Aug. 21, 1934. E. A. ROCKWELL 1,970,626

FUEL PUMP

Filed Nov. 9, 1931 2 Sheets-Sheet 1

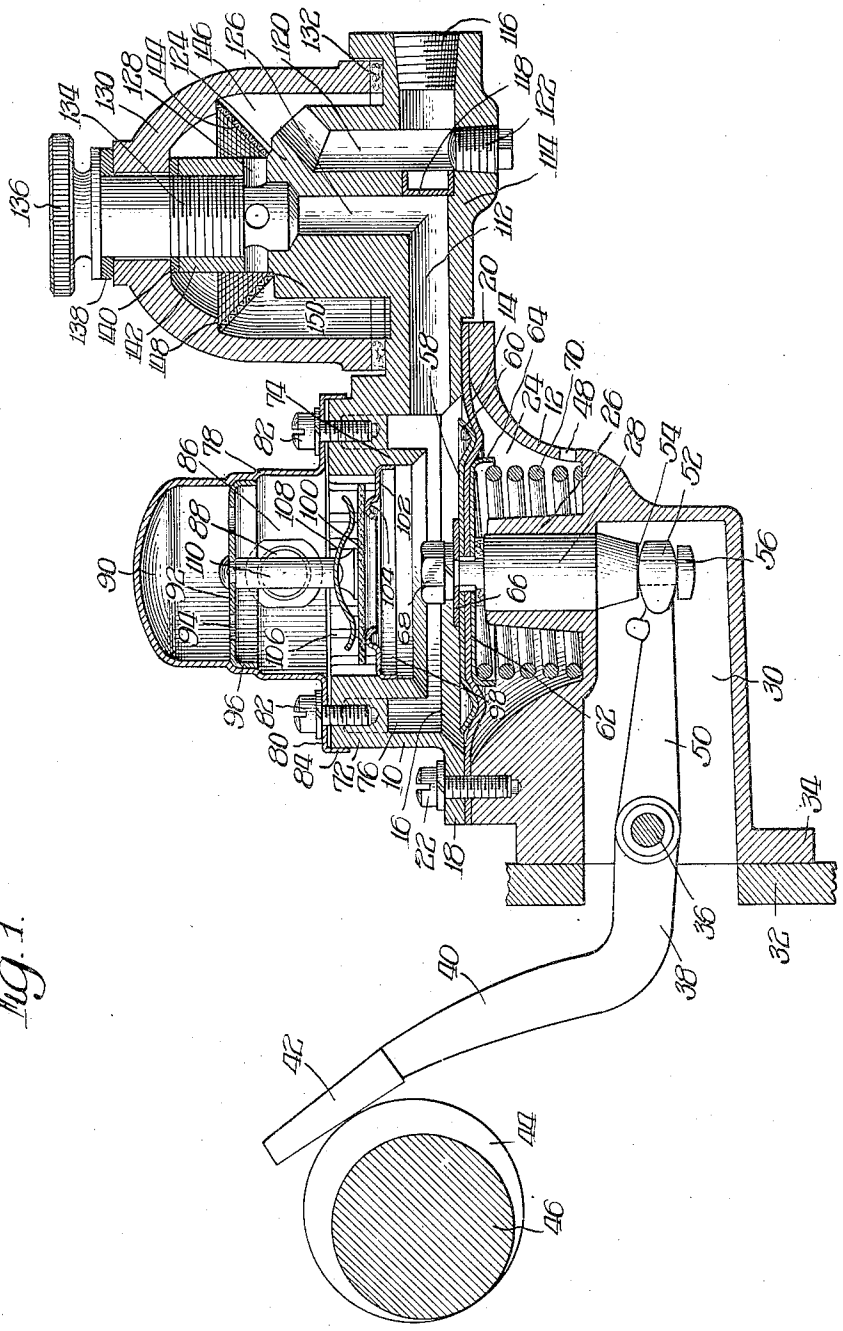


Fig. 1.

