March 22, 1938. J. A. GILLEN 2,111,970

FUEL PUMP

Filed July 19, 1933 2 Sheets-Sheet 1

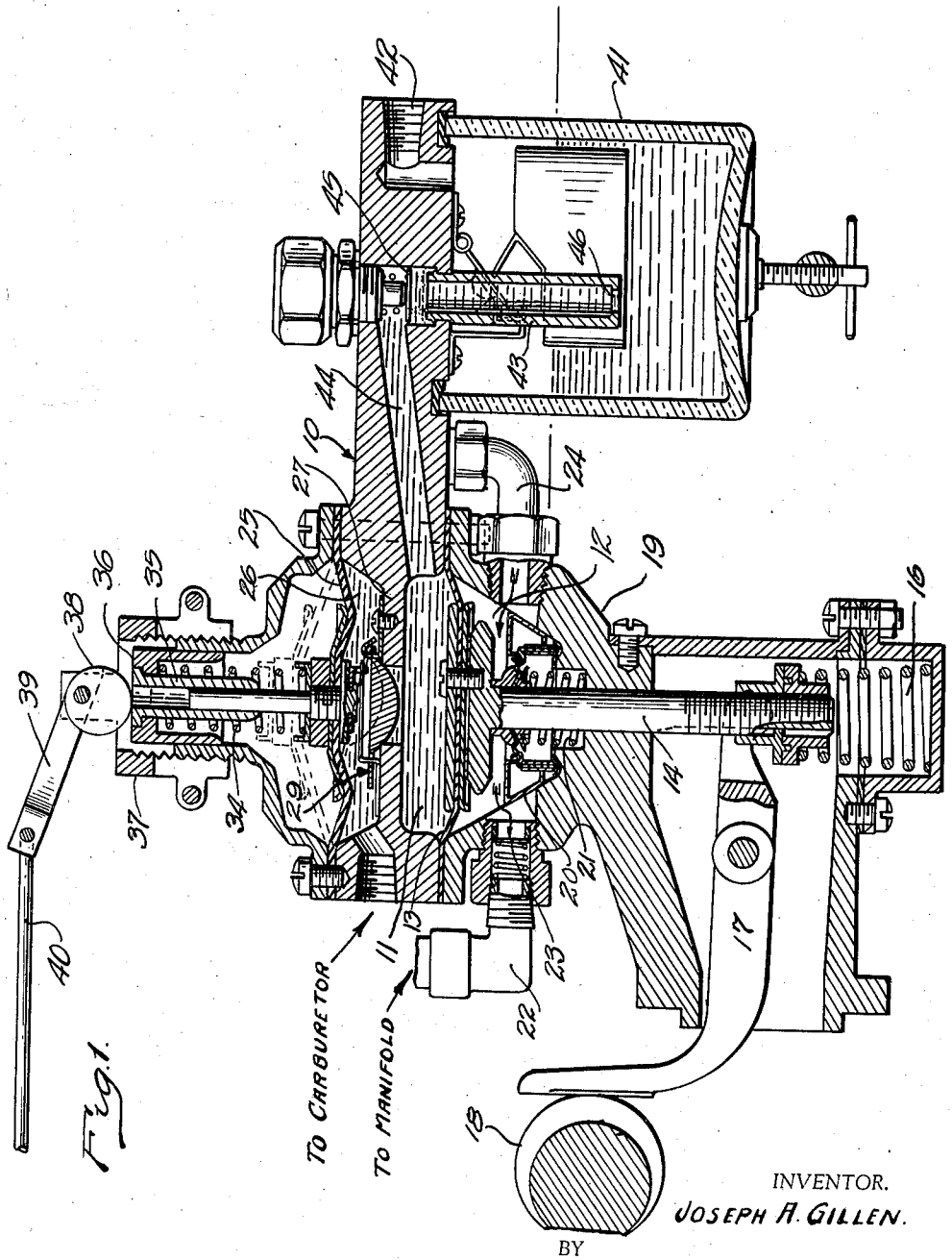

Fig. 1.

