Nov. 6, 1934. E. A. ROCKWELL 1,980,091

FUEL PUMP

Filed Sept. 10, 1930 2 Sheets-Sheet 1

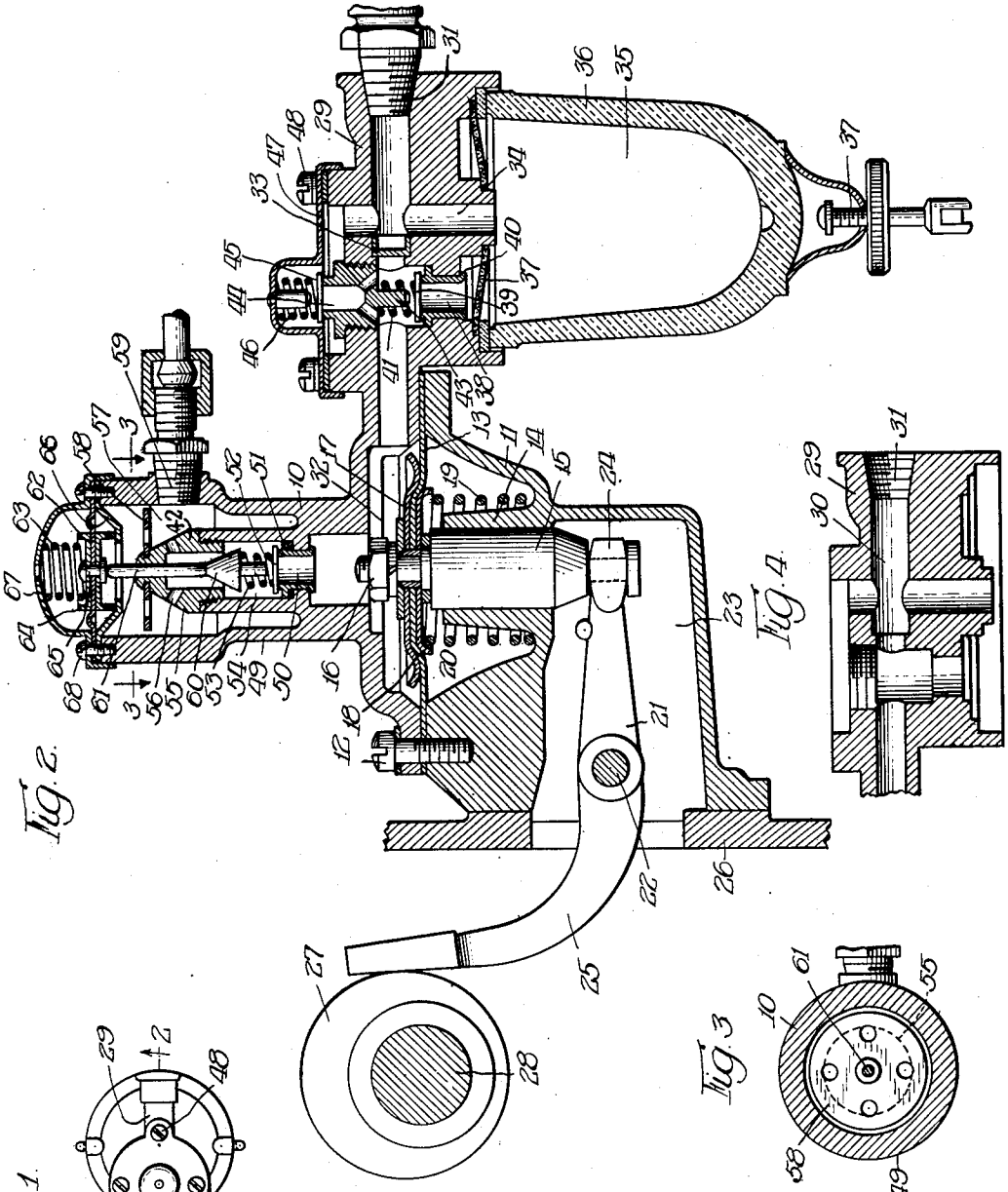


Fig. 2.

Fig. 4.

