tank 78a. The pipe 150 that communicates with the under side of the control valve S has a communication with the suction control chamber 82 through the passage 152a in the valve seat 152, and is controlled by a valve pin 154. The

outer end of the valve pin has wiping engagement with an intermediate part 155 of the lever 156. One end of the lever 156 is pivoted at 157 to the head 79, while the other end thereof straddles the float rod 87 in the path of float 86. A spring 158 encircles the lower end of the float rod 87, the lower end bearing on the nipple 89, and the upper end bearing against the end of valve operating lever 156, thereby normally permitting the valve P to assume open position. (This is due to the fact that valve pin 154 is not connected to lever 156.) The discharge from the liquid pump is divided into two branches by the valve seat 144. The one branch is the pipe 145, and the other is the bore 143 of cylinder 142, which by means of pipe 150 communicates through valve P with reservoir R by way of the suction control chamber 82.

In Fig. 10, I have shown an alternative construction for sealing the upper bearing 28a' from the oil sealing chamber 30'. In this form of the invention, the ball bearing 28a' and its mechanical seal ring 28' are formed alike in all respects, as the bearing 28a and ring 28 in Fig. 2. However, so as to prevent leakage into the ball bearing from oil seal chamber 30', like chamber 30 in Fig. 2, an additional seal is provided in the form of a stationary metal cap 160, in which is seated a flexible rubber-like ring 161. The ring grips and wipes against the shaft 29 and is held stationary in the cap 160. The cap seats in a shoulder 162 in the wall 22', in chamber 30', and is held in position by a resilient wire split ring 163 that seats in a circular groove 164 in the shoulder wall. In the form of the invention shown in Fig. 10, the cap 160 and the resilient ring 161 are disposed between the bearing 28a' and chamber 30' to furnish a seal and an additional closure for chamber 30'. The cap seals the upper portion of the seal chamber 30' to prevent oil and gasoline from leaking into the ball bearing 28a'. The oil sealing fluid in chamber 30' will be retained along the level of the lip of filling neck 165. Should any leakage occur, a relief passage 166 may be formed in the wall 22' leading from the upstanding collar 27'.

It is here pointed out, that wherever any liquid seal rings are suggested as being made of rubber, it is intended to include all synthetic rubbers such as chloroprene and neoprene, as well as the natural rubbers.

From the foregoing description, the operation of the invention will readily be apparent, and while the description refers to use with a gasoline dispensing apparatus, this is intended as exemplary.

Liquid such as gasoline is drawn into the strainer and settling chamber 117, through the suction pipe 120a, passes through the strainer 118 into the air and vapor separating chamber 115, passing over the baffle 114, down into the suction chamber 116 and thence to the eye or inlet connection 59 or 59' of the impeller of the centrifugal pump. The air and vapors released at the top of the separating chamber 115, pass through openings 84 between baffles 85 and are trapped in the float control chamber 82, where they are drawn from the top point 113a of this chamber by pipe 113, which leads down to the priming pump suction or inlet passage 48. The gasoline which is drawn into the impeller inlet connection at 59 or 59' passes through the impeller passages 64 and is collected in the centrifugal pump passage 60, where it is lead to the gasoline discharge passage 140. From here it is delivered through pilot controlled discharge valve S, thence through the pipe 145 to the conventional gasoline meter, etc. to the gasoline dispensing nozzle.

Picking up the course of the air and vapor which are drawn in at the vacuum pump suction connection 113, these gases are drawn in through the inlet port 45 of the liquid ring type vacuum pump or compressor. The compressed air and vapors are discharged through the outlet port 46, through the discharge passage 50 and check valve 51, to the discharge connection 53. From here these gases are lead through pipe 54 to connection 55 in the stripping or separating tank T where the air and vapors are stripped or separated from the excess liquid that is delivered with them.

The air is discharged through the top connection 139, through a suitable fire repellant gauze, to atmosphere through pipe 129 and 95. The separated liquid collected in the tank T is discharged by means of a float valve 134, through the discharge pipe 128 to the gasoline inlet chamber 116.

The combination liquid pump and gas exhauster that is employed in this unit is entirely novel and it is covered in my co-pending application heretofore indicated, wherein the specific features of this important element of the instant invention is claimed.

