

June 24, 1941.

W. J. PETER

2,246,951

PUMP UNIT FOR LIQUID DISPENSING APPARATUS

Filed Feb. 15, 1938

5 Sheets-Sheet 1

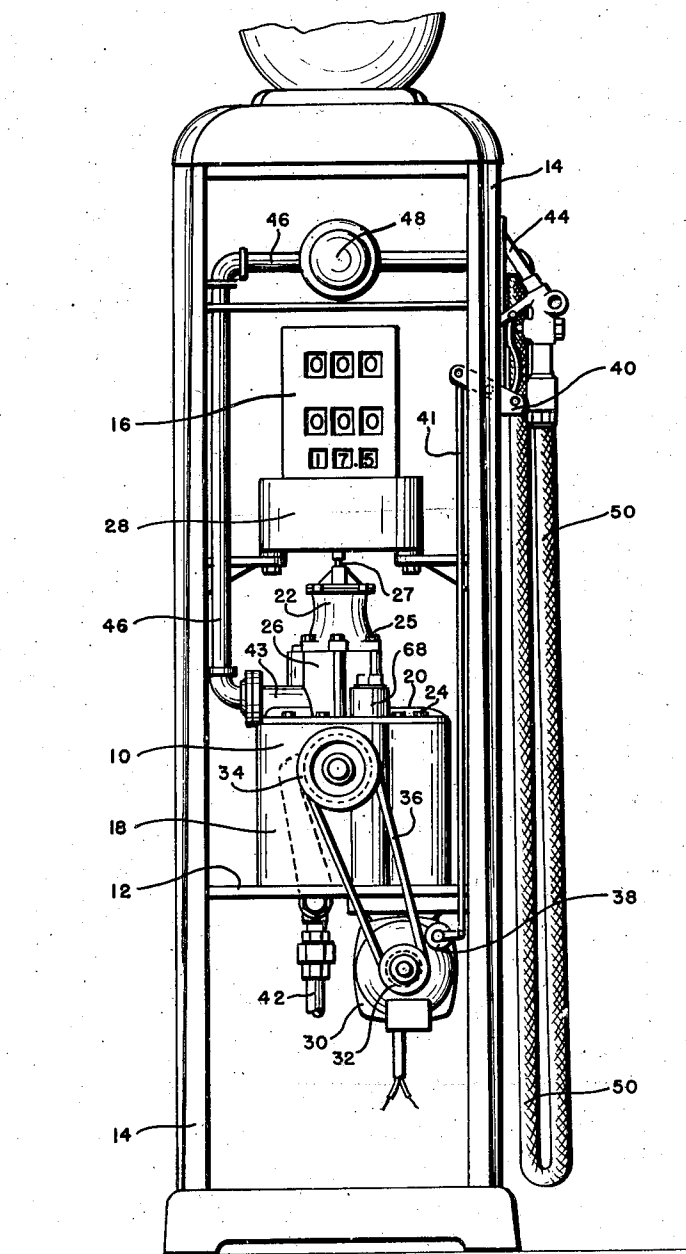


FIG. 1

