Jan. 23, 1934. E. A. ROCKWELL 1,944,575

FUEL PUMP

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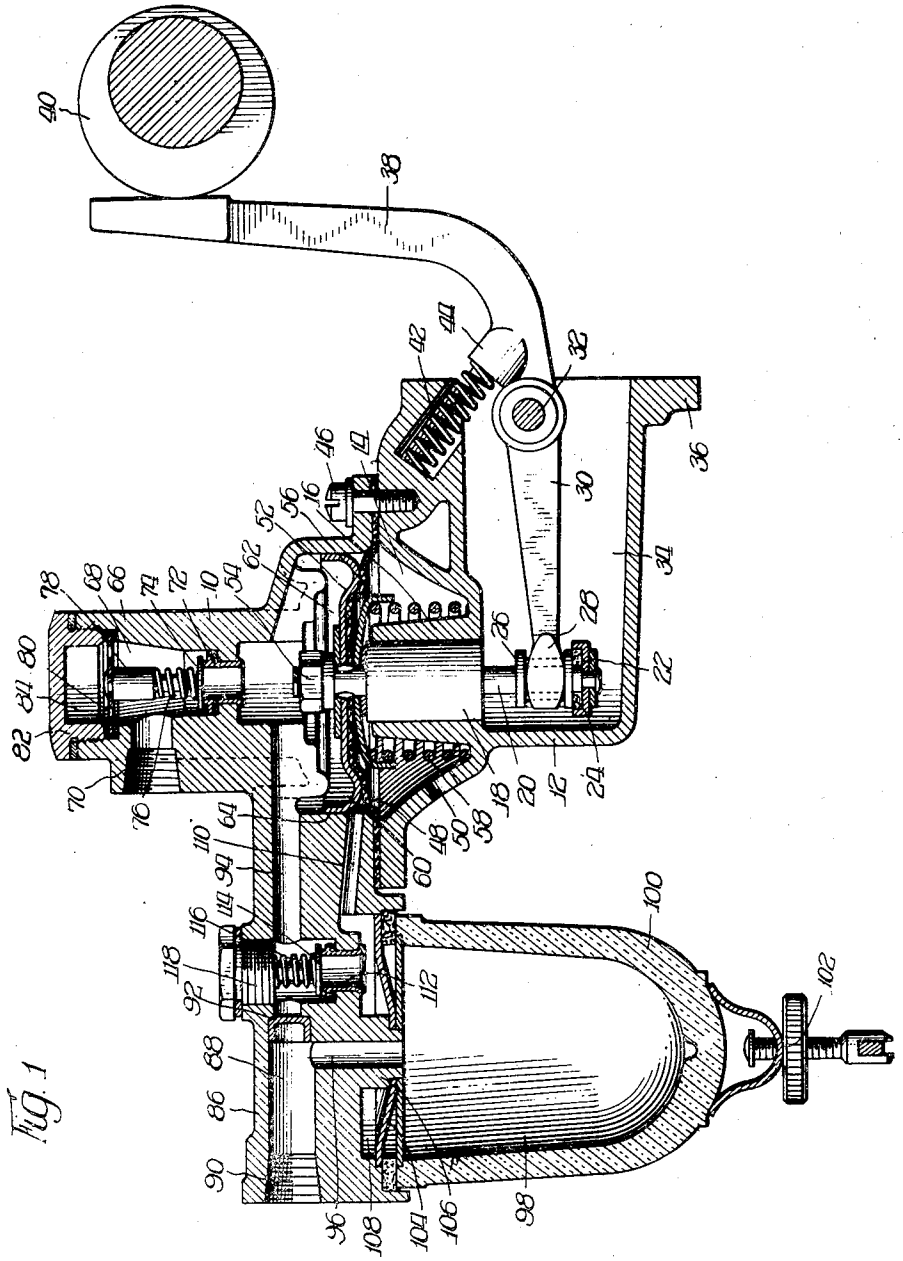