As is characteristic with the conventional centrifugal water pump, the discharge pressure built up by it in the discharge passages is liable to be quite a variable, depending upon the rate of delivery. There are times, therefore, when the pressure in the volute passage 60 will drop to an absolute value lower than the pressure created in the lobe 69 by the vacuum pump rotor. Under such conditions there would be a reversal of flow of the liquid from the lobe 69 through the clearance spaces 71a and 71, or 77 and 71' in the modified form of the invention, and into the volute passage 60 of the centrifugal liquid pump. There is the possibility that this pressure difference would be of such order as to seriously impair the efficiency and operation of the vacuum pump because of the loss of its seal in this manner.

There are several ways of providing for the maintenance of suitable pressure within the volute passage 60. One method is shown and described in this application as an example, but it is not intended that the invention is to be limited to this specific type of control. In the figures shown, there is employed a pilot controlled discharge valve S in the discharge of the centrifugal pump, the pilot valve being indicated in Figure 6 as P and controlled through operating lever 156, the spring 158 and the float 86.

It will be noted from Fig. 6 that the discharge valve seat 144 of the valve S is of smaller diameter than the reduced part 148. With the volute discharge pressure exerted to the valve S, this valve will remain closed as long as the pressure on the under side of the skirt portion 146 is approximately the same as that of the volute passage 60, provided of course that the pressure in the final discharge pipe 145 is lower than that in the volute passage 60. Provision is made for this equalization of fluid pressure between the volute passage 60 and the under side of the piston valve S by holding the pilot P closed. With this pilot valve closed, the pressure on the under side of the piston valve S and the inter-

connecting pipe 150 is effectively equalized by the leakage from the volute passage 60 of liquid around the clearance space 147 between the skirt portion 146 and its cylindrical housing 142.

The weight of the float 86 bearing on arm 156 holds the pilot valve P closed and thus maintains fluid pressure under the skirt part 146, along with upward pressure of spring 151 to retain the valve S tight on its seat 144.

As soon as the centrifugal pump is primed and the liquid level rises in the suction controller tank 82 to the point where it will raise the float 86, the pilot valve P will open from the force of the spring 158 and the pressure on the under side of its seat 152 that is communicated to it through the equalizing pipe 150.

As soon therefore as this pilot valve P opens, it will release liquid from the under side of the valve S to the suction side of the centrifugal pump inasmuch as the chamber 82 is directly on the suction side. The pilot valve P is of sufficient area to allow the liquid to escape from the under side of valve S at a faster rate than it can leak by the clearance space 147 around the valve. This release of liquid from the under side of the valve S in this manner will result in a much lower pressure on the under side of valve S than exists on its upper side in communication with the volute passage 60. The pressure on the under side of the valve S, due to its connection with the suction side of the centrifugal pump, is furthermore lower than the pressure above the seat 144. The result will be the immediate downward movement of valve S and resultant opening of the valve to place the volute passage 60 directly in communication with the discharge pipe 145.

It will be seen that this valve S will remain open as long as the pilot valve P is open while the centrifugal pump is in operation. There will also be a throttling effect communicated to valve S by any throttling of the pilot valve P, caused by drop in the liquid level of chamber 82. This throttling action will result in the maintenance of a lower limiting level in the suction control chamber 82, when a balance is reached between suction and discharge conditions. The maintenance of this lower limiting level serves three general purposes:

(1) It keeps the eye 59 of the centrifugal pump covered and thus allows it to maintain its normal operating pressure in the volute passage 60, 60' to provide the proper sealing between the clearance spaces 71*a* and 71, or 77 and 71'.

(2) It insures against the uncovering of the eye 59 of the centrifugal pump and the pumping of air by the centrifugal pump.

(3) It maintains a quantity of sealing liquid for recirculating purposes during the normal operation of the pump.

It will also be noted that the spring 151 is so proportioned that it will normally hold the valve S closed on its seat 144. The tension of this spring is such that it can be readily overcome by the differential pressures between the volute passage 60 and the suction chamber 116 referred to but will, while the pump is not running, hold the valve S closed to maintain the discharge line 145 full of liquid.

A further provision of this spring 151 is to act as a relief valve in conjunction with valve S should the pressure in line 145 become excessive during a shut-down period by the expansion of the liquid trapped therein, as might be caused on a hot day. Such expansion might be injurious to the delicate meter mechanism and this spring-loaded valve S will automatically relieve this system of excessive expansion pressures.