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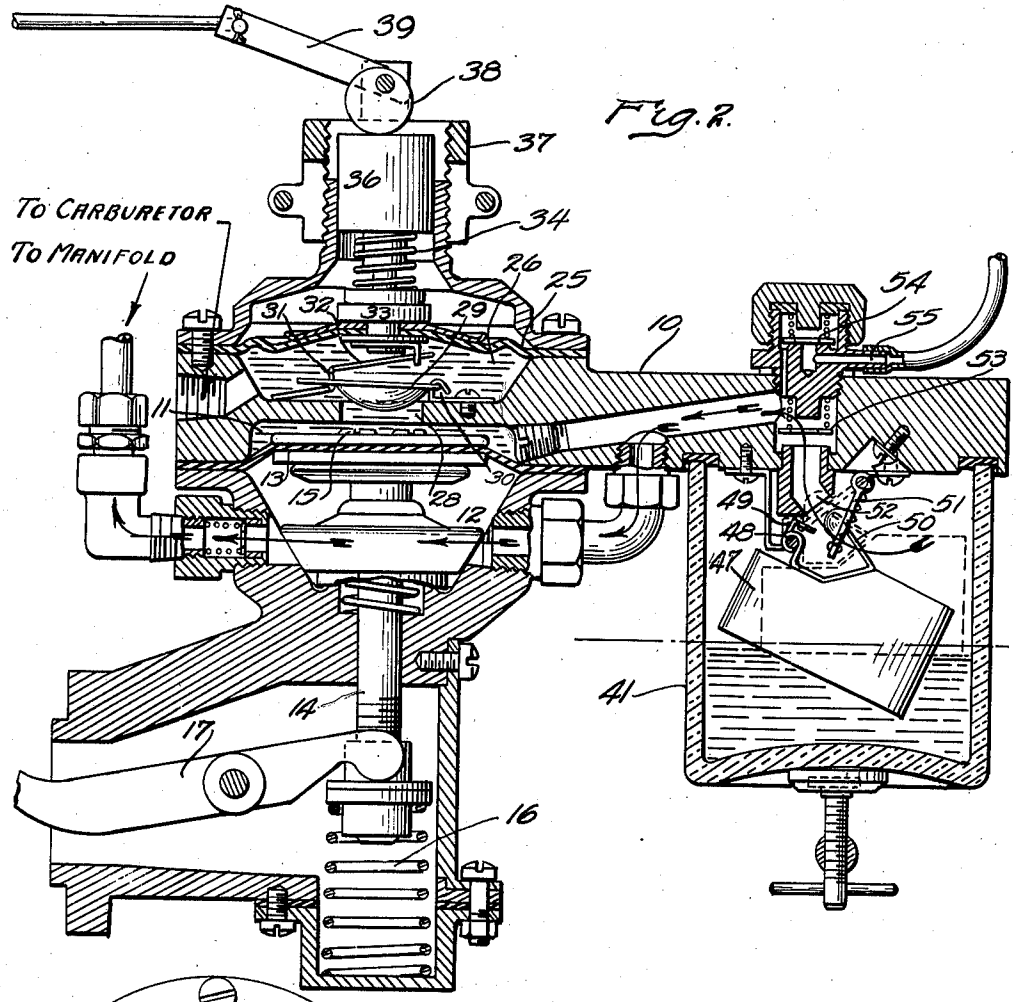

Fig. 2.

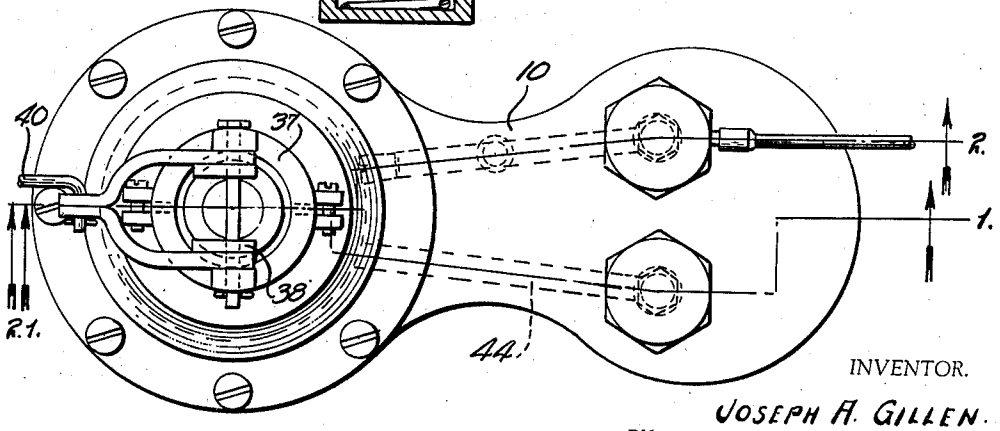

Fig. 3.