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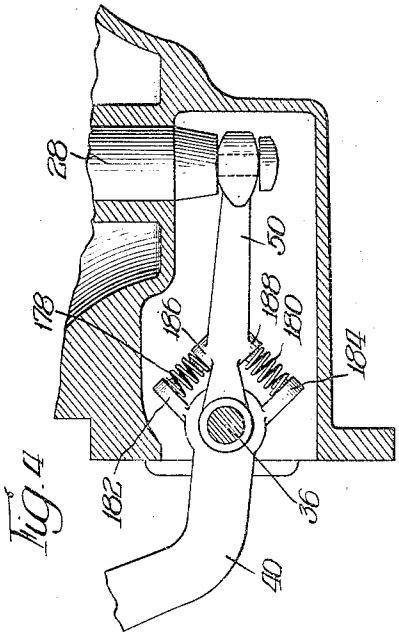


Fig. 4

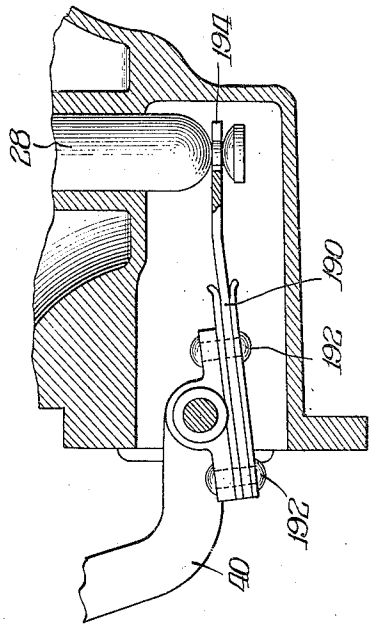


Fig. 5

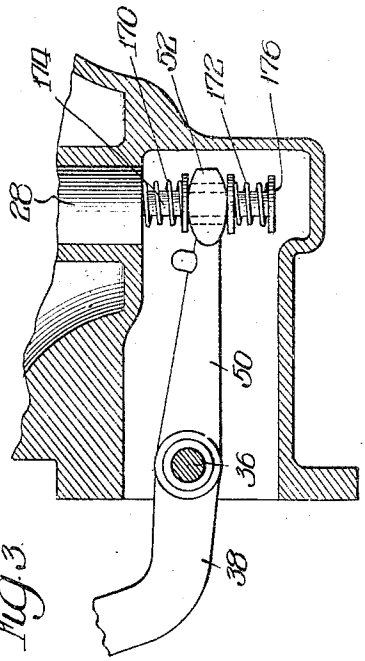


Fig. 3

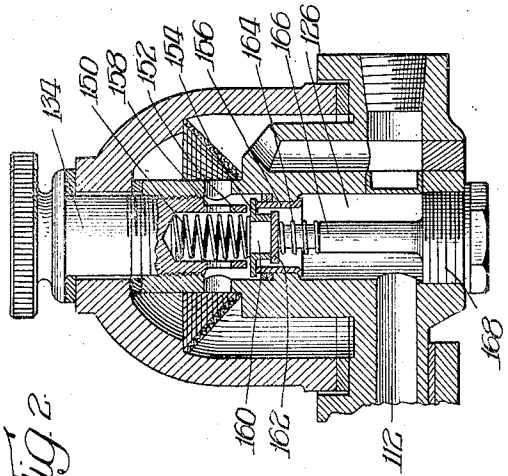


Fig. 2

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1,970,626

FUEL PUMP

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9 Claims. (Cl. 103—150)

This invention relates to improvements in fuel pumps particularly adaptable for supplying liquid fuel to an internal combustion engine from a fuel tank usually at a lower level than the engine carbureter.