It will be noted that when the liquid impeller of the centrifugal pump is delivering liquid through the discharge valve S, there will be at these times a pressure in the volute 60 normally in excess of the pressure in the lobe 69 or 69', and during the period of operation there will be a flow of some of this liquid through the clearance spaces 71*a* and 71 or 77 and 71', into the lobe 69 or 69'. This interchange of liquid serves a useful purpose besides maintaining the seal between the pump casing C and the impeller, as it is used by the vacuum pump rotor to fill up its clearance spaces and also to serve as a means of cooling to carry away the heat of the work of compression done by the vacuum pump. This additional sealing liquid is discharged by the vacuum pump with the compressed air or gas through outlet port 46, the discharge passages 49, 50 and 53, and the pipe 54.

Further provision is made for auxiliary sealing liquid for the filling up of the clearance spaces and for cooling purposes in the vacuum pump. There will be an auxiliary flow of sealing liquid from the suction chamber 116 of the liquid pump through a controllable or fixed orifice 167 (Fig. 10), through wall 20 to the inlet passage 48 of the vacuum pump, from where it flows into the vacuum pump inlet port 45 and finally through the discharge port 46 and pipe 54.

The flow of gasoline or liquid through the dispensing unit and the means of separating the gases from the primary fluid being pumped, as well as from the gas and sealing liquid mixture discharged from the vacuum pump will be understood in the foregoing description. These conditions occur during the normal operation of the unit after once getting under way with full delivery of the liquid itself. The provisions that have been made to obtain the so-called self-priming feature of the pump will now be described.

It is well known in the art that centrifugal liquid pumps of the type here used are not self-priming. In other words, they will not draw liquids from a lower level unless all of the intervening air or gas has been withdrawn from the suction line 120*a* and the impeller and casing of the centrifugal pump itself completely filled with the liquid. It is therefore necessary to provide an exhauster to withdraw the air and gases from the suction line and the pump casing before pumping by the centrifugal can begin. The vacuum pump that is provided in this structure in a novel combination with the liquid impeller itself is of course the means for evacuating the suction line and the pump casing to provide for the priming of the liquid impeller.

The vacuum pump itself, being a liquid ring pump, must be provided with an initial charge of sealing liquid and means for maintaining this sealing liquid during the time it is exhausting the suction line of the liquid pump.

In the present structure, provision is made to retain the sealing liquid by placing it in a liquid tight pocket consisting of a suction chamber 116 and the impeller casing 61*a*, such that the liquid can not be lost from this casing by gravity flows into the suction line 120*a*, nor can it be discharged completely by the impeller by the action of the float controlled discharge valve S. The liquid ring pump itself is placed at the lowest point of this pocket so as to insure the

complete benefit by this submergence in the body of liquid stored in this pocket.

In practice, the sealing liquid is poured into the suction control chamber 82 through the initial filling plug 168 in the wall 80, until it completely fills the vacuum pump chamber 61b, the centrifugal pump chamber 61a and the supply or suction chamber 116, to the level of the baffle 114. Any further filling of the chambers would result in the waste of this liquid over the baffle 114, down into the separating chamber 115 and eventually through the suction pipe 120a.

This priming liquid involves only a small quantity ranging from 2 to 4 quarts, or possibly greater, depending upon the size of the pump structure. It is thus seen that before starting up the unit, all of the pumping elements and the pump suction chamber are completely submerged in liquid.

Upon starting, the centrifugal pump can not pump the initial fill out as the discharge valve S will be closed. It will therefore retain liquid under pressure in the volute 60, which will continue to serve as a sealing means against the loss of seal in the lobe 69 during the remainder of the priming operation. The vacuum pump will therefore immediately start evacuating air and gas from the suction line 120a, through the inlet passage 48, pipe 113, suction control chamber 82, separating chamber 115, and settling chamber 117.