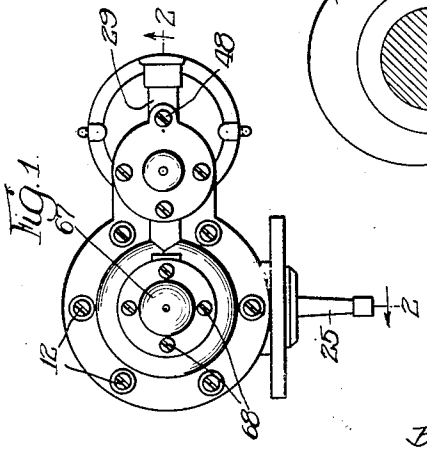


Fig. 1.

Fig. 3.

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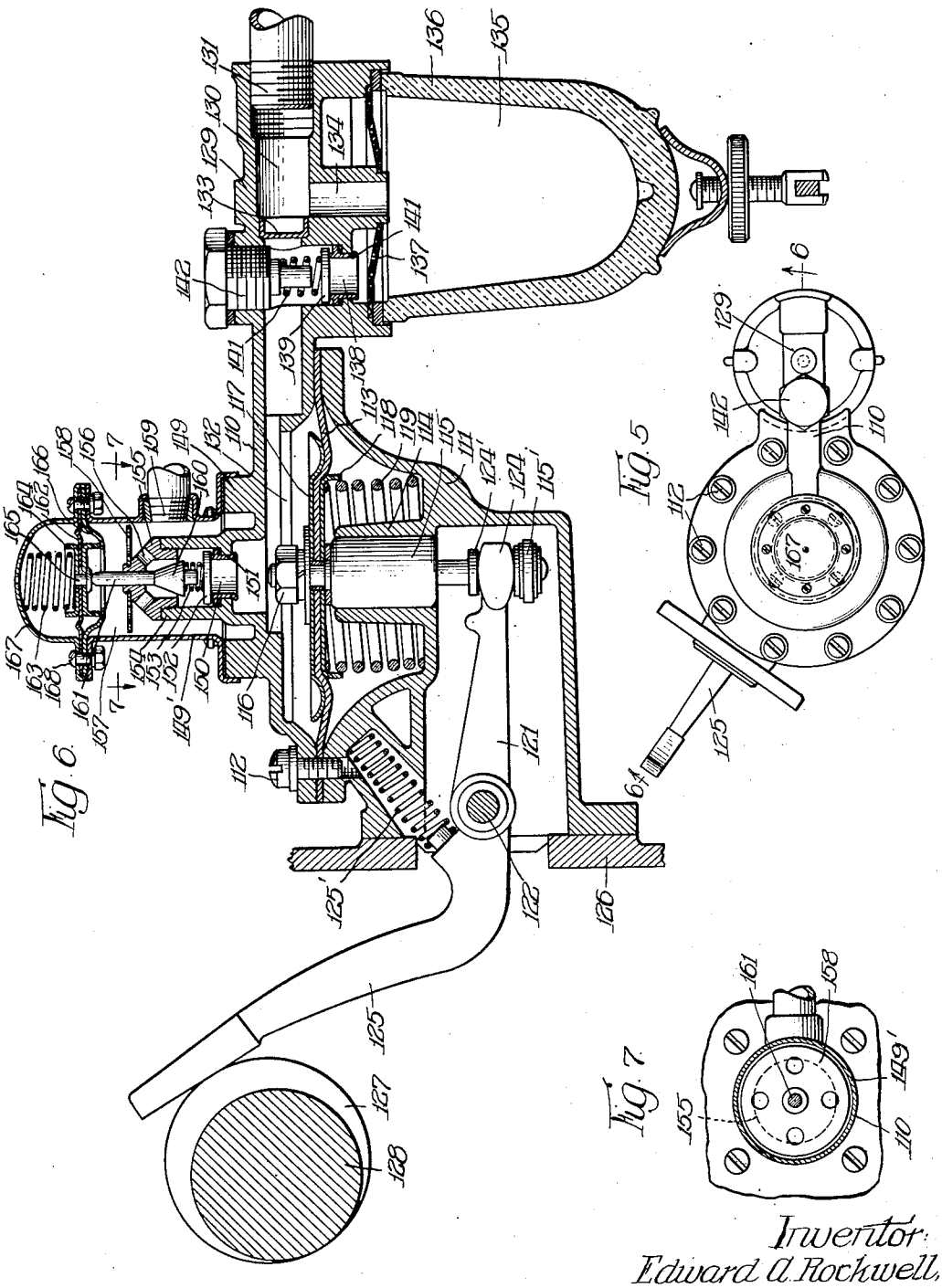