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5 Sheets-Sheet 2

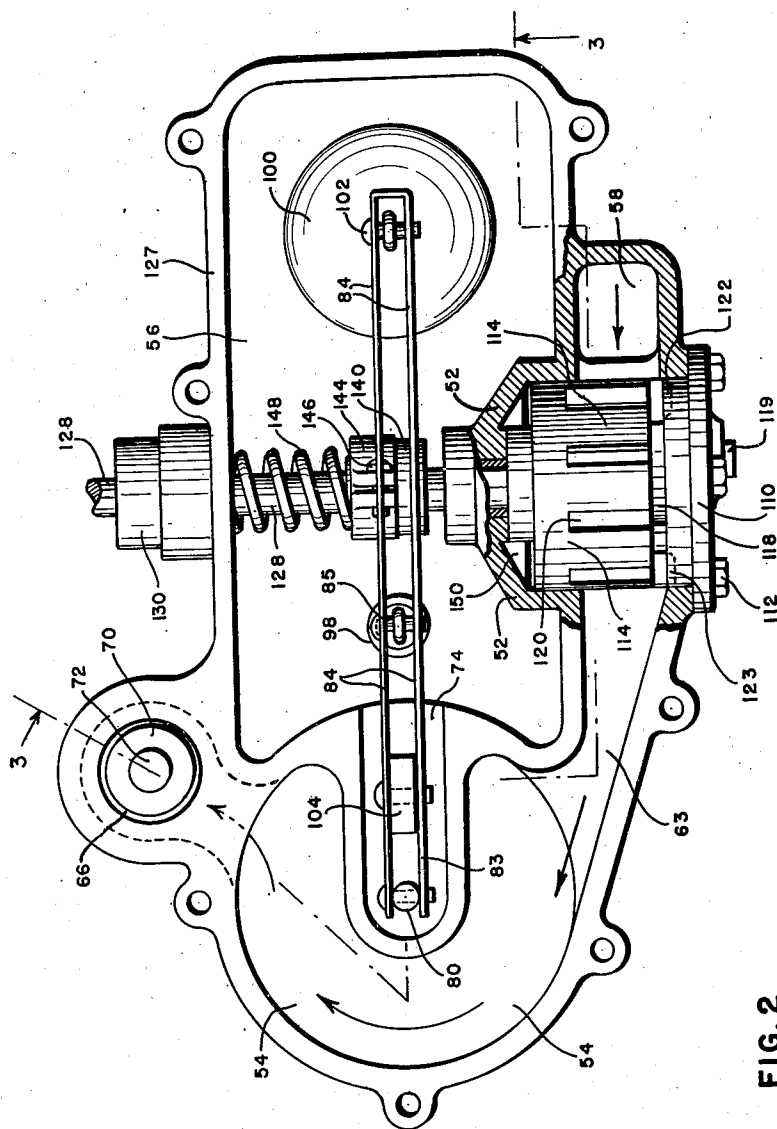


FIG. 2

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5 Sheets-Sheet 3

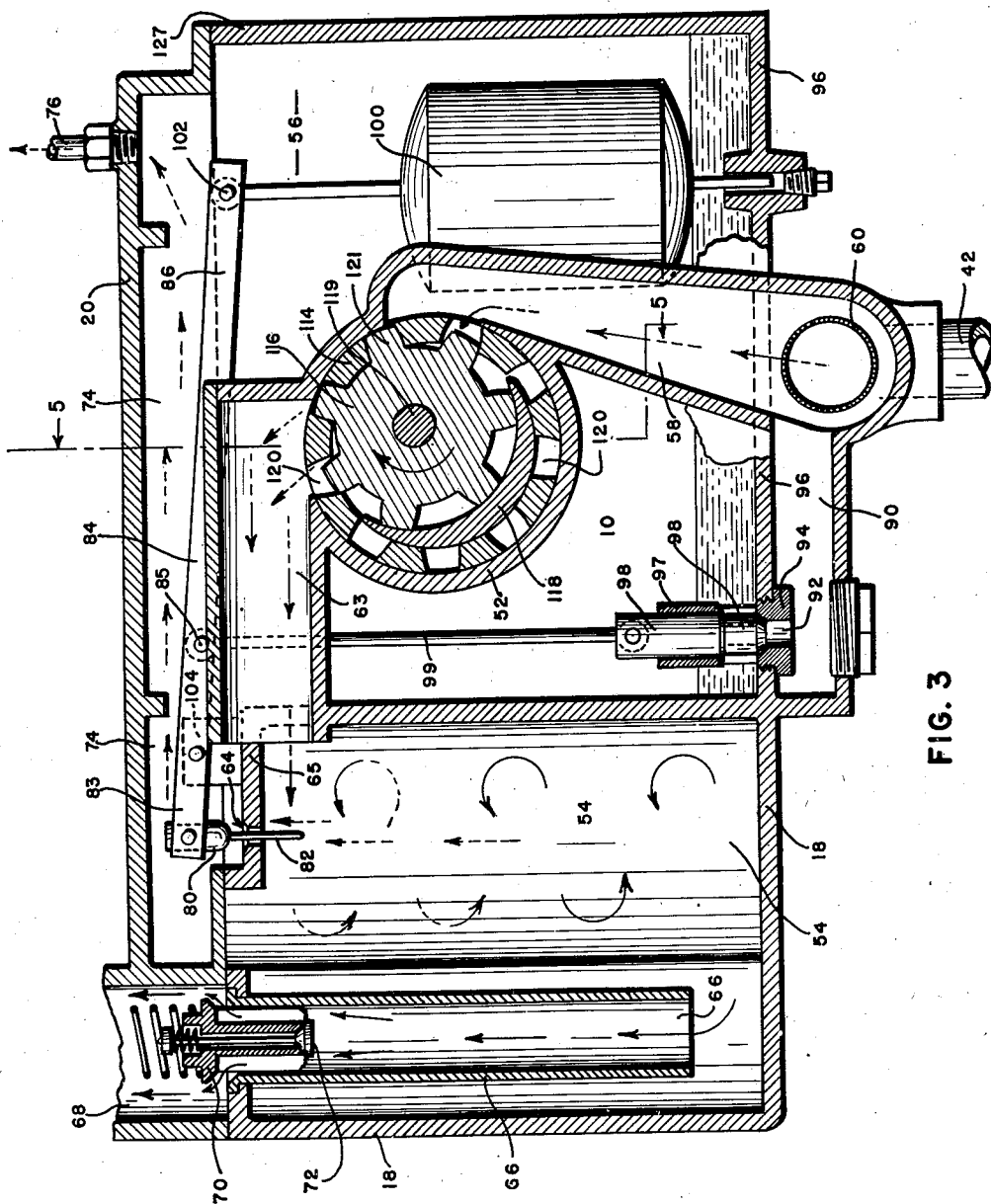