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Patented Mar. 22, 1938 2,111,970

UNITED STATES PATENT OFFICE

2,111,970

FUEL PUMP

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Application July 19, 1933, Serial No. 681,123

8 Claims. (Cl. 103—40)

This invention relates to fuel pumps, and has to do particularly with diaphragm pumps utilizing fixed stroke and constant displacement.

Heretofore, fixed stroke constant displacement pumps have been proposed utilizing a pump chamber and a reservoir chamber with an intermediate valve operable by an accumulation of fuel in the reservoir to permit surging back and forth without any effective pumping action. However, such prior art fuel pumps have generally utilized what is commonly called an air dome booster, with the result that the pressure derived therefrom alternates with the pressure of the pump delivery stroke and, except at very high speeds, the result is a noticeably intermittent fuel delivery. Furthermore, the use of an air dome, variations in temperature, and different motor speeds and loads have a detrimental effect on the air trap in the dome in that an increase in temperature results in an increase in pressure tending to force fuel into the carburetor past a closed valve, even though the valve between the pump chamber and reservoir chamber is open to permit surging, and also consequent flooding of the carbureter.

It is the object of the present invention to overcome the major difficulties heretofore experienced in a constant displacement pump by providing a variable capacity reservoir in combination with means for insuring a uniform and controllable pressure and flow, unaffected by any changes in temperature or liquid or gas conditions. More specifically, the present invention embodies a main pump diaphragm which is positively and continuously actuated with a fixed uniform displacement and which main diaphragm is so arranged within suitable chambers as to produce, when necessary, a double action, one action being effective to cause continuous pumping and the other action being effective to eliminate or drain any accumulation of vapor at the entrance side of the pump.

Another feature of the present invention has to do with a reservoir chamber in communication with one of the pump chambers, one of the walls of said reservoir being flexible and backed by a calibrated spring and including a loosely mounted suspended valve, said valve being mounted in a novel manner to positively prevent pulsations and pressure drop, particularly during the period immediately following the carbureter valve opening.

A specific feature of the present invention has to do with locating a calibrated spring as controlling one wall of a reservoir chamber instead of positioning a calibrated spring directly against the stem of the pump diaphragm.

Other features include a novel valve and float structure in combination with a standard fuel trap and also in combination with one of the pump chambers so arranged that the main pump chamber is always in communication with the liquid at or near the bottom of said fuel trap, and also so arranged that any vapor accumulating in said fuel trap would positively be removed directly from the fuel trap.

Other features include adjustment of the reservoir diaphragm for controlling pressures at low speeds, detailed construction of the float and valve action in the fuel trap, and other features of construction and combination as will be more clearly set forth in the specification and claims.

In the drawings:

Fig. 1 is a vertical sectional view of the preferred form of my fuel pump assembly and showing particularly the fuel trap float in closed position, the main pump in lowermost position, the intermediate valve in closed position, and showing the reservoir diaphragm in its lowermost position in solid lines and in its full extended position in dotted lines.

Fig. 2 is a sectional view similar to Fig. 1 showing the reservoir diaphragm in such extended position as to slightly open the intermediate valve to effect surging between the reservoir chamber and the pump chamber, and also showing the action of the auxiliary pump in removing accumulated vapor in the fuel trap.

Fig. 3 is a plan view of the unit shown in Figs. 1 and 2 and showing particularly the arrangement of the two valve units at the top of the fuel trap.

This application is a continuation in part of my copending application Serial No. 644,303, filed November 25, 1932.

Actual connections between the fuel pump and the source of supply and the motor are eliminated because such connections are standard for a fuel pump of this type. It will be understood, however, that the legend "To manifold" from the auxiliary pump chamber is merely so directed as to indicate the general direction of any fuel vapors pumped through this auxiliary pump chamber; it being the preferred arrangement that such exhaust conduit be connected to some part of the manifold or carbureter air intake so that such line is not affected by any vacuum from the motor.