Fig. 6

Fig. 5

Fig. 7

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Patented Nov. 6, 1934 1,980,091

UNITED STATES PATENT OFFICE

1,980,091

FUEL PUMP

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Application September 10, 1930, Serial No. 480,865

6 Claims. (Cl. 103—40)

This invention relates to improvements in fuel pump construction of the type that is adapted to be actuated by the engine for the delivery of fuel from the supply tank to the carbureter of the engine in which the fuel is delivered from the pump in accordance with the flow permitted by the float chamber of the carbureter.

A commercially successful fuel pump has been previously designed which consists of a pair of casing parts clamping therebetween a pumping diaphragm which is urged in a discharge direction by a compression spring held between the lower casing part and the bottom of the diaphragm, the diaphragm being actuated in a suction direction through a stem guided for movement by the lower casing part and engaged by a lever carried by a fulcrum pin in the lower casing part and including an arm protruding from the pump so that the pump, as a unit, may be mounted on the engine casing adjacent an aperture thereof, whereby the protruding arm of the lever comes into thrust engagement with a cam of the engine cam shaft. The lever is thereby given a positive stroke by the active phase of the cam and imparts a positive suction stroke to the diaphragm. If the diaphragm is intended to have a constant stroke in both directions, the lever will be returned during the passive phase of the cam by the compression discharge spring but if it is desired to have a variable discharge stroke of the diaphragm, the lever is connected by lost motion means to the stem of the diaphragm and is returned during the passive phase of the cam by a follower spring reacting between the lever and the lower casing part of the pump. The diaphragm cooperates with a pumping chamber provided with an inlet connection from the source of fuel supply and a discharge connection to the carbureter, the inlet and discharge passages being controlled for one-way flow by ordinary check valves.

The fuel pump when installed in a motor vehicle is at a much greater distance from the fuel supply tank than from the carbureter and, therefore, it is desirable to develop a much higher suction pressure for drawing the fuel from the supply tank into the pumping chamber than the maximum discharge pressure required for delivering fuel to the float chamber of the carbureter, for example, the maximum discharge pressure may only be two inches of mercury while, in order to secure the desired maximum flow, the suction pressure should be as high as twelve inches of mercury, or thereabouts.

If a constant stroke diaphragm is employed, separate means must be provided, such as a by-pass with a pressure-controlled valve to prevent delivery to the carbureter when the float-actuated valve is closed. If the pressure-controlled by-pass is in the usual position between the pumping chamber and the inlet connection around the inlet check valve, it will be obvious that a high suction developed in the chamber will tend to open the by-pass valve and, therefore, it is not possible to obtain a suction pressure greater than the relatively low maximum discharge pressure permitted. Furthermore, if the pump is of the type in which the diaphragm has a variable discharge stroke with the compression discharge spring designed to be inoperative when the relatively low discharge pressure is reached, it will be obvious that when maximum delivery of the fuel is required, as for example, with the vehicle running in high speed, the diaphragm will be rapidly vibrating and the discharge spring will not have sufficient strength to fully react in the short interval permitted by the rapid movements of the actuating lever.

It is a purpose of the present invention to provide an improvement in a fuel pump whereby the above-noted objections in the previous design of fuel pump are removed and the present construction contemplates the provision of a pressure-controlled valve on the discharge side of the pump beyond the outlet check valve which is normally opened to permit full flow of the fuel through the delivery line but which will be moved to seated position in the direction of fuel flow when the relatively low maximum discharge pressure is reached. Since this valve seats in the direction of fuel flow, further delivery of fuel from the pumping chamber is positively prevented and with the form of pump shown, a constant stroke diaphragm and a pressure-controlled by-pass is provided, the pressure at which the by-pass valve opens may be made as high as desirable so as to be unaffected by the high suction pressure in the inlet line while, on the other hand, in the case of a pump with a variable stroke diaphragm, the strength of the compression spring instead of being limited by the relatively low maximum pressure may be much stiffer so as to react more quickly during high speed operation for maximum delivery of fuel.