Fuel pumps as heretofore constructed and used generally include a pumping chamber cooperating with a pumping element which is suitably actuated from an engine-driven element for reduction and expansion of the chamber for intake and discharge of fuel therefrom. In order to prevent return flow and to maintain the flow in one direction towards the carbureter, inlet and outlet check valves have been used controlling the passage leading to and from the pumping chamber and these valves are customarily maintained in normal seated position by spring means. The fuel pump is generally positioned on the engine casing a substantial distance from the supply tank, therefore, a high suction pressure is required to produce the maximum flow through the tubing from the supply tank to the fuel pump while, on the other hand, a very much lower pressure is required to feed the fuel the short distance upwardly to the float chamber of the carbureter. The action of the pump due to the pulsations of the diaphragm is obviously intermittent but it would be highly objectionable if the movement of the fuel in the long supply line is also intermittent since the shocks due to the stopping of the flow of the fuel through the supply line would disturb the action of the inlet valve and more suction pressure would be required to produce the desired maximum flow.

In order to maintain a substantially uniform flow of the fuel through the supply line, it has been proposed to use a fuel receiving chamber adjacent the inlet side of the pump into which the fuel can uniformly flow while it is intermittently sucked therefrom to the pumping chamber.

Another manner of avoiding troubles due to the use of an inlet check valve is to omit the inlet check valve and to so design the pump that the fuel will be delivered through the outlet check valve upon a discharge stroke of the pumping elements without substantial stoppage of the flow into the pumping chamber. This may be done by using a large area outlet valve and by so arranging the inlet and outlet passages to the pumping chamber that the movement of the pumping element directs the fuel past the inlet passage and directly towards the outlet passage. This type of pump is also adaptable for use with a constant stroke pumping element since the back pressure may become sufficient to overcome the inertia effect of the fuel in the supply line and cause an oscillation of the fuel in the supply line to the pumping chamber whereby delivery is prevented. However such pumps are usually difficult to prime at low engine speeds.

It is an object of the present invention to provide a fuel pump of the inertia type, that is, one in which back flow from the pumping chamber through the supply line is prevented by the inertia of the incoming fuel instead of by a check valve which seats against return flow and which pump is so designed that it will give a commercially satisfactory operation under all engine speeds.

A particular improvement of the pump consists in the provision of a vapor trap chamber in communication with the pumping chamber which maintains a body of air and fuel vapor directly acting on the fuel being supplied through the pumping chamber. The proportions of the vapor trap chamber together with the resistance to flow of the fuel past the outlet check valve and through the outlet passage determines the maximum discharge pressure of the pump.

It is a further purpose of the present invention to provide a fuel pump having a pumping chamber with a constant stroke diaphragm forming a bottom wall thereof and to deliver the fuel through a wide area outlet passage directly over the operating face of the diaphragm and to surround the outlet passage by an annular vapor trap chamber, the inlet passage being provided leading laterally in from the side of the pumping chamber. The discharge through the outlet passage is past a very light sensitive check valve into a chamber having connection at its lower portion to the delivery line and means in the upper portion of the chamber for combing out the vapors and collecting the vapors at the top of the chamber which thereby forms a vapor dome. The concentric arrangement of the diaphragm pumping chamber, vapor chamber in the pumping chamber, outlet passage and outlet vapor dome is a very desirable construction since the vapors generated by the action of the pump tend to rise upward and scavenge the liquid fuel from both of the vapor collecting chambers.

A further improvement of the present invention resides in the means for controlling the flow of fuel through the pumping chamber to assist the inertia effect which tends to prevent back flow. The fuel is caused to flow through a substantially tortuous course immediately adjacent the inlet to the pumping chamber whereby the reversals in direction of the flow of fuel further impede the

return flow of the fuel. According to my construction the supply line is so connected to the pump as to deliver substantially toward the pump chamber but flow passages are provided for directing the fuel upwardly and downwardly before reaching the intake passage to the pumping chamber.