Fig. 3

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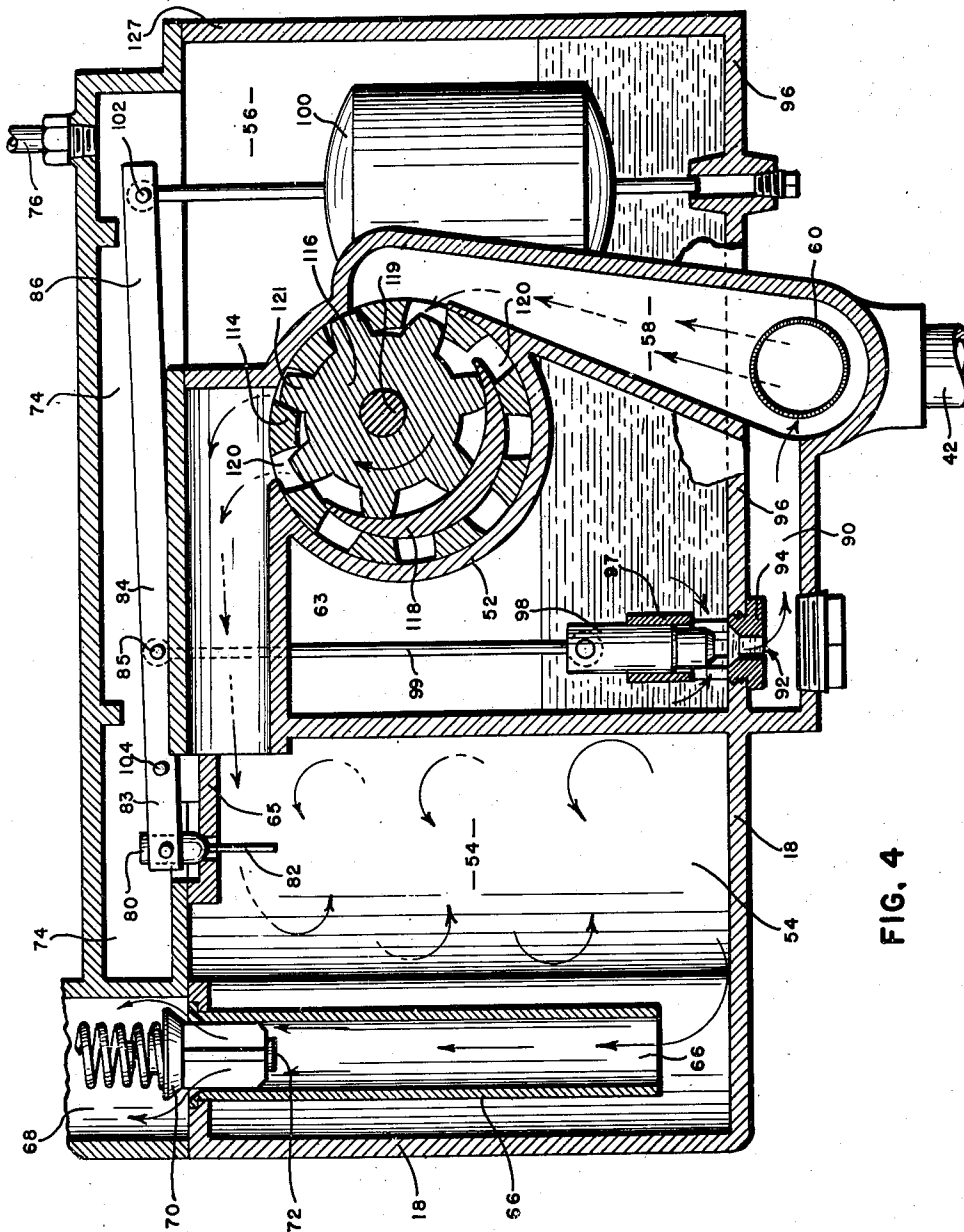
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5 Sheets-Sheet 4