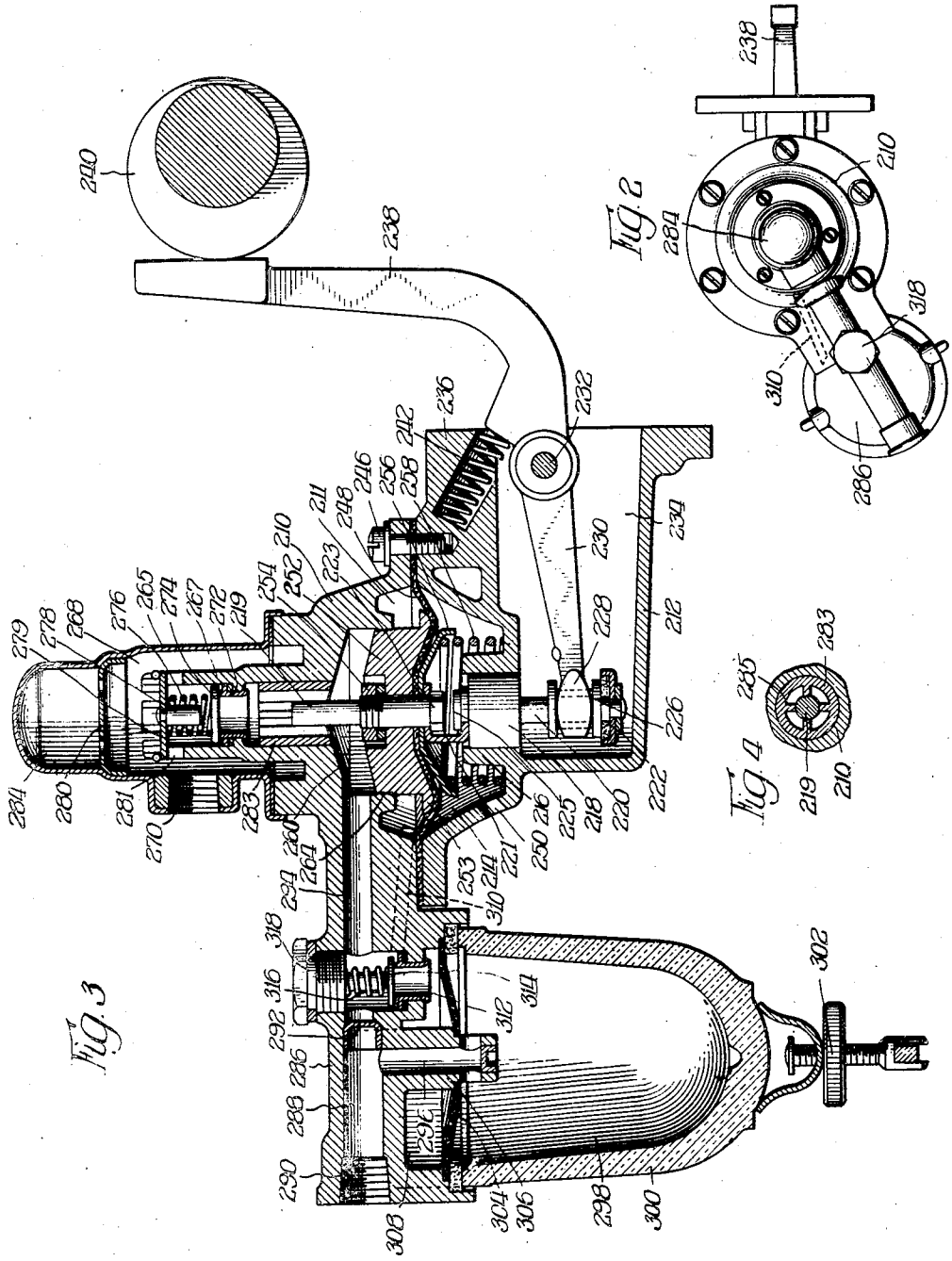
Fig. 1

Inventor:
Edward A. Rockwell,
By Wilkinson, Huxley, Byron & Knight
Attys.

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FUEL PUMP

Edward A. Rockwell, Chicago, Ill.

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Serial No. 501,503

5 Claims. (Cl. 103—154)

This invention relates to improvements in fuel pumps principally used for delivering fuel from a low level source of supply to the carbureter of an internal combustion engine.