A further improvement consists in the provision of filtering means positioned in a fuel receiving and sediment chamber of small dimensions closely adjacent the intake to the pumping chamber.

According to a preferred embodiment of the pump, a removable cup-shaped member is seated on the upper side of the upper pump casing part laterally positioned with respect to the outlet vapor dome and forming a communication between the upwardly directed and downwardly directed intake passages.

A further improvement in the pump design resides in the provision of valve means in the intake passage which operates to maintain the volume of fuel in the supply line for priming purposes but does not resist the flow of fuel in opposite directions in the intake passage.

Further advantages and improvements of the present invention will be more readily apparent from the complete description taken in connection with the attached drawings in which a preferred embodiment of the pump is illustrated.

In the drawings:

Figure 1 is a vertical section taken through the pump in a manner to most clearly illustrate the internal construction.

Figure 2 is a detail vertical section of the intake side of the pump illustrating a modified construction in which a double acting valve mechanism is utilized.

Figures 3, 4 and 5 are detail sections of the actuating means illustrating modified constructions for transmitting movement from a constant stroke lever to the pumping diaphragm in a manner to prevent over-stressing the diaphragm.

In the drawings, referring first to the construction illustrated in Figure 1, an upper pump casing part 10 is provided for seating on a lower casing part 12 in a manner to secure therebetween a flexible pumping diaphragm 14. The upper casing part may be internally recessed to provide a pumping chamber 16 surrounded by a marginal flange 18 which seats against the upwardly facing marginal flange 20 of the lower casing part 12. The casing parts may be secured by screw bolts 22. The lower casing part 12 includes a recessed chamber 24 beneath the pumping diaphragm 14 and having a central upwardly extending boss 26 which forms a guide for a pump stem 28 depending into a lower chamber 30 laterally opening toward an aperture of an engine casing 32.

The casing part 12 has a flange 34 by which it is secured to the engine casing 32. A fulcrum pin 36 is provided in the chamber 30 for mounting a double arm actuating lever 38. The lever 38 includes an arm 40 protruding into the engine casing and reaching upwardly for engaging at its thrust end 42 an engine driven cam 44 associated with a driven shaft 46. The cam 44 imparts a positive movement to the lever 38 in one direction and the lever may be returned and maintained in contact with the cam during the passive phase thereof by means of a coiled compression spring 48, the action of which will be more fully described in the following description.

The lever 38 includes an arm 50 extending within the casing chamber 30 and having a fork-shaped end 52 which engages a reduced portion of the stem 28 between the shoulders 54 and 56. The fork-shaped end 52 of the lever is suitably shaped to transmit, by its movement in an arc-shaped path, a reciprocatory movement in a straight line to the pump stem 28. The flexible diaphragm 14 is clamped between an upper disk-shaped member 58 having a depressed annular portion 60 and a lower disk-shaped member 62 having a depending flange 64. The disks 58 and 62 are secured to the opposite sides of the diaphragm 14 and to the pump stem 28 by means of a washer 66 and nut 68. A compression spring 48 surrounds the boss 26 and reacts between the bottom of the chamber 24 and the disk 62. The disk members serve to strengthen the diaphragm and allow only sufficient flexibility of the diaphragm to permit the operation thereof and are so designed as to prevent slack in the diaphragm at any point in its movement. It is obvious that the positive movement of the lever 38 by the active phase of the cam will move the pumping diaphragm downwardly against the resistance of spring 48 while during the passive phase of the cam, the pumping diaphragm will be returned by the action of the spring 48 which is sufficiently stiff to return the lever 38 for its full stroke independent of pressure conditions within the pumping chamber. A vent opening 70 may be provided leading into the chamber 24 through a wall of the casing 12.