Provision for the necessary make-up seal is made, as before mentioned, through the orifice 167, Fig. 10, by the retention of the liquid in the supply or suction chamber below the approximate level 169. The liquid that is fed to the vacuum pump through orifice 167 from this reserve seal, also by the centrifugal impeller through clearance spaces 71a and 71 or 77 and 71', after passing through the vacuum pump and its discharge passages 49 and 52, is eventually delivered to the stripping tank T where the liquid is stripped from the mixture and this same liquid is then returned, by means of the pressure differential existing through the float valve 134 to the same reserve body of liquid in the supply or suction chamber 116 by means of the pipe 128. It is thus seen that this body of liquid is maintained at approximately the level 169 during the continued priming operation of the vacuum pump. As the vacuum pump continues to withdraw air and gases from the suction line 120a, it causes the raising of the liquid in the suction line until it eventually fills the settling chamber 117 and is then drawn up into the separating chamber 115, where it flows over the baffle 114 filling the supply or suction chamber 116 and finally rises to a point in the suction control chamber 82 where it causes float 86 to rise and open pilot valve P, thus allowing the discharge valve S to open. The centrifugal impeller then can resume operation to pump the liquid to its delivery point.

The vacuum pump continues to withdraw air and gas above the liquid and that separated from it through the pipe 113 at the point 113a in the suction control chamber 82. This action causes the further rise of the liquid level in the suction control chamber 82. As this level continues to rise, due to the evacuation of the gases above it by the vacuum pump, it causes the further rising of the float 86. As this float rises, it engages the vent valve operating arm 96, which through appropriate linkage, as shown and described, operates to open vent valve V. The opening of the vent valve V admits air from atmosphere through the atmospheric connection 95 into the suction control chamber 82 in an amount sufficient to equal the capacity of the vacuum pump at this particular operating condition. This action stops the further rise of liquid in the chamber 82 and a balance is reached which holds the level of the liquid up into chamber 82 approximately at the level 170. Any unusual amount of entrained air coming up with the liquid from the suction connection will cause a temporary lowering of the level 170 and consequent closing of the vent valve V. This action will put the full capacity of the vacuum pump to handling this excess air and it will result in the pulling up of the liquid to approximately the level 170, where again the vent valve V through the action of the float will bleed in just sufficient air to cause a balanced condition.

The action above described acts as an unloader for the vacuum pump in that it prevents the carrying over of gasoline into the vacuum pump suction. Such carry-over would materially increase the power requirements. As far as is known, no other gasoline pump has this unloading provision.

Of course, as soon as the above balanced condition is reached, the pump is fully primed and is in normal operating condition. In the usual gasoline pump installations, a check valve or a foot valve is placed in the suction line 120a so that after the line is first primed it will not have to be primed on each subsequent operation of the pump. Any subsequent inward leakage of air into this suction line 120a or any flashing of the volatile vapors caused by elevated temperatures due to exposure to heat from the sun, etc. would be detrimental not only to the pumping action of the centrifugal pump, which is peculiarly sensitive to the presence of gases and vapors, but would also result in inaccuracies in the measurement of the gasoline being delivered through the displacement meter to the customer. To take care of these unusual conditions, I have provided an over capacity in the vacuum pump operating in conjunction with the suction control and the controlled discharge valve, as before described, and the separating means on the suction side of the pump. It is therefore practically impossible for air to be delivered with the gasoline.

Various elements of the vacuum pump assembly have been arranged so as to completely enclose them in the bottom settling chamber 117. During the normal operation of the unit, this makes provision for all of the joints of the vacuum pump being completely flooded and sealed with gasoline or other liquid being pumped, and thus reduces the possibilities for atmospheric air leakage on the suction side of the pump.

Another detail of importance is the provision made for the proper sealing of the drive shaft 29 from leakage of air inward to the suction chamber or possible leakage of gasoline from the suction chamber up into the bearing 28a or 28a', as shown and described in connection with Figures 2 and 10.

A mechanical seal is employed consisting of a rotating member 35 held and driven from the shaft by means of the flexible bushing 36, the two units being forced on the shaft so that the bearing face 37 of the member 35 bears firmly against a corresponding polished stationary surface of wall 22 or 22'. The whole assembly is re-

tained in position for take-up of possible wear by means of the spring 33 and washer 39.

Above the stationary sealing surface 37, I provide a chamber 39 which would be supplied with a lubricant maintained at a level of the opening in filling neck 165, through conventional means, see Fig. 10. The positioning of the seal in this manner allows for more effective lubrication of the sealing surface 37 and at the same time provides a definite liquid seal above the sealing surface 37 for the exclusion of inward leakage of atmospheric air to the suction which of course would be highly detrimental to the operation of the unit.