According to the broadest phase of the invention, it will be apparent that the discharge pressure controlling valve may be anywhere in the line between the pumping chamber and the float chamber of the carbureter but it is a specific object of the invention to so design the fuel pump

that the discharge pressure-controlled valve is unitarily assembled therewith and the construction which is specifically described in the following description consists in mounting the valve in an upward extension of the pump being urged to seating position by the same spring which seats the outlet check valve, the pressure controlled valve being normally held in open position by a spring-pressed diaphragm closing at the upper end of the pump extension forming a vapor dome chamber with the delivery connection at the bottom of the chamber so that the vapor pressure acting upon the diaphragm will cause the diaphragm to move and permit the valve to be seated when the maximum discharge pressure has been reached.

Further and additional objects of the invention will be more clearly understood from the following detail description taken in connection with the attached drawings, in which—

Figure 1 is a plan view of the exterior of a unitary fuel pump with the present improvement applied thereto;

Figure 2 is a complete vertical section taken through the pump in a manner to most clearly illustrate the construction as indicated by 2—2 in Figure 1;

Figure 3 is a detail horizontal section taken on the plane indicated by 3—3 in Figure 2;

Figure 4 is a detail section of a portion of the upper pump casing part illustrating the borings for the fuel passages;

Figure 5 is a plan view of a modified construction of the fuel pump;

Figure 6 is a complete vertical section taken on the plane indicated by 6—6 on Figure 5, and

Figure 7 is a detail horizontal section taken on the plane indicated by 7—7 in Figure 2.

The form of fuel pump illustrated in Figures 1 to 4 which is of the type having a constant stroke pumping element and a pressure-controlled by-pass will be first described. The pump casing consists of an upper casing part 10 and a lower casing part 11 clamped together by bolts 12 in the usual manner, holding therebetween a flexible diaphragm 13. The lower casing part 11 has an integral boss 14 forming a guide bearing for the stem 15 having a reduced upper end attached by a nut 16 inserted thereto to the diaphragm 13 and further serving to clamp to the opposite sides of the diaphragm rigid disk members 17 and 18 which render inflexible the central area of the diaphragm and the upper disk member 17 being formed to prevent any slack in the diaphragm. A compression spring 19 is mounted in a chamber 20 of the lower casing part surrounding the boss 14 and serves to produce the discharge stroke of the diaphragm. An operating lever 21 is carried by a fulcrum pin 22 mounted in a chamber 23 of the lower casing part and has a yoke end 24 engaging the lower end of the stem 15 in a manner to accommodate the arcuate movement of the lever relative to the linear movement of the stem. The lever has a protruding arm 25 whereby, when the pump is mounted as shown on an engine casing 26, the end of the lever arm 25 comes into thrust engagement with a cam 27 carried by an engine cam shaft 28. It will be apparent from this form that the lever and the diaphragm will have constant strokes in both directions and the spring 19 will serve to maintain the lever arm 25 in contact with the cam during the idle phase of the cam movement.

The upper casing part 10 has a lateral extension 29, shown in detail in Figure 4, with a straight bored passage 30 from the threaded inlet pipe connection 31 to the pumping chamber 32. This passage is closed, as shown in Figure 2, by the plug 33 so that the fuel is directed downward as it flows in from the suction line through the vertical bored passage 34 into a fuel-receiving trap chamber 35 formed by the transparent cup 36, held by detachable securing means indicated in general as 37 to the lower portion of the lateral extension. The cup 36 serves to hold in place a filter 37 surrounding the vertical inlet passage 34 so that the fuel to reach the vertical passage 38, in order to flow again into the passage 30 on the other side of the plug 33, must pass through the filter. The upwardly directed passage 38 is controlled by a check valve 39, seating on a valve seat member 40 and normally moved to seated position by spring 41. A threaded plug 42 is mounted in the pump extension 29 and includes a stem 43 holding the spring 41 into position and having bored passages 44 therein. The upper end of the plug 42 forms a seat portion for a relief check valve 45 normally held in seated position by a spring 46 supported between a cap member 47 and the check valve, the cap member being formed of pressed metal and secured by bolts 48 to the casing extension 29. It will be readily apparent that in ordinary operation of the pump, fuel will intermittently flow into the pumping chamber past the inlet check valve 29 and, if the pressure in the pumping chamber becomes excessive, the valve 45 will be lifted to permit the fuel to flow from the pumping chamber back towards the inlet pipe connection and the fuel will be simply recirculated around the plug 33 through the passages provided.