The upper casing part 10 includes an upward extension 72 concentric with the diaphragm and pumping chamber and having a substantially wide central opening therethrough. A depending annular flange 74 extends from the upward extension 72 downwardly towards the pumping diaphragm and is surrounded by an annular vapor trapping chamber 76. A pressed metal cap member 78 is provided having a horizontal flange 80 seating on the upper face of the extension 72 and secured thereto by screw bolts 82. A depending marginal flange 84 extends from the horizontal flange 80 and surrounds the tubular extension 72. The cap member 78 forms an outlet chamber 86 from which the fuel is delivered through the outlet connection 88. The upper portion of the cap member 78 forms a vapor dome 90 separated from the lower chamber 86 by a plate 92 having perforations 94, the plate 92 being formed with a flange 96 for being upwardly pressed into place in the cap member 78.

The flow passage 98 from the pumping chamber towards the outlet chamber 86 is controlled by a light large area check valve 100 seating downwardly against a valve seat member 102 which is upwardly pressed into the casing extension 72 and has an upwardly facing annular ridge 104 upon which the valve 100 seats. The central opening through the casing extension 72 is surrounded by a plurality of vertically disposed radial ribs 106 which form shoulders for centering the valve 100 and for permitting fuel flow around the circular edge of valve 100 through the spaces between the ribs 106. In order to resiliently limit the opening movement of the valve 100, spring arms 108 are provided secured to the lower end of a stem 110 which, in turn, is secured at its upper end to the perforated transverse plate 92.

The pump is provided with a lateral inlet passage 112 formed in an offset extension 114 of the upper casing part 10, the passage 114 being in line with a threaded inlet connection 116 but separated therefrom by a closure 118 inserted through the passage. The fuel flowing in through the inlet connection 116 is directed upwardly

through a passage 120 closed at the lower end by a plug 122. The passage 120 extends through an upwardly disposed tubular portion 124 of the casing extension 114 which has formed therein a central vertical passage 126 in communication with the horizontal passage 112. Lateral openings 128 are formed in the extension 124 and the vertical intake passage 120 is in communication with the lateral openings 128 through which the fuel may be directed towards the pumping chamber by means of a removable glass cup 130 which seats at its open bottom end on a gasket 132 and against the upper face of the casing extension 114 thereby surrounding the extension 124 which has the flow passages formed therein. In order to secure the removable cup 130 to the pumping casing, a threaded pin 134 is provided with a knurled head 136 and suitable sealing gaskets 138 and 140 are provided. The threaded pin 134 is screwed into the threaded portion 142 of the upwardly directed extension 124. A conical shaped screen 144 is held within the chamber 146 formed by the removable cup 130 between a shoulder 148 of the cup and a shoulder 150 of the upwardly directed extension 124. The screen 144 is, therefore, so positioned as to separate the inlet passage 120 from the flow passage 128 which leads into the downwardly directed inlet passage 126. The sediment collected by the screen 144 drops to the lower part of the chamber 146 and may be removed therefrom by removal of the cup 130.

The pump disclosed in Figure 1 tends to lift fuel from a low level source of supply and deliver the fuel to a carbureter positioned above the pump. If it is assumed that the pump has been primed and the pumping chamber full of fuel, each discharge stroke of the pumping diaphragm will deliver a small quantity of fuel past the very light large area check valve 100 since the resistance of the inlet passage to backward flow and the inertia of the fuel flowing towards the pumping chamber from the source of supply is greater than the resistance to opening of the discharge valve. Each suction stroke of the pumping diaphragm will tend to draw fuel into the pumping chamber. There will be some surging of the fuel back and forth in the inlet passage but the pump will operate to deliver sufficient fuel above the check valve 100 and this fuel will be delivered to the carbureter. The action of the pumping diaphragm and the surging effect of the fuel will tend to create fuel vapor which collects in the vapor trapping chamber 76 and the trapped vapor will maintain a constant pressure upon the fuel delivered from the pump. As soon as the float chamber of the carbureter is filled, the resistance to delivery of fuel from the pump will be sufficient to overcome the vapor pressure in the pumping chamber and the fuel will be oscillated in the pumping chamber without delivery past the outlet check valve. The annuar chamber 76 will serve to trap a fixed volume of fuel vapor and therefore it is unnecessary to employ a float end check valve, as formerly used in an inertia type of fuel pump. The up-side-down filter construction is used for the reason that there must be very little volume in the filter chamber so as to maintain a high inertia effect and if the bowl 130 were swung underneath it would be so small that it would be difficult to visibly see the flow of fuel through the bowl. Furthermore, by the up-side-down construction it is possible to place the filter chamber closer to the center line of the pumping chamber.