Mechanically-driven diaphragm fuel pumps have been developed in which the diaphragm is positively moved for its suction stroke through a lever engaging a cam on the cam shaft within the engine casing and with resilient means for producing the discharge stroke whereby the delivery pressure is limited by the force of the resilient means. The lever which is pivotally carried by the pump casing has a lost motion connection to the stem of the diaphragm so that the lever has a constant stroke while the stem and diaphragm may have a variable stroke. Piston pumps have not been satisfactory for pumping fuel due to the difficulty of properly sealing the pump against leakage of the fuel but a piston pump has the advantage over the diaphragm pump in that the minimum capacity of the pumping chamber may be reduced from that required in a diaphragm pump. Therefore, a piston pump may be designed to have a more effective priming action and there is no loss of delivery through flexing of the diaphragm.

I have previously disclosed in my application, Serial No. 321,854, filed November 6, 1928, a construction of a fuel pump embodying a piston wherein the operating stem for the piston is sealed by a flexible diaphragm which is secured to the pump casing and to the stem.

In a later application, Serial No. 487,144, filed October 4, 1930, I have disclosed a further improvement consisting in the provision of means for sealing the operating stem for a piston against leakage by maintaining a predetermined reduction in pressure in a chamber within the pump casing between the piston and the guide bearing for the stem.

The present application involves certain improvements over the pump constructions disclosed in my earlier applications.

It has also been proposed to use in association with the fuel pump a fuel-receiving chamber into which the inlet line from the source of supply delivers and from which the fuel is drawn into the pumping chamber past the inlet check valve. The fuel-receiving chamber serves the purpose of a sediment-trapping chamber and a filter. The outlet from the sediment-trapping chamber is preferably open at a point below the top of the chamber and the inlet passage opens below the outlet passage whereby the production of a high suction in the pumping chamber serves to trap vacuum at the top of the fuel-receiving chamber which tends to maintain a continuous flow of fuel into the fuel-receiving chamber. During high delivery rates the vacuum trapped will be higher than during low delivery rates.

It is a purpose of the present invention to employ the source of trapped vacuum in the fuel receiving chamber, as above described, for increasing the effective force of the discharge spring at high delivery rates.

It is further a purpose of the present invention to employ a piston as the principal pumping member which is sealed by a flexible diaphragm and to mount the spring which produces the discharge strokes outside of the diaphragm so that the volume of the vacuum sealing chamber between the piston and the diaphragm is a minimum.

Further improvements of the present invention will be more readily apparent from the following description taken in connection with the attached drawings, in which

Figure 1 is a complete vertical section of a fuel pump with an associated fuel-receiving and sediment-trapping chamber with the present improvements of a piston and a sealing diaphragm;

Figure 2 is a plan view of a modification;

Figure 3 is a vertical section of the modified construction, and

Figure 4 is a detail horizontal section of a portion of Figure 3.

In Figure 1 the pump casing comprises an upper casing member 10 and a lower casing member 12. The lower casing part is formed in the usual manner with a recessed chamber 14 surrounding a cylindrical boss 16 which forms a guide bearing for a reciprocable stem 18. The stem 18 has a reduced lower end 20 having a stop 22 secured to its extremity which serves as a seat for a cushion 24. A spool collar 26 is slidable on the stem and is engaged by the yoke-shaped end 28 of a lever 30. The lever is carried by a pivot 32 within a lower cavity 34 of the casing member 12. The casing member 12 is preferably secured by its flange 36 adjacent an aperture in the engine casing. One arm 38 of the lever protrudes into the engine casing for engagement with a driving cam 40. During the active phase of the cam the lever is positively moved in a direction to move the stem 18 downwardly and is returned by a stiff spring 42 reacting between the casing part 12 and a boss 44 on the lever. The upper casing part 10 is clamped to the lower casing part 12 by means of bolts 46 and the flexible diaphragm 48 is clamped therebetween enclosing the cavity 14

in the lower casing part which is preferably provided with a vent opening 50 permitting atmospheric pressure to act in the chamber 14 at all times.

Instead of employing the diaphragm 48 as the principal pump member, a pressed-metal piston 52 is mounted immediately above the diaphragm 48 closely fitting the cylinder portion of the upper casing part. The piston 52 and diaphragm 48 are secured to the stem 18 by the nut 54 threaded on to the reduced upper end of the stem 18. A flanged disk 56 is supported immediately beneath the diaphragm 48 and a compression spring 58 is mounted surrounding the boss 16, reacting between the bottom of the cavity 14 and the disk 56 whereby the spring produces the discharge strokes of the diaphragm and piston. The pumping piston 52 is preferably formed with a substantially flat central portion and a downwardly recessed and upwardly flanged peripheral portion 60. The upwardly flanged portion cooperates with the pumping chamber 62 formed in the upper casing part 10 and may have circumferential saw teeth or threads 64 which tend to prevent leakage of the fuel past the piston during the discharge strokes.