The upper casing part 10 includes an upwardly directed extension 49 having therein a delivery flow passage 50, a valve seat member 51 being pressed into the extension 49 and cooperating with a check valve 52 normally held in seated position by a spring 53. The extension 49 includes therein a cylindrical portion 54 to which is attached at its upper end a threaded plug 55 having outlet passages 56 for flow of the fuel into an enlarged chamber 57. The chamber is divided by a perforated disk member 58 which forms a separating plate for the vapor and fuel so that the upper portion of the chamber 57 constitutes a vapor dome while the delivery pipe connection 59 is made to the side of the extension 49 below the plate 58. The perforated plate 58 is supported by the threaded plug 55. The plug 55 further, at its bottom, forms a seat for a conical valve 60 guided for movement by stem 61 extending through the upper end of the plug 55 so that the valve 60 seats in the direction of fuel flow. The valve 60 is urged to its seating position by the same spring 53 as the outlet check valve 52. The valve 60 is moved to its normally open position by means of a diaphragm 62 and compression spring 63. The diaphragm includes a rivet 64 securing disks 65 to the opposite sides of the diaphragm and positioned in thrust engagement at its lower end with the upper rounded end of the valve stem 61. The diaphragm is clamped for assembly to the upper end of the extension 49 by the inner stop ring 66 and the upper cap member 67 secured by bolts 68.

The operation of the pump will be readily understood. The spring 63 is adjusted to the desired discharge pressure and normally holds the valve 60 in open position and the pump will operate in its customary manner with the diaphragm making a constant stroke in both direc-

tions and serving to draw the fuel past the inlet check valve and deliver the fuel past the outlet valve towards the carbureter. As soon as the vapor pressure in the chamber 57 becomes sufficient, the diaphragm 62 will be lifted thus allowing the valve 60 to be seated by the force of the spring 63 whereupon, since the discharge stroke of the pump diaphragm can no longer deliver fuel past the outlet check valve, the by-pass check valve 45 will be lifted against the resistance of the relatively strong spring 46 and the fuel will be re-circulated until the valve 60 is again open to permit further delivery.

The compression spring 63 which acts upon the controlling diaphragm 62 must necessarily be greater in strength than the spring 53 which reacts between the check valve 52 and the conical valve 60 in order that in the normal operation of the pump the check valve 52 will be lifted thereby compressing the spring 53 but without producing any movement of the controlling diaphragm against the force of the compression spring 63. The stop ring 66 is therefore provided to limit the movement of the controlling diaphragm when assembled and during the normal operation of the pump; thus the lower disk member 64 will come into seating engagement upon the stop member 66 and limit the normal open position of the conical valve 60, as shown in Figure 2. The preferred construction in which the controlling diaphragm is mounted at the top portion of the vapor trap chamber is desirable since the fuel is kept out of contact with the controlling diaphragm and thus leakage at its connections is prevented.

Referring now to the form of construction illustrated in Figures 5, 6 and 7, there is shown a type of fuel pump in which the pumping diaphragm may have a variable discharge stroke due to a lost motion connection between the lever and the stem of the diaphragm. The pressure actuating discharge controlling valve is substantially similar in structure and operation to that described with reference to the first embodiment but, instead of employing a recirculating valve, the relief of an excessive pressure in the pumping chamber is provided by the lost motion means allowing a variable discharge stroke of the pumping diaphragm and with this construction the compression spring which acts upon the pumping diaphragm may be much stiffer than that customarily employed.