As conventionally applied, lubrication for seals of this nature is usually supplied around the rotating seal 37 itself. By placing the lubrication on the opposite side more effective lubrication of the sealing surfaces 37 is obtained, because of the natural centrifugal force that tends to throw the oil outwardly between these surfaces.

As a further protection for the bearing 23a', I provide an additional shaft seal 161. This seal would prevent the passage of the oil from the oil sealed chamber 39' up into the bearing. There is a possibility of a slight positive head on the suction chamber of the pump when the unit is shut down. This pressure is limited to the height of the gasoline discharge nozzle, but because of the air chambers in the inlet and discharge separators, this pressure could not exceed one or two feet. If for any reason the mechanical seal assembly should leak between the surfaces 37 or around the resilient member 36, up into the oil sealing chamber 39', the possibility of this gasoline reaching the bearing would be remote because of the extra seal 161 and the overflow level in the opening in filling neck 165.

As additional protection to the bearing, there is employed in this structure a ball bearing 23a or 23a' provided with an integral seal 23 or 23', and a further relief passage 166.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A pump assemblage comprising a housing equipped with a closed liquid reservoir adapted for communication with a liquid storage tank disposed at a lower level, a gas pump in communication with the liquid reservoir at one point for creating sub-atmospheric pressures in the reservoir effective to transfer liquid from the tank to the reservoir, a liquid pump in communication with said reservoir at a different point below said first point for discharging liquid from said reservoir, and part of said gas pump being confined within the reservoir below said first point whereby the liquid in the reservoir will form a seal for said part.

2. A pump assemblage comprising a housing equipped with a closed liquid reservoir adapted for communication with a liquid storage tank disposed at a lower level, a gas pump in communication with the liquid reservoir at one point for creating sub-atmospheric pressures in the reservoir effective to transfer liquid from the tank to the reservoir, a liquid pump in communication with said reservoir at another point below said first point for discharging liquid from the reservoir, pumping means forming part of said pumps effective to separate the respective pumping chambers thereof, means providing a liquid seal between said chambers, means influenced by the liquid within the limits of the said points to place said reservoir in and out of communication with atmosphere, to maintain said liquid pump primed and to maintain proper seal pressure on said liquid sealing means, and each pump having a portion confined within the reservoir.

3. A pump assemblage comprising a housing equipped with a closed liquid reservoir adapted for communication with a liquid storage tank disposed at a lower level, a gas pump in communication with the liquid reservoir at one point for creating sub-atmospheric pressures in the reservoir effective to transfer liquid from the tank to the reservoir, a liquid pump in communication with said reservoir at another point below said first point for discharging liquid from the reservoir, pumping means forming part of said pumps effective to separate the respective pumping chambers thereof, means providing a liquid seal between said chambers, means influenced by the liquid within the limits of the said points to place said reservoir in and out of communication with atmosphere, to maintain said liquid pump primed and to maintain proper seal pressure on said liquid sealing means, said gas pump having a part confined within the reservoir.

4. A pump assemblage comprising a housing equipped with a closed liquid reservoir adapted for communication with a liquid storage tank disposed at a lower level, means in the reservoir to maintain the liquid level in the reservoir within predetermined limits, comprising a gas pump communicating with the reservoir above said limits for creating sub-atmospheric pressures in the reservoir effective to transfer liquid from the tank to the reservoir, a liquid pump communicating with said reservoir below said limits for discharging liquid from said reservoir, liquid sealing means between said pumps and below said limits, a valve operable to control the discharge of the reservoir at a predetermined level, and means influenced by the liquid at one limit in the reservoir to maintain said valve inoperative when the level is below the predetermined amount, thereby to keep said liquid pump primed, and to maintain adequate pressures on the liquid sealing means.

5. A pump assemblage comprising a housing equipped with a closed liquid reservoir adapted for communication with a liquid storage tank disposed at a lower level, means in the reservoir to maintain the liquid level in the reservoir within predetermined limits, comprising a gas pump communicating with the reservoir above said limits for creating sub-atmospheric pressures in the reservoir effective to transfer liquid from the tank to the reservoir, a liquid pump communicating with said reservoir below said limits for discharging liquid from said reservoir, liquid sealing means between said pumps and below said limits, a valve operable to control the discharge of the reservoir at a predetermined pressure, and means influenced by the liquid at one limit in the reservoir to maintain said valve inoperative when the level is below the predetermined limit, and means, influenced by the liquid at the other limit in the reservoir, to place said reservoir in communication with the atmosphere, said liquid controlled means being cooperative with each other to keep said liquid pump primed, and to maintain adequate pressures on the liquid sealing means.