The upper casing part 10 includes an upwardly directed cylindrical portion 66 having an upwardly flared substantially conical chamber 68 therein forming part of the outflow passage. A bored and threaded opening 70 leads laterally through the extension 66 into the chamber 68 and is intended to form a connection for the outlet pipe line. The lower end of the chamber 68 is bored for communication with a pumping chamber 62 and has provided therein a valve seat member 72. A check valve 74 is arranged to normally seat upon the upper end of the valve seat member 72 and is normally seated through means of a spring 76 surrounding the reduced lower end of a stem 78. The stem 78 is secured at its upper end to a perforated disk 80 held in place at the upper end of a chamber 68 by a threaded plug 82 having a downwardly facing cavity 84. The construction is such that vapors and gases in the fuel will be collected in the cavity 84 after passing through the perforated disk 80 while the fuel will be delivered laterally towards the outlet pipe line.

The upper casing part 10 is provided with an integral lateral extension 86 longitudinally bored to provide an inflow passage 88 which is threaded as at 90 for the connection of the inlet pipe line. The initial part of the bored passage 88 is separated by a plug 92 from the final portion 94 which communicates directly with the pumping chamber 62. The inflow passage 88 is in communication with the vertical passage 96 which delivers the fuel downwardly into a chamber 98 formed by a transparent cup 100, removably held by securing means partially shown at 102. The cup 100 serves to clamp a strainer disk 104 at its upper end which surrounds a boss 106 through which the passage 96 extends. The lateral extension 86 of the casing part 12 is preferably recessed to form a chamber 108 above the strainer and this chamber is placed in communication with the back side of the pumping piston 52 by means of a passage 110.

The outflow passage from the chamber 98 is through a valve seat member 112 upon which the inlet check valve 114 is normally seated by a spring 116 held in place by the threaded plug and pin 118 whereby the fuel, in passing the check valve 114 flows through the longitudinal passage 94 into the pumping chamber. The suction impulses produced in the pumping chamber tend to create a reduction of pressure in the chamber 108 and this action is described as trapping vacuum in the upper portion of the fuel-receiving chamber from the source of fuel supply.

Any fuel that might flow past the piston 56 will flow back into the receiving chamber through the passage 110. In this form any reduction of pressure transmitted through the passage 110 is subjected equally to the piston and the diaphragm since the cross-sectional areas of the movable portion are the same.

In the modification illustrated in Figures 2, 3 and 4, a piston and a sealing diaphragm are employed, as in the first modification, but the diaphragm is of larger area than the piston whereby a reduction of pressure in the space above the diaphragm serves to increase the effective force of the discharge spring and therefore to increase the maximum delivery of the pump at high speeds.

The construction in general is substantially the same as in Figure 1. The pump casing comprises an upper casing part 210 and a lower casing part 212. The lower casing part 212 has a recessed chamber 214 into which protrudes a central boss 216 forming a guide for a reciprocable stem 218. The stem 218 has a lower reduced end 200 with a stop 222 secured to the lower extremity and having slidable thereon a spool collar 226. The collar 226 is engaged by a yoke-shaped end 228 of a pivoted lever 230 carried by pivot 232 within the lower cavity 234 of the casing member 212. The casing member 212 is carried by flange 236 upon an engine casing adjacent an aperture thereof. One arm 238 of the lever protrudes within the engine casing for thrust engagement with the driving cam 240. The lever is maintained in thrust engagement with the cam during the inactive phase thereof by the stiff return spring 242.

The upper casing member 210 is clamped to the lower casing member 212 by means of bolts 246 and a flexible diaphragm 248 is clamped therebetween, enclosing the cavity 214 in the lower casing part. The chamber 214 has a vent opening 250 permitting atmospheric pressure to act in the chamber 214 at all times.