My fuel pump in its preferred form is provided with a main casting 10 which forms a

main pump chamber 11, said main pump chamber being separated from an auxiliary pump chamber 12 by a diaphragm 13. This diaphragm 13 is provided with a diaphragm stem 14 rigidly connected thereto. A portion of the diaphragm itself is backed on each side by relatively large diameter washers, and the top of the stem is connected to the diaphragm and to the washers by a plurality of screws 15, preferably three in number, which are spaced away from the axis of the diaphragm so as to positively prevent distortion and buckling of the diaphragm. It will be understood that the enlarged top of the diaphragm stem may abut directly against the diaphragm instead of utilizing a washer.

The lower end of the diaphragm stem 14 is backed by a relatively heavy spring 16; by the word "relative" I refer to such light calibrated springs as are usually used at this position. In actual practice I prefer to use a spring of around forty pounds. Actuation of the diaphragm stem is by means of a lever 17 and cam 18, it being obvious here that the spring 16, being relatively strong, will insure that the end of the lever 17 will always be in firm contact with the cam, thus eliminating much of the noise hitherto inherent in fuel pumps of this type.

The auxiliary pump chamber 12 is formed by a lower housing 19 cooperating with the diaphragm 13. As best shown in Fig. 1, this lower housing 19 is provided with a seal 20 cooperating with the diaphragm stem and in combination with a spring 21 to seal and retain any oil in the lower portion of the housing 19. One side of this chamber 12 is connected with an outlet 22, controlled by a valve 23, and the other side of said chamber is connected with an inlet conduit 24, as will be later described.

The housing 10 cooperates with a diaphragm 25 to form a reservoir chamber 26. The chambers 11 and 26 are separated by a partition 27 which is apertured as at 28 to permit communication between the two chambers. The flow of liquid in an upward direction through this aperture 28 is controlled by means of a lost motion suspended valve 29.

The valve 29 is preferably pivotally mounted at one side as at 30 and at the other side is connected by means of a lost motion connection 31 with a lever 32 which is preferably pivotally mounted at its upper end with the stem 33 of the diaphragm 25, and at its lower end is adapted to slidingly engage the partition 27 during a portion of its movement to cushion the closing action of the valve. In Fig. 1 the valve is shown in its closed position and with the diaphragm 25 at its lowermost position. To keep the diaphragm from contacting with the valve and impose unnecessary pressure thereagainst, I may utilize a suitable bridge (not shown). In Fig. 2, I have shown the upper diaphragm at about two-thirds of its maximum movement or, in other words, the reservoir chamber 26 is shown as being about two-thirds full. In this last position the valve is shown as being open but will in all probability close when the pumping diaphragm 13 lowers. However, it will be seen that if the diaphragm 25 is slightly more extended than shown, that the valve 29 will be held in open position.

The upper diaphragm 25 is backed by an accurately calibrated spring 34, the calibration of which spring, as will be later described, determines the actual pressure of liquid delivered to the carbureter under all conditions of speed and liquid or vaporous condition of the fuel. The stem of the diaphragm 25 is guided by an inner sleeve 35 and the spring 34 is backed by an outer sleeve 36.

An adjusting collar 37 is connected to the outer and inner sleeves 35 and 36 through a suitable cam 38 whereby the collar 37 may be adjusted to vary the strength of the spring 34 as desired. In addition to this manual adjustment, I have provided a mechanical or automatic adjustment in the form of a lever 39 connected to the cam 38 and in turn connected by a suitable link 40 directly to the dash or to the throttle lever. The main purpose of this latter connection is to reduce the strength of the spring during such time as a lower pressure and a smaller quantity of fuel is desired; although it will be distinctly understood that my device is very efficient even when the strength of the spring 34 and hence pressures are maintained constant under all speed and load conditions.

It will be seen that Fig. 1 is a section taken on line 1—1 of Fig. 3. Here a fuel trap 41 is supported in the usual manner on the bottom of the housing 10 and includes an inlet 42 and an outlet 43 in the form of an open ended pipe which protrudes into the fuel trap a considerable distance. The upper end of this outlet pipe 43 is connected to a feed conduit 44 through a spring actuated valve 45. Thus, under normal pumping operations, liquid fuel is drawn up through the opening 46 in the pipe 43 past the valve 45 and into the pumping chamber 11, although it will be seen that under back pressure conditions, the valve 45 will be closed.