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5 Sheets-Sheet 5

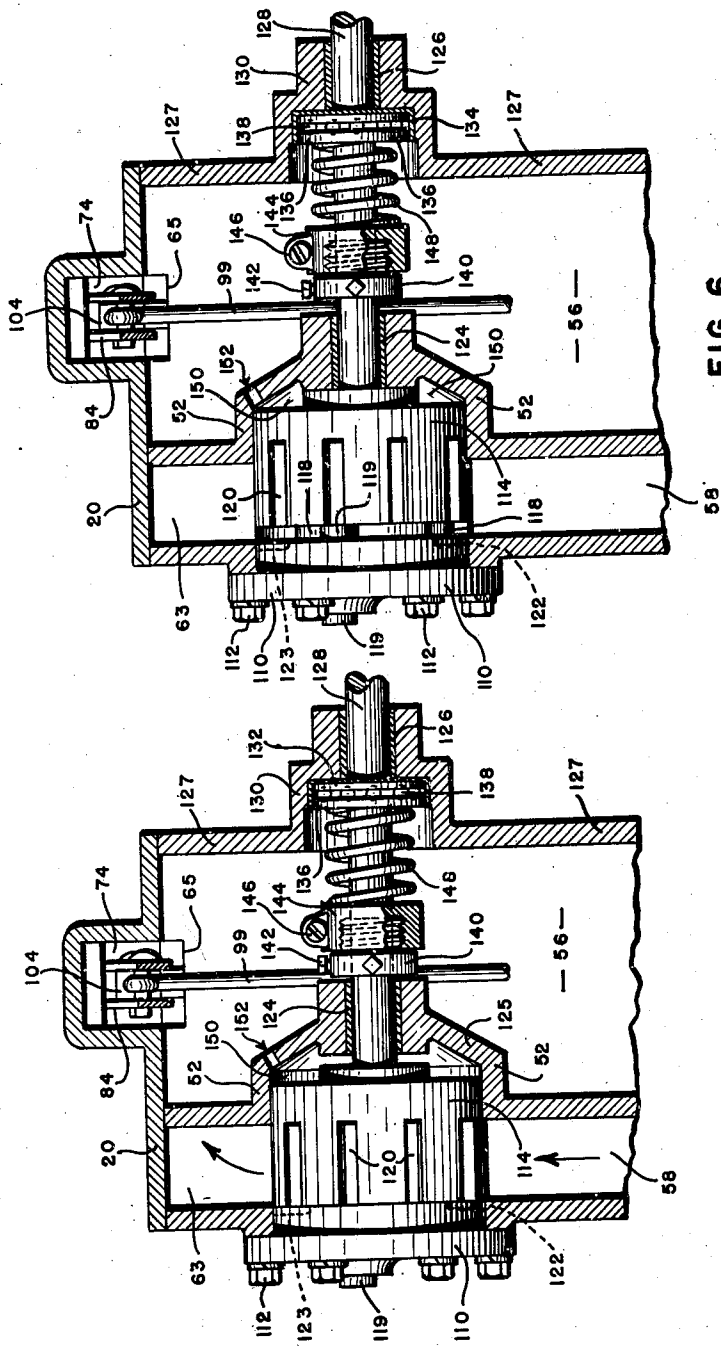


FIG. 6

FIG. 5

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2,246,951

PUMP UNIT FOR LIQUID DISPENSING
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Application February 15, 1938, Serial No. 190,559

3 Claims. (Cl. 103—42)

My invention relates to dispensing apparatus, and more particularly to a pumping unit for liquid dispensing apparatus of the type used in gasoline filling stations.

In certain of the liquid dispensing apparatus heretofore known it has been customary to provide the pump with a by-pass controlled by a pressure operated valve so that when the pump motor is energized while the nozzle discharge valve is in closed position, the by-pass valve will operate to permit the liquid discharged from the pump housing to be returned to the suction side of the pump. A disadvantage of the by-pass valve type of dispensing apparatus lies in the fact that the pump is required to force the liquid through the by-pass valve against the pressure exerted by the valve spring thereby increasing the power consumption normally required to maintain operation of the pump.

The use of a centrifugal pump for dispensing apparatus has been suggested for the purpose of eliminating the by-pass valve, the operating characteristics of the centrifugal pump being such that the power input to the centrifugal pump decreases as the effective head or resistance to flow is increased. Another desirable feature of the centrifugal pump resides in the fact that the power input required to start a primed centrifugal pump with the discharge valve closed is only 40 to 50 percent of that required for full load, the pump operating merely to churn the liquid within the pump housing until the discharge valve is opened. A pump, therefore, having these operating characteristics which distinguish a centrifugal pump from the positive displacement type of pump is desirable for use in a dispensing apparatus where the pump may be required to operate as much as 50 per cent or more of the time without liquid actually being dispensed from the system for the reason that operating costs would thereby be reduced and the cost of the heretofore necessary by-pass valve interconnecting equipment eliminated.

The application of the centrifugal type of pump for use in dispensing apparatus such as used for dispensing gasoline for automobiles, presents difficulties of such importance that their use in gasoline dispensing apparatus is in many cases impractical. For example, if the suction of the centrifugal pump is depended upon for lifting liquid to the pump chamber, the pump must be maintained in primed condition for successful operation; that is, the pump chamber

and suction line must both be completely filled with liquid before the pump will work. If air or gas is permitted to enter the pump or suction line at any time, such as by permitting the supply tank to become drained or by the occurrence of a leak in the suction line, its presence will prevent the pump from developing the necessary vacuum and discharge pressure for successful operation. Again, if the supply tank or the liquid level therein should be at any appreciable distance below the pump, the weight of the liquid in a primed suction line may be sufficient to cause a vacuum condition which would tend to vaporize highly volatile gasolines and thereby provide a body of gas in the pump chamber sufficient to prevent the pump from developing the necessary vacuum and discharge pressure for successful starting operation. The difficulties thus encountered in the use of a centrifugal pump in dispensing apparatus is readily apparent for the reason that an operator cannot afford the time required to prime a centrifugal pump, should priming be necessary, before each dispensing operation, or even the trouble of priming the pump after each refilling of the supply tank.