A solid piston 252 is mounted immediately above the diaphragm 248 and is secured to the stem 219 by nut 254. The stem 219 is separate from the stem 218 but is connected thereto by the yoke-shaped metal piece 221 engaging the stem 219 above the nut-shaped head 223 and having a slotted engagement with the stem 218 below the head 225. Due to the slotted connection by the yoke-shaped member 221, the stem 219 may be slightly out of alignment with the stem 218 to compensate for inaccuracies in construction. A flange disk 256 is carried by the stem 219 immediately below the diaphragm 249 and forms a seat for a compression spring 258 which reacts between the bottom of the cavity 214 and the disk 256 in order to transmit a discharge impulse to the diaphragm 248 and piston 252. The piston 252 cooperates with the pumping chamber 260 above the upper conical end of the piston 252. The lower end of the piston 252 has a downwardly convexed flange 253 which contacts the diaphragm 248 and takes up the slack during the suction stroke of the piston. The peripheral edge of the piston 252, adjacent its pumping face, may be formed with saw teeth or threads 264 which tend to prevent leakage of

the fuel past the piston during the intake strokes.

The casing part 210 has secured to its upper side a pressed metal cover 265 having a chamber 268 therein. A bored and threaded opening 270 leads laterally into the chamber 268 and forms a connection for the outlet pipe line. The pump casing part 210 protrudes into the chamber 268, as shown, by the extension 267 and has a flow passage therethrough including an outlet check valve 274 adapted to normally seat upon the upper end of the valve seat member 272 through the force of the spring 276 above the valve 274. The spring 276 surrounds a depending stem 278 carried by an imperforate disk member 279. The extension 267 has lateral flow openings 281 immediately beneath the disk member 279 which communicate with the chamber 268. The upper end of the pressed metal cover 265 has a dome-shaped chamber 284 closed at its lower portion by a perforated disk 280 which acts to separate the vapor from the fuel and trap the vapor in the dome 284, while the fuel is delivered towards the outlet pipe line. As shown in detail in Figure 4, the lower portion of the extension 267 includes therein a guide 283 having radial flanges 285 which guide the movement of the upper end of stem 219 and whereby the fuel may flow through the passages between the flanges 285.

The upper casing part 210 has an integral lateral extension 286 longitudinally bored to provide a flow passage 288 threaded as at 290 for connection to an inflow pipe line. The initial part of the flow passage 288 is separated from the final portion 294, which communicates with the pumping chamber by a plug 292. The inflow passage 288 is in communication with a vertical passage 296, which delivers the fuel downwardly into a fuel receiving chamber 298 formed by a transparent cup 300, removably held by securing means, partially held at 302. The cup 298 serves to support a strainer disk 304, surrounding a boss 306, through which the flow passage 296 extends. The bottom face of the casing extension 286 is recessed to form a chamber 308 above the strainer 304 and this chamber is in communication with the back side of the pumping piston 252 by means of the passage 310, as shown in Figure 3. The outflow passage from the chamber 308 is through a valve seat member 312 upon which the inlet valve 314 is normally seated by means of a spring 316 held in place by the threaded plug and pin 318. Fuel after passing the check valve 314 flows through the longitudinal passage 294 and into the pumping chamber.

It will be noted that the cross sectional area of the diaphragm is greater than the cross sectional area of the effective pumping area of the piston 252 and therefore a chamber 211 is formed above the diaphragm 248 which is in communication with the chamber 308, above the strainer disk through the passage 310. Any fuel that might leak past the piston into the chamber 211 during operation of the pump is directed through the passage 310 into the fuel receiving chamber and again sucked into the pumping chamber. At high speeds of operation of the pump, a high degree of vacuum may be maintained at the upper portion of the chamber 308 on the inlet side of the pump, which high degree of vacuum acts to constantly draw fuel into the fuel receiving chamber, while the fuel is intermittently sucked into the pumping chamber. The high degree of vacuum will also act in the chamber 211 and, therefore, tend to increase the effective force of the discharge spring which produces the discharge stroke of the piston. This is a desirable feature since maximum delivery of a variable stroke fuel pump having a compression spring for producing the discharge stroke is generaly limited by the strength of the spring and the spring cannot be any stronger than determined by the maximum shut-off pressure permitted. Therefore, the present means serves to increase the maximum delivery of the pump without increasing the shut-off pressure.

In the ordinary design of mechanically-driven diaphragm fuel pump the central portion of the diaphragm must be strengthened and the annular flexible portion should be as small as possible to provide for a sufficient delivery of fuel at high speeds of operation. According to my invention as disclosed herein, the heavy duty of pumping is taken care of by the solid piston while the flexible diaphragm can have a much larger annular flexible portion than the usual pumping diaphragm and since it is only subjected to suction, the diaphragm material can be made much thinner and will stand up longer than the pumping diaphragm which must withstand both suction and pressure.