Fig. 2, which is a sectional view taken on line 2—2 of Fig. 3, illustrates my preferred method of controlling the exhausting of any vapor which may accumulate in the upper portion of the trap 41. A float member 47 is pivotally mounted as at 48 within the trap 41 and this float member is provided with an opening actuating arm 49 and a closing actuating arm 50. A valve 51 is pivotally mounted and adapted to close a relatively short exhaust conduit 52. The closed position of the float 47 and valve 51 is shown in dotted lines in Fig. 2, and the open position is shown in solid lines. As best shown in Fig. 2, a spring is associated with said valve 51 as to produce an over center snapping action of the valve whereby when the float 47 starts either the closing or opening action of the valve, the spring will follow through such movement with a snap action. The exhaust conduit 52 is connected with a spring pressed valve 53 similar to valve 45 shown in Fig. 1, but in connection with this exhaust conduit 52 and in addition to the valve 53, I have provided an opposed valve member 54 which may be connected with the atmosphere or to means to be actuated, such as a windshield wiper, through a conduit 55. It will be seen that when the float 47 is up and the valve 51 closed, that the exhausting action produced by the diaphragm 13 moving in the chamber 12 will be through the valve 54 and the conduit 55.

It is of utmost importance that the float 47 and connecting valve mechanism be connected to the fuel trap 41 or some other fuel reservoir at the intake side of the fuel pump. All tendency to pound is eliminated by the snap action of the valve 51 and this apparatus, in combination with the positive acting diaphragm 13, insures that any vapor collecting in the fuel trap by reason of an increase in temperature, or otherwise, is positively withdrawn and completely independent of any vacuum condition produced by the motor.

Considering the spring 34 at a predetermined calibration as being held in this position, I obtain a constant delivery of liquid from the reservoir chamber 26 at all speeds. This absolute control of delivery pressure is best explained by starting with the diaphragm 25 in its lowermost position with the valve engaging the seat, as best shown in Fig. 1 or, in other words, with the pump reservoir 26 at its minimum cubic capacity. Successive pump strokes will now supply fuel to said reservoir 26 past the valve 29, said valve during each stroke returning to closed operating position until a reserve of fuel has accumulated in the carbureter or other unit and in the reservoir from back pressure. It will be seen that any appreciable back pressure will immediately tend to enlarge the reservoir chamber 26 by distorting the diaphragm 25, with the result that this accumulated reserve is held under pressure by the calibrated spring acting on the diaphragm in opposition to whatever back pressure is set up. In my preferred arrangement, reserve of fuel that may have accumulated in the reservoir is equal to two-thirds of the cubic capacity of the reservoir before valve 29 is raised to such a position by the lost motion connection as to render the pumping action ineffective in supplying additional fuel from the conduit 44.

The extreme importance of this lost motion connection will here be obvious, because it will be seen that if the valve 29 were rigidly connected to the diaphragm 25 the valve would be held open during the return stroke of the main diaphragm 13 resulting in a surging action downwardly and a consequent drop in pressure; by allowing an intermittent closing action of the valve, even though the diaphragm 25 is considerably distorted, it will be seen that I maintain a positive pressure which acts immediately when the carbureter valve is open and which maintains this pressure until the diaphragm 25 is allowed to drop to its lowermost position. It will furthermore be obvious that during each up stroke, the two diaphragms will act as the effective walls of the chamber, with the result that the lower diaphragm 13 takes the place of the partition wall 27 insuring a positively maintained pressure during all up strokes under any conditions and also during the down stroke if the valve is suspended.

A single pump discharge stroke is sufficient to render the valve 29 inoperative by expanding the reservoir beyond the two-thirds capacity point. The fuel thus pumped in above the two-thirds capacity is therefore returnable by the pressure in the reservoir past the suspended valve to the pump chamber. The pump is again brought into active operation by the slightest discharge from the pump reservoir to the carbureter.

It is important to note here that in using the words "the slightest discharge of the cubic contents of a fuel reservoir to a carbureter" as rendering the pump action again active should not be understood as being the cubic liquid fuel content of the reservoir. The valve action here described and disclosed is not dependent upon cubic liquid fuel content in the reservoir to be effective. The reserve one-third expansibility of the diaphragm has for its purpose the absorption of pressure arising from heat conditions wherein fuel expands and vapor is formed that would otherwise exert an excessive pressure against the resistance of a carbureter float controlled valve, or the like; this action also allows the withholding or unseating of the valve 29 for a period of time necessary to balance the pressure and reduce the cubic content to normal before the pump again becomes active in supplying fuel. It will furthermore be noted because of the mechanism suspending the valve 29, that all hammering and excessive wear between the valve and valve seat is completely eliminated.