A gear pump of the positive displacement type has heretofore been modified to include certain of the desirable operating characteristics of a centrifugal pump. This type of pump is provided with pinion and ring gears, the ring gear being slidably keyed to a drive shaft and biased by a spring for bearing and sealing engagement with portions of the pump housing. Since the ring gear is loosely supported upon the drive shaft, the bearing surfaces of the housing are mainly relied upon for the maintenance of the rotor assembly in true operating condition. The ring gear being thus loose on the drive shaft, tends to cant and unevenly wear the bearing surfaces of the housing, thereby materially reducing the sealing effect. This causes undesirable slippage of liquid and decreased efficiency.

One of the several objects of my invention, therefore, is to construct an improved pumping unit of the gear type having desirable operating characteristics of both the positive displacement type of pump and the centrifugal type of pump, whereby it will operate to move fluid by positive displacement until opposed by a back pressure of a predetermined amount, and thereafter, upon further increase of back pressure, will tend to idle, similarly as in the case of a centrifugal pump.

Another object of my invention is to construct an improved pump which will operate as a positive displacement pump until subjected to a back pressure or head of a predetermined amount, and thereafter will provide for a definite return flow of liquid within the pump housing as the back pressure is further increased, the power demand being decreased as the return flow is increased.

Another object of my invention is to construct an improved pump having operating characteristics such as will permit continued operation of the pump with occasional deliveries of liquid without the use of the usual pressure operated by-pass valve heretofore required with positive displacement pumps.

Another object of my invention is to provide a compact pumping and metering unit for liquid dispensing apparatus.

Another object of my invention is to provide a compact pumping unit for liquid metering apparatus with an improved means for effectively separating air and gas from the liquid prior to the delivery of the liquid through the meter.

Another object of my invention is to provide a novel combined pumping and air separating unit.

A further object of my invention is to so construct and arrange a pump housing and drive shaft bearing means as to eliminate the usual stuffing box heretofore found necessary for the drive shaft to prevent leakage from the pump housing.

A still further object of my invention is to so combine an air and liquid separator with a pump in a single unit so that the usual stuffing box, heretofore provided to prevent leakage about the pump shaft, is eliminated.

A still further object of my invention is to provide means including bearing structure for a pumping unit which will prevent liquid from leaking therefrom along the drive shaft thereof, and at the same time render the pump assembly highly sensitive to forces applied axially thereof.

The foregoing objects and others ancillary thereto are accomplished by my invention as follows:

In order to provide a dispensing pump combining the desirable operating characteristics of both the positive displacement type of pump and a centrifugal type of pump, I have constructed a compact pumping unit comprising a casing enclosing a pump housing, a pressure chamber and an expansion chamber with connecting passages therebetween. The pump housing and expansion chamber are so arranged that the drive shaft extends through the latter wherein an adjustable spring and thrust bearing assembly is mounted on the shaft to effectively urge the pumping elements against an end plate or other appropriate wall portion of the pump housing to insure positive displacement of liquid by the pump until a back pressure of an amount sufficient to force the pumping elements from the end plate against the action of the spring is established. Upon movement of the pumping elements axially of the pump shaft, the seal between the pumping elements and the end plate of the housing is broken, thereby providing a return passage across the end plate between the discharge and suction sides of the pumping elements. The establishment of such return passage permits liquid to flow freely across the unsealed end of the pumping elements, whereupon the pumping elements tend merely to idle at reduced power con-

sumption similarly as in the case of a centrifugal pump.

The elimination of the usual stuffing box heretofore necessary for a drive shaft extending into the pump housing is accomplished by my invention by arranging a chamber, such as the expansion chamber of the gas and liquid separator, adjacent the pump housing with the drive shaft extending therethrough. Any liquid leaking from the pump housing through the drive shaft bearing is collected in the adjacent chamber and returned to the suction side of the pump, the liquid in the chamber being maintained at a level below the drive shaft by means of a float controlled valve.

By eliminating the usual stuffing box and providing a liquid return chamber through which the drive shaft extends, bearing structure may be selected for the drive shaft which will permit the pump assembly to be highly sensitive to forces applied axially thereof.

For a more complete understanding of the invention, reference may be had to the accompanying drawings, in which:

Figure 1 is a view in elevation of a gasoline dispensing pump with the front cover removed disclosing the installation of my novel pumping unit therein;

Figure 2 is a plan view of my pumping unit with the cover portion removed and parts broken away to show the inlet connection to the pump housing;

Figure 3 is a view in vertical section of my novel pumping unit with the parts shown somewhat diagrammatically to illustrate the connective relations thereof;

Figure 4 is the same view as in Figure 3 with the float and valve positions changed;

Figure 5 is a view in vertical section taken approximately along line 5-5 of Figure 3 showing the pumping elements in sealing position for positive displacement of liquid; and

Figure 6 is the same view as in Figure 5 with the pumping elements moved to an unsealed position.

Referring to the drawings, the pumping unit 10 of my invention is shown in Figure 1 mounted on an appropriate base 12 within the housing 14 of a gasoline dispensing apparatus of the type having a register 16 for indicating the quantity and cost of the gasoline dispensed. It will be understood, however, that the computing and registering features of the apparatus form no part of the invention, and that the invention is applicable in any of the conventional types of liquid dispensing apparatus used in dispensing gasoline as well as in many other situations.