The pump casing has an upper casing part 110 and a lower casing part 111 clamped together by bolts 112 and securing therebetween a flexible pumping diaphragm 113. The casing part 111 has an internal cylindrical boss 114 guiding the longitudinal movement of the pump stem 115 which is attached by a threaded nut 116 to the diaphragm. Diaphragm controlling disks 117 and 118 are shown clamped to the opposite sides of the diaphragm, as previously described. The compression discharge spring 119 which reacts against the lower side of the pumping diaphragm is similar to the spring 19, shown in Figure 2, but need not be as strong as the spring 19 since it does not provide the force for maintaining the lever in contact with the cam. Instead, the lever 121 carried by the fulcrum pin 122 has its yoke end 124 engaging a movable sleeve 124' upon the lower end of a pump stem 115 adapted to come into engagement with a stop member 115' secured to the lower end of the pump stem. The protruding arm 125 of the lever, when the pump is mounted on the engine casing 126, comes into thrust engagement with the cam 127 upon the shaft 128 and the lever is maintained in contact with the cam during the passive phase thereof by the follower spring 125' reacting between the pump casing 111 and the arm 125 of the lever.

The construction so far described corresponds to the previous design of fuel pump except that the strength of the spring 119 is not limited by the maximum pressure at which the pump is permitted to deliver, but, instead may be sufficiently strong to react quickly for the full discharge stroke of the diaphragm when the pump is being operated at high speed and therefore will give the maximum delivery of fuel from the pump. The upper casing part 110 has a lateral extension 129 formed with a straight bored passage 130 leading from the inlet pipe connection 131 to the pumping chamber 132. The passage is, however, closed by a plug 133 and the fuel is caused to flow from the first portion of the horizontal passage 130 down through the vertical passage 134 into the fuel receiving chamber 135 formed by the cap 136. Fuel flows upward from chamber 135 through the filter screen 137 and through the vertical passage 138 controlled by the check valve 139 seated upon a valve seat member 140. The check valve is moved to its seating position by spring 141 which is held at its upper end by the threaded end 142 mounted in the extension 129.

The pump casing part 110 has an integral upward extension 149 surrounding a vertical flow passage 150 formed in valve seat member 151 controlled by check valve 152. The outlet check valve 152 is moved to its seating position by the spring 153. There is provided a substantially cylindrical extension from the pump casing 153 closed at the upper end by the threaded plug 155 having apertures 156 for delivering fuel into the chamber 157. The chamber 157 is included within the pressed metal cylinder 149' which is seated upon and secured to the pump casing extension 149. A perforated transverse plate 158 separates the chamber 157 into upper and lower portions and serves as a combing plate for trapping the vapor in the upper portion of the chamber while the fuel flows out through the outlet pipe connection 159. A conical valve 160 is provided seating in an upward direction against the lower end of the threaded plug 155 and is guided for movement by a stem 161 which extends through the upper end of the plug 155. The valve 160 is controlled by a flexible diaphragm 162 acted upon by a compression spring 163. The diaphragm 162 has clamped to its opposite sides disk members 164 held by rivet 165, the rivet 165 being in a position to come into thrust engagement with the upper rounded end of the valve stem 161. The spring-pressed controlling diaphragm is assembled between a stop ring 166 and a cap member 167 clamped to the upper end of the pressed-metal cylinder 149' by bolt and nut connections 168. In the assembly, the spring 163 will be sufficiently strong to bring the diaphragm 162 into a stopped position with the lower disk member 164 seating upon the stop ring 166 and the valve 160 will be urged upwardly by the spring 153 and come into contact with the diaphragm 162 and be held in normally open position.

The spring 153 is lighter than the compression spring 163 and, therefore, the reciprocations of the pumping diaphragm will develop sufficient pressure to open the outlet check valve without

moving the valve 160 until the vapor pressure in the chamber 157 has been built up to such an extent by the shutting off of the float controlled valve of the carbureter to which the pump delivers that the pressure will move the controlling diaphragm against the force of the spring 163 and allow the valve 160 to be moved to its seating position by the spring 163. When this occurs, further delivery of fuel from the pumping chamber past the outlet check valve is prevented. In the first embodiment, the pressure is relieved by the opening of the recirculating valve, but, according to the present described embodiment, the pressure in the pumping chamber becomes sufficient to balance the force of the spring 119 acting upon the pumping diaphragm and prevent further pumping movements of the pumping diaphragm. Therefore, the lever 121 will continue to be moved for its full stroke in both directions without causing any movement of the diaphragm due to the lost motion movement of the spool 124' on the stem 115.