While the diaphragm 25 is operative under any conditions of liquid or gas or partial liquid and gas in the chamber 26, it will be understood that because of the auxiliary pumping apparatus as disclosed in Fig. 2, a complete vapor condition can never be possible because the pipe 43 always extends to a position below the level of the liquid in the trap 41 and that all vapor that may accumulate in this fuel system because of extreme heat or otherwise, and which would tend to normally cause "vapor lock", is drawn off by the pump 12 whenever the float 47 drops to a position as to open the valve 51. It will be understood here that the spring of the valve 53 is slightly lighter in strength than the spring over the valve 54, with the result that the valve 54 will remain closed whenever the valves 51 and 53 are opened.

As the pump develops sufficient pressure in the discharge stroke to more than equalize any pressure in the pump reservoir 26, it is apparent that this greater pressure in the pump chamber 11 prevents any loss of pressure in the reservoir 26 when the valve 29 opens to allow replacement of the reserve content, thereby cooperating with the calibrated spring 34 and valve aperture 28 to maintain a constant pressure towards the carbureter. In actual practice I have found that by using a calibrated spring 34 of two pounds and using a quarter inch three foot outlet line, I obtain a constant flow of twenty-five gallons per hour at any speed, actual tests being made from around two hundred pumping strokes per minute to about sixteen hundred pumping strokes per minute and with a half pound calibrated spring 34 the fuel pump delivered is fifteen gallons per hour at any speed. In view of the above tests, it will be seen that under all normal conditions, except when the pump first starts, there will be a positive back pressure and some distortion of the diaphragm 25, so that it might be said that the lost motion connection 31 becomes effective under all normal conditions.

The relatively great strength of the spring 16 not only eliminates any noise in connection with the lever 17, but operates as a positive drag on the cam shaft thereby eliminating all gear noises which become particularly noticeable after several thousand miles of travel.

It will also be seen that I have provided a threaded adjustment between the valve stem 14 and the actuating lever 17 whereby to readily accommodate the fuel pump to any variations in location between the fuel pump support and the position of the cam.

What I claim is:

1. In a liquid fuel supply system for pumping liquid toward a unit adapted to intermittently close and set up a back pressure, a constant displacement pump, a pump chamber, an inlet conduit leading to said pump chamber, a flexible wall reservoir chamber connected to said pump chamber, and to said unit for accumulating reserve fuel during the back pressure period, a valve aperture between said two chambers of larger size than said inlet conduit, a valve for said aperture operatively connected to said diaphragm, said connection being such that the

valve will open and close with each stroke of the pump independently of the movement of the diaphragm until a predetermined amount of liquid accumulates in the reservoir chamber, at which time said connection is such that the valve will move with said diaphragm to thus uncover said aperture and be rendered temporarily inoperative.

2. In a liquid fuel supply system for pumping liquid toward a unit adapted to intermittently close and set up a back pressure, a constant displacement pump, a pump chamber, an inlet conduit leading to said pump chamber, a continuously movable flexible wall reservoir chamber connected to said pump chamber, and to said unit for accumulating reserve fuel during the back pressure period, a valve aperture between said two chambers of larger size than said inlet conduit, a valve for said aperture operatively connected to said diaphragm, said connection being such that the valve will open and close with each stroke of the pump independently of the movement of the diaphragm until a predetermined amount of liquid accumulates in the reservoir chamber, at which time said connection is such that the valve will move with said diaphragm to thus uncover said aperture and be rendered temporarily inoperative.

3. In a liquid fuel supply system for pumping liquid toward a unit adapted to intermittently close and set up a back pressure, a constant displacement pump, a pump chamber, an inlet conduit leading to said pump chamber, a continuously movable flexible wall reservoir chamber connected to said pump chamber, and to said unit for accumulating reserve fuel during the back pressure period, a valve aperture between said two chambers of larger size than said inlet conduit, a valve for said aperture operatively connected to said diaphragm, said connection being such that the valve will open and close with each stroke of the pump independently of the movement of the diaphragm until a predetermined amount of liquid accumulates in the reservoir chamber, at which time said connection is such that the valve will move with said diaphragm to thus uncover said aperture and be rendered temporarily inoperative, said valve moving to operative opening and closing position and moving independently of the diaphragm when the volume of liquid in said reservoir chamber is lowered a predetermined amount whereby to allow liquid fuel to be advanced into said pump chamber.