A modification of the inlet chamber is shown in Figure 2 which may be employed if necessary for quick priming. In this construction the plug 134 is hollowed out at its lower end to receive a valve seating spring 150 and has a cylindrical extension 152 which serves to limit the opening movement of a check valve 154 which seats upon the valve seat member 156 in a direction towards the pumping chamber. The cylindrical extension 152 of the plug 154 is provided with openings 158 permitting access of the fuel to the interior of the spring cavity. The check valve 154 has a central passage 160 which is controlled by a second check valve 162 arranged to seat upwardly against the depending portion of the check valve 154. The check valve 162 is retained on its seat by the spring 164 positioned by the vertical stem 166 carried by a removable plug 168.

It will be understood therefore that a suction impulse in the fuel pumping chamber will cause the check valve 162 to open and the fuel flows downwards through the vertical passage 126 and laterally through the passage 112 into the pumping chamber. The spring 150 is not sufficiently stiff to resist surging of the fuel in a backward direction during the delivery stroke of the fuel pump and the valves 162 and 154 will move together to permit backward flow of the fuel into the trap chamber. However, the spring 150 is sufficient to hold the check valve 154 on its seat during priming of the pump. This construction will therefore properly prime at low engine speeds.

In order to transmit a yielding impulse to the pumping diaphragm in either direction and prevent over-stressing, I may employ any one of the constructions shown in Figures 3, 4 and 5 or other designs which would operate in a similar manner. In Figure 3 the lever 38 has its inwardly extending lever arm 150 connected to the pump stem 28 through a pair of springs 170 and 172 positioned above and below the yoke-shaped end 152 of the lever arm 50. The upper spring 170 surrounds a reduced extension 174 of the stem 28 and reacts upwardly against the enlarged portion of the stem 28. The lower spring 172 similarly surrounds the stem 174 and reacts downwardly against an abutment 176 carried by the stem 174.

In Figure 4 the lever arm 50 is connected to the pump stem 28, the same as in Figure 1, but is relatively movable with respect to the lever arm 40 about the pivot 36. The separate parts 50 and 40 of the lever are connected through a pair of springs 178 and 180, which extend between lugs 182 and 184, integral with the lever arm 40, and abutments 186 and 188 integral with the lever arm 50.

In Figure 5 the lever arm 40 has attached thereto a resilient leaf spring arm 190 through rivets 192 and the spring arm 190 is connected to the pump stem 28 through its slotted end 194. In this construction the leaf spring 190 may yield in either direction.

I claim:

1. In a fuel pump, a pump casing, an expansible and reducible pumping chamber in said pump casing, a continuously open intake passage including a U-shaped bend within said pump casing leading into said pumping chamber from a source of fuel supply, a discharge passage from said pumping chamber, a relatively light large area check valve in said discharge passage and means for trapping fuel vapor within said pumping chamber to maintain a constant pressure on the fuel delivered from said pumping chamber.

2. In a fuel pump, a pump casing, an expansible and reducible pumping chamber in said pump casing, a reciprocable pumping element forming the bottom wall of said pumping chamber, a continuously open intake passage including a U-shaped bend with said pump casing leading laterally into said pumping chamber from a source of fuel supply, a discharge passage leading upwardly from said pumping chamber substantially concentric with said pumping element, a relatively light large area check valve in said discharge passage and means for trapping fuel vapor within said pumping chamber to maintain a constant pressure on the fuel delivered from said pumping chamber.