According to the previous forms of fuel pumps in which the pumping diaphragm has a variable discharge stroke determined by the force of the compression discharge spring, the strength of the spring is limited by the maximum discharge pressure at which the pump delivers and, therefore, at high speed operation, the discharge spring would not be strong enough to react quickly enough in the short interval of time allowed by the idle movement of the lever, but where a delivery pressure regulating valve is employed, as described in the present invention, the discharge spring may be made much stronger in order to give a higher flow during high speed operation of the pump.

I claim:

1. An apparatus for feeding fuel from a source to a place of use consisting of a pump, fuel supply and delivery lines connected thereto, a valve in the delivery line seating against back flow to the pump, a second valve in the delivery line beyond the first valve seating in the direction of fuel flow, a spring reacting on said second valve holding it normally open, means acted upon by the discharge pressure beyond said second valve arranged to compress said spring and allow said second valve to seat when the discharge pressure reaches a predetermined amount and a second spring reacting between the two valves for seating both said valves, said second spring being weaker than the first mentioned spring whereby the second mentioned valve is held normally open and operates for applying pressure to the second spring in a direction for holding the first valve normally seated.

2. An apparatus for feeding fuel from a source to a place of use consisting of a pump having a casing, fuel supply and delivery lines connected thereto, an upwardly projecting portion of the pump casing having an upwardly directed flow passage and a lateral connection discharging towards said delivery line, a flexible diaphragm closing the upper end of said upwardly projecting portion of said pump casing, a check valve in the upwardly extending flow passage adapted to seat against back flow to the pump, a second valve in the flow passage above the first valve, said second valve being engaged by said diaphragm to be held normally open and a spring reacting between the valves for seating both of said valves whereby when the delivery pressure reaches a predetermined amount, said diaphragm will be moved to permit said second valve to seat.

3. An apparatus for feeding fuel from a source to a place of use comprising a pump casing having a pumping chamber therein, a check valve controlled inlet passage leading to said pumping chamber, an upwardly directed check valve controlled outlet passage leading from said pumping chamber, a vapor trapping chamber at the upper end of said outflow passage, a laterally directed discharge connection at the lower portion of said vapor trapping chamber and above the outlet check valve, a normally open valve in said upwardly directed flow passage below said laterally connected discharge connection and above the outlet check valve, a flexible diaphragm closing the top portion of said vapor trapping chamber adapted to engage said normally open valve and a spring reacting upon said diaphragm tending to hold said valve normally open, whereby, when the delivery pressure in the vapor trapping chamber reaches a predetermined amount, said diaphragm will be moved against the force of said spring and said normally open valve will be allowed to seat.

4. A unitary fuel pump adapted to be cam-actuated by the engine for delivering fuel from a supply tank to a carbureter of an engine, a pumping chamber therein, a delivery passage leading therefrom, a check valve controlling said delivery passage for one-way flow therethrough, a chamber in said delivery passage on the discharge side of said check valve, an outflow connection below the top of the chamber, a flexible diaphragm closing the top of said chamber and a valve in the delivery passage normally held in open position by said diaphragm whereby the vapor pressure trapped in said chamber and acting on said diaphragm causes the closing movement of said valve to prevent the passage of fuel to the discharge side of said valve.

5. In a fuel pump construction, an upwardly directed delivery passage from the pumping chamber, a check valve controlling said passage for one-way flow therethrough, a second valve above said first-mentioned check valve adapted to seat in a direction of fuel flow and a spring reacting between said valves tending to urge said valves to seated positions and means for normally holding said second valve in open position.

6. In a fuel pump construction, a pump casing having a pumping chamber therein, said casing including an upwardly directed projection containing an outflow passage, a flexible diaphragm secured to said projection closing the upper end thereof, a cap member secured to said projection on the exterior of said diaphragm, a compression spring enclosed within said cap member reacting upon said diaphragm in a direction to move said diaphragm downwardly, a stop member within said projection limiting the downward movement of said diaphragm, a valve within said projection having an upwardly directed stem adapted to engage said diaphragm by said valve normally held in open position, a check valve below said first-mentioned valve and a spring reacting between said valves for normally seating said check valves whereby said last-mentioned spring causes said first-mentioned valve to seat in a direction of fuel flow when said diaphragm has been upwardly moved by the delivery pressure.

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