It will further be understood that the feature of constructing the diaphragm with a larger cross sectional area than the face of the pumping member is advantageous when the suction connection is provided leading into the chamber between the pumping member and the diaphragm even though there may be no leakage past the pumping member since the suction acts to increase the effective force of the compression spring and to increase the delivery of fuel at high speeds.

It will be understood that although I have disclosed certain specific embodiments in my present invention, that many modifications and changes may be resorted to without departing from the spirit of my invention as expressed in the appended claims.

I claim:

1. In a fuel pumping system, a pump comprising a pump casing having a pumping chamber therein, an inflow passage leading to said pumping chamber, a solid piston forming a movable wall of said pumping chamber, a fuel receiving and sediment trapping chamber included in the inflow passage, an inlet check valve in the inflow passage beyond said trapping chamber, the top portion of said trapping chamber being above the opening of the inflow passage leading to said inlet check valve whereby a vacuum will be trapped therein, said pump casing having a chamber beneath the piston into which fuel may leak from the pumping chamber and a communicating passage between the top portion of said trapping chamber and said leakage-receiving chamber.

2. In a fuel pump, a casing having a pumping chamber therein, a solid piston cooperating with said pumping chamber, a flexible sealing diaphragm clamped to said piston adjacent the side opposite the pumping chamber, the cross sectional area of the movable portion of the diaphragm being greater than the cross sectional area of the effective pumping face of the piston, said casing having an annular chamber surrounding the piston and sealed by the diaphragm, said casing having a chamber on the side of the diaphragm opposite to the piston, resilient means in said last-mentioned chamber reacting upon said diaphragm and piston to produce the discharge stroke thereof and means for producing a reduction in pressure in the annular chamber

to assist the effective discharge force of the resilient means.

3. In a fuel pump, a casing having a pumping chamber therein, said chamber including a cylindrical portion, a solid piston closely cooperating with the cylindrical portion to form a movable wall of said pumping chamber, a flexible diaphragm clamped at its marginal edge to the casing adjacent the piston on the side opposite the pumping chamber, a reciprocable operating stem secured to the piston and diaphragm at the central portions thereof, a boss integrally formed with said casing forming a guide bearing for the operating stem, a resilient compression spring surrounding the boss and reacting upon the diaphragm and piston to produce the discharge strokes thereof, means for producing positive movement of said stem in a direction for suction and means brought into action through operation of said pump for producing a variable reduction in pressure between said piston and said diaphragm to variably assist the effective discharge force of the resilient compression spring.

4. In a fuel pump, a pump casing having a pumping chamber therein, a reciprocable pumping member forming a movable wall of said pumping chamber, a reciprocable stem for actuating said pumping member, resilient means for producing a discharge stroke of said pumping member, means for positively moving said stem in a suction direction against the resistance of said resilient means, said casing having a chamber on the opposite side of the pumping member from the pumping chamber, a flexible diaphragm sealing said last-mentioned chamber, said flexible diaphragm having an effective cross sectional area greater than said pumping member and means brought into action by the operation of said pump for producing a reduction of pressure in the chamber between the pumping member and the diaphragm to assist the effective discharge force of the resilient means.

5. In a fuel pump, a pump casing having a pumping chamber therein, intake and discharge passages in said pump casing, inlet and outlet check valves in said passages, a fuel receiving chamber in said intake passage on the intake side of the inlet check valve adapted to trap vacuum at the top portion thereof during operation of the pump, a reciprocable pumping member forming a movable wall of said pumping chamber, a reciprocable stem secured to said pumping member, a flexible diaphragm clamped at its marginal edge to said pump casing and secured at its central portion to said stem, the effective movable area of said diaphragm being greater than said pumping member, a chamber between said pumping member and said diaphragm, a passage placing said last-mentioned chamber in communication with the top portion of said fuel receiving chamber whereby operation of said pump tends to produce a reduction of pressure in the chamber between the pumping member and the diaphragm, a discharge producing spring reacting between said stem and said pump casing and intermittently operable means for moving said stem in a suction direction against the resistance of said spring.

EDWARD A. ROCKWELL.