6. A pump assemblage comprising a housing equipped with a closed liquid reservoir adapted for communication with a liquid storage tank disposed at a lower level, a gas pump in com-

munication with the liquid reservoir at one point for creating sub-atmospheric pressures in the reservoir effective to transfer liquid from the tank to the reservoir, a liquid pump in communication with said reservoir at a different point below said first point for discharging liquid from the reservoir, means influenced by the liquid within the limits of said points to place said reservoir in communication with the atmosphere, a valve controlling the discharge of liquid from said liquid pump at a predetermined level in said reservoir, said latter means including a normally open connection between said valve and the reservoir at a point between said means and said different point, and means responding to the influence of the liquid level in the reservoir to control the opening and closing of said valve.

7. A pump assemblage comprising a housing equipped with a closed liquid reservoir adapted for communication with a liquid storage tank disposed at a lower level, a gas pump in communication with the liquid reservoir at one point for creating sub-atmospheric pressures in the reservoir, a liquid pump in communication with said reservoir at a different point below said first point, both pumps being arranged below said points, said liquid pump having a discharge passage, means influenced by the liquid in the reservoir within the limits of said points to place the reservoir in communication with the atmosphere, a valve shell having a valve seat across the discharge passage, said valve shell being formed with a cylinder provided with an opening in communication with said valve seat, said cylinder having a normally open connection with said reservoir, a piston valve mounted in the cylinder between said connection and the valve seat and normally bearing against said valve seat, and means responding to the influence of the liquid level in the reservoir for closing said connection.

8. A pump assemblage comprising a housing forming a closed liquid reservoir, a pump casing in said housing and at least partially in said reservoir, a rotor in said pump casing effective to divide said casing into a plurality of pump chambers, said rotor forming in combination with one of said pump chambers, a centrifugal liquid pump, and forming in combination with the other of said chambers a liquid ring, gas pump, said gas pump being completely immersed in said reservoir, under operating conditions, said rotor being effective to withdraw liquid and gas, respectively from the reservoir at different levels.

9. A pump assemblage comprising a housing forming a closed liquid reservoir, a pump casing in said housing and at least partially in said reservoir, a rotor in said pump casing effective to divide said casing into a plurality of pump chambers, said rotor forming in combination with one of said pump chambers, a centrifugal liquid pump, and forming in combination with the other of said chambers a liquid ring gas pump, said gas pump being completely immersed in said reservoir, under operating conditions, said rotor being effective to withdraw fluids from the reservoir at different levels, and means controlled by the liquid in the reservoir to place the reservoir in communication with the atmosphere.

10. In a pumping system effective to handle liquids and gases, a source of supply, a reservoir in communication therewith, means to prevent the liquid level in the reservoir from descending below a predetermined elevation, and means to separate gas from liquid, means in communication with said reservoir to initially place a vacuum on said source of supply thereby to pump liquid into said reservoir, and to pump separated gas from said separating means, means to pump separated liquid from said reservoir to an ultimate discharge, means arranged below said liquid level to provide a liquid seal between the vacuum creating means and the liquid pumping means, means effective at a predetermined level in the system to control discharge of the liquid from the system and to control vacuum conditions within the system, thereby to keep said liquid pumping means primed and to maintain proper pressures on the liquid sealing means.

11. In a pump assemblage having a source of supply and an ultimate delivery means, pumping means effective to place a vacuum on the source of supply and draw fluid therefrom, means interposed between said source of supply and pumping means effective to separate gas from liquid in said fluid including a float tank having a connection for delivery of gas to said pumping means, and a reservoir for delivery of liquid to a liquid pumping means, said pumping means and liquid pumping means being arranged below the lowest liquid level in the reservoir, said tank having a float valve connection to atmosphere effective to balance vacuum conditions with liquid level conditions in the assemblage, valve means for said ultimate delivery means, and pilot valve means connected to said float tank, and to said delivery valve means, said pilot valve means being constructed and arranged to control said operation of said delivery valve means in accordance with vacuum and liquid level conditions in said assemblage.

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