The casing of the pumping unit 10 comprises a body portion 18 and a cover portion 20 removably secured thereto by bolts 24. A meter 22 is adapted to be secured by stud bolts 25 in communicating relation with flow openings in the upright throat portion 26 of the cover 20. The meter shaft 27 is operatively connected to the register 14 by means of a price variator 28. An electric motor 30 is provided for driving the pump by means of the pulleys 32 and 34 and the belt 36. The pump motor is controlled by a switch 38 operatively connected to the hose hook 40 by means of a connecting rod 41. During a dispensing operation, the gasoline is drawn into the pumping unit from the usual supply tank, not shown, through a suction line 42 and delivered to the meter 22 and thence from the discharge outlet 43 to the nozzle 44 through the

pipe connections 46, the Visaguage 48 and the hose 50.

The details of the pumping unit of my invention are best illustrated in Figures 2 to 6, wherein a pump housing 52, a pressure chamber 54, and an air and liquid separating or expansion chamber 56 are shown in a compact arrangement. The pump housing 52 communicates with the suction line 42 by means of an inlet conduit 58 which contains a strainer 60. The discharge outlet of the pump housing 52 is connected to the pressure chamber 54 by means of a passage 63 for discharging the liquid tangentially into the pressure chamber to aid in separating any air or gas held in suspension in the liquid, the air or gas escaping through the small duct 64 centrally located in the top wall 65 of the pressure chamber 54. A liquid outlet pipe 66 has its inlet end located adjacent the lower portion of the pressure chamber 54 and its outlet end communicating with the duct 68 which leads to the meter 22 through the upright throat portion 26. The outlet pipe 66 and duct 68 have been shown diagrammatically in Figures 3 and 4 as being located at one end of the unit for purposes of illustration, they being, in the preferred embodiment, located at the side of the unit opposite the discharge passage 63 as shown in Figures 1 and 2. A check valve 70 containing a pressure relief valve 72 is located in the outlet of the pipe 66 to prevent drainage of the meter 22 and at the same time relieve any excess pressure that might be developed in the connecting pipes 46 and the delivery hose 50 due to temperature conditions while the pump is standing idle.

The velocity of the air and gaseous vapor escaping through the small duct 64 and the passage 74 is reduced upon entering the relatively large expansion chamber 56 so that particles of liquid retained therein are precipitated before the gas reaches the atmospheric vent tube 76 located at the opposite side of the expansion chamber. An air valve 80 having a valve stem 82 extending through the duct 64 is pivotally mounted on the short arm 83 of the double lever 84 for controlling the duct 64. A connecting passage 90 between the expansion chamber 56 and the inlet conduit 58 includes a liquid return port 92 which is formed by a valve seat 94 threadably secured in the bottom wall 96 of the expansion chamber 56. The valve seat 94 is provided with an upright ported sleeve or guide member 97 for slidably engaging the valve 98 which is connected at 85 to the long arm 86 of the lever 84 by means of a pivoted connecting rod 99. A float 100 is provided for vertical movement within the expansion chamber and is pivotally connected to the lever 84 at 102. The double lever 84 is pivotally supported on the upper wall 65 of the pressure chamber at 104.

The particular positive displacement pump illustrated with my invention is of a conventional type, it being understood that other known types of positive displacement pumps may also be modified in accordance with the principles of my invention to produce the desired results obtained by the embodiment illustrated.

The housing 52 of the gear pump used in the illustrated embodiment of my invention is of cylindrical shape and includes a removable wall portion or end plate 110 secured thereto by means of a plurality of bolts 112. The pumping elements comprise a cylindrical rotor or ring gear 114 and a coacting pinion or idler gear 116.

Secured to and extending inwardly of the end plate 110 is an element 118 of crescent shape in cross-section which is located between the idler gear and the rotor adjacent one side of the housing, the idler gear being rotatably mounted on a pin 119 also extending inwardly from the end plate 110. The rotor 114 is provided with slots 120 extending to the end thereof adjacent the end plate 110. The idler gear 116 is provided with teeth 121 adapted to engage the slots 120 of the rotor and the inner face of the crescent shaped element 118. As the rotor 114 is revolved in a clockwise direction, as viewed in Figures 3 and 4, the idler gear 116 is engaged in the slots 120 of the rotor on the side opposite the crescent shaped element 118. This engagement of the teeth in the slots of the rotor provides an effective seal between the gear 116, the rotor 114 and the portion of the pump housing 52 between the inlet and outlet openings to the pump housing. The teeth of the idler gear 116 begin to withdraw from the rotor slots as they come opposite the housing inlet and are completely withdrawn as they pass beyond the inlet. This withdrawal of the gear teeth from the rotor slots produces a vacuum which draws fluid from the conduit 58 into the voids provided by the open slots 120 and the spaces between the teeth 121, the spaces between the teeth 121 having communication with the conduit 58 by means of the recess 122 in the peripheral portion of the end plate 110. As the gear teeth 121 and rotor slots 120 pass beyond the housing inlet, the spaces provided thereby are sealed by the walls of the housing, the end plate 110, and the crescent shaped element 118. When the gear teeth 121 and the rotor slots 120 move opposite the discharge passage 63, the fluid contained in the spaces provided thereby is forced into the passage 63 by movement of the gear teeth 121 into the slots 120; the complete engagement of the teeth and slots taking place just as the rotor slots move out of communication with the passage 63. The peripheral portion of the end plate 110 has a recess 123 formed therein adjacent the discharge passage 63 through which the fluid contained in the spaces between the teeth 121 may escape as the teeth re-engage the slots 120. The pumping elements 114 and 116 thus produce a positive displacement of fluid from the inlet conduit 58 to the discharge passage 63.