4. In a liquid fuel supply system for pumping liquid toward a unit adapted to intermittently close and set up a back pressure, a constant displacement pump, a pump chamber, an inlet conduit leading to said pump chamber, a flexible wall reservoir chamber connected to said pump chamber, and to said unit for accumulating reserve fuel during the back pressure period, a valve aperture between said two chambers of larger size than said inlet conduit, a valve for said aperture operatively connected to said diaphragm, said connection being such that the valve will open and close with each stroke of the pump independently of the movement of the diaphragm until a predetermined amount of liquid accumulates in the reservoir chamber, at which time said connection is such that the valve will move with said diaphragm to thus uncover said aperture and be rendered temporarily inoperative, and a calibrated spring back of said diaphragm to permit of continuous reciprocating movement thereof.

5. In a constant displacement fuel pump, a reserve chamber in communication with a diaphragm pump chamber through a valve and relatively large valve opening, means permitting continuous opening and closing of said valve even after the demand for liquid has been temporarily supplied and reserve liquid accumulated, a wall of said reserve chamber connected to and controlling said valve and being movable to accommodate reserve liquid or vapor and by reason of said relatively large opening to do so without materially increasing pressure in the reserve chamber, a second constant displacement pump chamber, a fuel trap having separate conduits leading to each of said pump chambers, a float controlled valve for putting any accumulation of vapor in said trap in communication with said second pump chamber, one of said conduits extending to a considerable distance below the normal level of liquid in said trap for feeding liquid to said first named pump chamber.

6. In a constant displacement fuel pump, a reserve chamber in communication with a diaphragm pump chamber through a valve and relatively large valve opening, means permitting continuous opening and closing of said valve even after the demand for liquid has been temporarily supplied and reserve liquid accumulated, a wall of said reserve chamber connected to and controlling said valve and being movable to accommodate reserve liquid or vapor and by reason of said relatively large opening to do so without materially increasing pressure in the reserve chamber, a second constant displacement pump chamber, a fuel trap having separate conduits leading to each of said pump chambers, a float controlled valve for putting any accumulation of vapor in said trap in communication with said second pump chamber, one of said conduits extending to a considerable distance below the normal level of liquid in said trap for feeding liquid to said first named pump chamber, and a valve member positioned in said last named conduit and a relief valve cooperating with said float controlled valve to control the flow of vapor to said second pump chamber.

7. In a fuel pump of the flexible diaphragm constant displacement type, a main pump chamber on one side of said diaphragm, an auxiliary pump chamber on the other side of said diaphragm and leading through a check valve to a manifold, a fuel trap, an imperforate conduit leading from said main chamber to a point below the normal level of liquid in said trap, a float in said trap, a second conduit connecting said auxiliary chamber with said trap, a valve actuated by said float for opening said last named conduit when an accumulation of vapor lowers the level of liquid in said trap, an auxiliary conduit connected to said second conduit through a valve when said float operated valve is closed, a spring pressed valve connecting said trap with said second conduit, a spring pressed valve connecting said auxiliary chamber with the manifold and relief means in communication with said auxiliary pump chamber.

8. In a constant displacement fuel pump, a reserve chamber in communication with a diaphragm pump chamber through a valve, and relatively large valve opening, means for permitting continuous opening and closing of said valve even after the demand for liquid has been temporarily supplied and reserve liquid accumulated,

a wall of said reserve chamber connected to and controlling said valve and being movable to accommodate reserve liquid or vapor and by reason of said relatively large opening to do so without materially increasing pressure in the reserve chamber, a diaphragm stem, a lower pump chamber, a vapor chamber seal member, said pump chamber and diaphragm stem cooperating with the pump diaphragm and vapor chamber seal member to form a second constant displacement pump, a fuel trap having separate conduits leading to each of said pump chambers, a float controlled valve for putting any accumulation of vapor in said trap in communication with said second pump chamber, one of said conduits extending to a considerable distance below the normal level of liquid in said trap for feeding liquid to said first named pump chamber, said pump being operative to pump vapor to and through said second pump chamber whereby the effective capacity of said second pump chamber is independent of the effective capacity of said reserve chamber and first pump chamber.

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