3. In a fuel pump, a pump casing, an expansible and reducible pumping chamber in said pump casing, a constant stroke reciprocable diaphragm forming the bottom wall of said pumping chamber, a continuously open intake passage including a U-shaped bend with said pump casing leading laterally into said pumping chamber, a discharge passage leading upwardly from said pumping chamber concentric with said diaphragm, a check valve in said discharge passage and an annular vapor trapping space within the upper part of said pumping chamber.

4. In a fuel pump, a lower pump casing part adapted to be mounted on an engine casing, an upper pump casing part clamped to said lower pump casing part, a reciprocable pumping diaphragm clamped between said casing parts, means for actuating said diaphragm for a constant stroke, said upper pump casing part forming a pumping chamber, said upper pump casing part having an annular flange depending into said pumping chamber to form an annular vapor trapping space around said flange, a discharge passage leading upwardly through said upper pump casing part concentric with said diaphragm, a relatively light large area check valve in said discharge passage immediately above said pumping diaphragm and an intake passage including a U-shaped bend within said pump casing leading laterally into said pumping chamber.

5. In an inertia type fuel pump, a pump casing having inlet and outlet connections, an expansible and reducible pumping chamber within said pump casing, a discharge passage leading upwardly from said pumping chamber to said outlet connection, a relatively light large area check valve in said discharge passage, an intake passage leading from said inlet connection to said pumping chamber, said intake passage being continuously open and including a U-shaped bend within said pump casing to restrict return flow of the fuel during delivery of fuel from said pumping chamber through said discharge passage.

6. In a device of the character described, a low level fuel supply and an inertia type fuel pump at a higher level, comprising a casing, an expansible and reducible pumping chamber within said casing, a constant stroke reciprocable diaphragm forming a movable wall of said chamber, a continuously open intake passage leading to said chamber, a discharge passage having a larger area of opening than the supply passage leading from said chamber, a check valve in said discharge passage and a vapor trapping cavity on the intake side of said check valve effective to prevent excessive discharge pressure.

7. In a device of the character described, a low level fuel supply and an inertia type fuel pump at a higher level, comprising a casing, an expansible and reducible pumping chamber within said casing, a constant stroke reciprocable diaphragm forming a movable wall of said chamber, a continuously open intake passage leading to said chamber, a discharge passage having a larger area of opening than the supply passage leading upwardly from said chamber, a relatively light large area check valve in said discharge passage and a vapor trapping cavity in said pumping chamber effective to prevent excessive discharge pressure.

8. In a device of the character described, a low level fuel supply and an inertia type fuel pump at a higher level, comprising a casing, an expansible and reducible pumping chamber in said casing, a constant stroke reciprocable diaphragm forming a movable bottom wall of said chamber, a continuously open intake passage leading laterally into said chamber from a source of fuel supply, a discharge passage having a larger area of opening than the supply passage leading upwardly from said pumping chamber substantially concentric with said diaphragm, a check valve in said discharge passage and an annular vapor trapping cavity within said pumping chamber and surrounding said discharge passage, said cavity being effective to prevent excessive pressure upon the fuel delivered past said discharge check valve.

9. In a device of the character described, a low level fuel supply and an inertia type fuel pump at a higher level, comprising a casing, an expansible and reducible pumping chamber within said casing, a constant stroke reciprocable diaphragm forming a movable bottom wall of said chamber, a continuously open intake passage leading laterally into said pumping chamber from a source of fuel supply, said intake passage being formed to restrain backward flow of the fuel flowing towards said pumping chamber, a discharge passage having a larger area of opening than the supply passage leading from said pumping chamber, a relatively light large area check valve in said discharge passage and a vapor trapping cavity within said pumping chamber effective to prevent excessive discharge pressure.

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