Referring to Figures 5 and 6 of the drawings, the pump housing is shown provided with a bearing 124 in a wall 125 thereof contiguous the expansion chamber 56, the bearing 124 being in alignment with a bearing 126 located in a side wall 127 of the expansion chamber 56. Mounted in the bearings 124 and 126 is a drive shaft 128 connected to the rotor 114. The bearing 126 is provided with an inwardly offset portion 130 to accommodate a thrust bearing 132, comprising a stationary portion 134 and a rotatable ring portion 136 between which are located a series of roller bearings 138. A threaded collar 140 is connected to the drive shaft by means of set screws 142. Threadably engaging the threaded portion of the collar 140 is an adjustable split collar 144 provided with laterally extended flanges through which a bolt 146 extends for tightening same in the desired position on the threaded portion of the collar 140. A spring element 148 surrounding the shaft 128 is located between the split collar 144 and the rotatable ring element 136 of the thrust bearing 132 for

the purpose of urging the rotor 114 and idler gear 116 into sealing relation with the end plate 110.

In order to prevent the building up of pressure in the space 150 on the back side of the rotor 114, a small duct 152 is provided in the wall 125 of the pump housing at a point spaced above the bearing 124 so that air and liquid working into the space 150 may be vented into the expansion chamber 56. The duct 152 is located in the upper part of the housing so as to insure the presence of a body of liquid in the space 150 for the purpose of providing a cushioning effect to supplement the cushioning action of the spring element 148 upon sudden closing of the nozzle discharge valve.

Assuming that the dispensing system has been primed with the pressure chamber 54 partially filled with liquid and the air valve 80 in open position, as shown in Figure 3, the operation of the pumping unit is as follows:

Preparatory to performing a dispensing operation, the hose nozzle 44 is removed from the hose hook 42 and the hose hook raised to actuate the motor switch 38. The starting of the pump motor operates to rotate the pump shaft 128 by means of the belt 36 and the pulleys 32 and 34. The rotor 114 and the idler gear 116 in revolving operate as a positive displacement pump and provide a suction in the duct 58, as previously described. Any air or gaseous vapors present in the duct 58 will be withdrawn by the pumping elements 114 and 116 and discharged to the pressure chamber where the air and gaseous vapor will readily escape into the expansion chamber 56 through the open port 64 and eventually to the atmosphere through the vent connection at 76.

If the valve of the discharge nozzle remains closed, the further operation of the pumping elements 114 and 116 in drawing liquid through the duct 58 will build up a back pressure within the pressure chamber which will soon overcome the action of the spring 148 and cause the pumping elements to be forced out of sealing relation with the end plate 110. The breaking of the seal between the pumping elements and the end plate provides a return passage between the discharge and suction sides of the pumping elements through which liquid tends to flow from the discharge to the suction side thereof. The establishment of the return passage by the unsealing of the pumping elements with respect to the end plate provides a return flow which permits the pumping elements to idle without any further appreciable increase in discharge pressure.

As the pressure chamber becomes filled with liquid, a certain amount of the liquid may pass through the small port 64 and enter the expansion chamber 56. This overflow of liquid together with any liquid that may seep through the bearing 124 and the vent 152 collects in the bottom portion of the expansion chamber. As the level of the liquid in the expansion chamber rises, the float 100 is moved upwardly, thereby tending to close the air valve 80 and open the liquid return valve 98 toward the extreme positions illustrated in Figure 4. The opening of the liquid return valve 98 permits the collected liquid in chamber 56 to flow through the passage 90 into the suction conduit 58. The relationship between the ports 64 and 92 and the float controlled valves therefor are such that the liquid level in the expansion chamber 56 is prevented from ever rising to the height of the

bearings supporting the drive shaft 128. Since the liquid level is prevented from ever reaching the bearing 128 in the outer wall 127 of the expansion chamber, the usual stuffing box heretofore found necessary to prevent leakage about the pump shaft is no longer needed in pumping units constructed in accordance with my invention.

The elimination of the usual stuffing box by providing a liquid return chamber, such as the expansion chamber 56, adjacent the pump housing with a second bearing 126 in the outer wall thereof, aids in minimizing the operating friction on the drive shaft 128 and in maintaining the shaft and pump assembly in a trued relation relative the pump housing. The friction ordinarily exerted by the presence of the usual stuffing box thus being eliminated, and the level of the liquid in chamber 56 being maintained at a point below the outer bearing 126, the bearings 124 and 126 may be such as to render the pump assembly movable axially thereof upon predetermined small changes in the difference of forces exerted thereon by the spring 148 and the back pressure at the discharge side of the pump without the possibility of liquid leaking from the pumping unit at the bearing 126. In this way, the pump assembly is made highly sensitive so as to respond quickly to back pressures exerting axial forces exceeding the predetermined force urging the pump assembly into pumping engagement with the end plate of the pump housing.

When the discharge valve of the hose nozzle 44 is opened, the lowering of the back pressure on the discharge side of the pump housing permits the spring 148 to return the pumping elements 114 and 116 into sealing relation with the end plate 110, thereby preventing further return flow of liquid. As long as the discharge valve is held open by the operator, the pumping elements operate as a positive displacement pump. When the dispensing operation is completed, the closing of the discharge valve causes the back pressure to be again increased by the continued operation of the pump to an amount sufficient to overcome the action of the spring 148 and cause the pumping elements to again shift out of sealing relation with the end plate 110. The unsealing of the pumping elements with respect to the end plate of the pump housing causes the pump to operate similarly to a centrifugal pump, the pumping elements tending more and more to merely idle as the back pressure increases above the amount necessary to initiate the unsealing operation until a state of equilibrium between the back pressure and the unsealed position of the pumping elements has been reached. Since little or no liquid is being actually discharged from the pump housing during the unsealed relation of the pumping elements, the power required to drive the pumping elements is considerably less than that required during the sealed relation thereof, when full capacity discharge of the pumping elements is being performed.

It will be recognized from the foregoing description of my compact pumping unit that the construction and arrangement of the elements thereof will successfully operate to move or lift liquid by positive displacement until opposed by a back pressure of a selected predetermined amount, and thereafter, to move or lift liquid in decreasing volume as the back pressure is further increased until a state of equilibrium is

established, similarly as in the case of a centrifugal pump; that as the back pressure is increased above the predetermined amount the volume of liquid delivered is decreased, and the power required for continued operation of the pumping elements is also decreased; that air and gas is effectively separated from the liquid prior to the discharge of liquid from the unit or through an associated meter; and that the usual stuffing box heretofore necessary to prevent leakage from the pump housing at the drive shaft thereof is eliminated.

Although I have shown and described only one specific embodiment of my invention, I am fully aware that many modifications thereof are possible; for example, other types of positive displacement pumps or gear pumps of other designs having the pumping element or elements thereof resiliently urged in sealing relation with a portion of the pump housing may be substituted for the particular pump construction illustrated; and that the end plate or some other part of the pump housing may be constructed or provided with means responsive to a back pressure in excess of a predetermined amount to break or reduce the sealing relation between the pumping element or elements and the pump housing, whereby the continued operation of the pumping element or elements would tend to merely idle. My invention, therefore, is not to be restricted except in so far as is necessitated by the prior art and the scope of the appended claims.

I claim:

1. A pumping unit comprising a casing having inlet and outlet connections, a pump chamber in said casing in communication with said connections, a liquid return chamber in communication with said inlet connection, aligned bearings mounted in a wall of said pump chamber and a wall of said liquid return chamber, a drive shaft supported for sensitive axial movement in said bearings, pumping means secured to said drive shaft and movable therewith axially within said pump chamber, means for resiliently urging said pumping means axially into pumping engagement with a portion of said pump chamber, means providing an intercommunicating passage between a space in said pump chamber behind said pumping means and said liquid return chamber, and adapted to permit ready discharge to said liquid return chamber of liquid collected

in said space upon axial movement of said pumping means in response to a back pressure in excess of a predetermined amount.

2. A pumping unit comprising a pump housing having inlet and discharge openings, means forming a chamber having a wall in common with said pump housing, a bearing in said common wall and a bearing in a wall of said chamber opposed to said common wall, a pumping device in said housing provided with a drive shaft supported in said bearings for sensitive axial movement, and means for urging said shaft axially thereof to hold said device against a portion of said housing opposite said common wall whereby said device is adapted to positively displace liquid through said housing, said common wall having means adapted to provide communication with said chamber to relieve pressure on the side of said device adjacent said common wall, and said urging means being responsive to a back pressure in excess of a predetermined amount to permit movement of said device toward said common wall to reduce the pumping action thereof.

3. Pumping apparatus of the type described comprising a pump housing having inlet and discharge connections, said discharge connection including a pressure chamber, a gas and liquid separating means including an expansion chamber in communication with the atmosphere and in restricted communication with said pressure chamber, said pump housing and expansion chamber having a common wall, a bearing in said common wall, a drive shaft extending through said expansion chamber and said bearing into said housing and supported in said bearing for sensitive axial movement, pumping means secured to said drive shaft and movable therewith axially in said housing, means for resiliently urging said shaft axially toward a wall of said housing opposite said bearing, said means being responsive to a back pressure in excess of a predetermined amount to permit movement of said shaft along said bearing away from said opposite wall thereby to reduce pumping action of said pump, means providing a liquid return connection between said expansion chamber and the suction side of said pump, and liquid return control means responsive to a change in the liquid level in said expansion chamber for maintaining said liquid level below said drive shaft.

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