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FUEL PUMP

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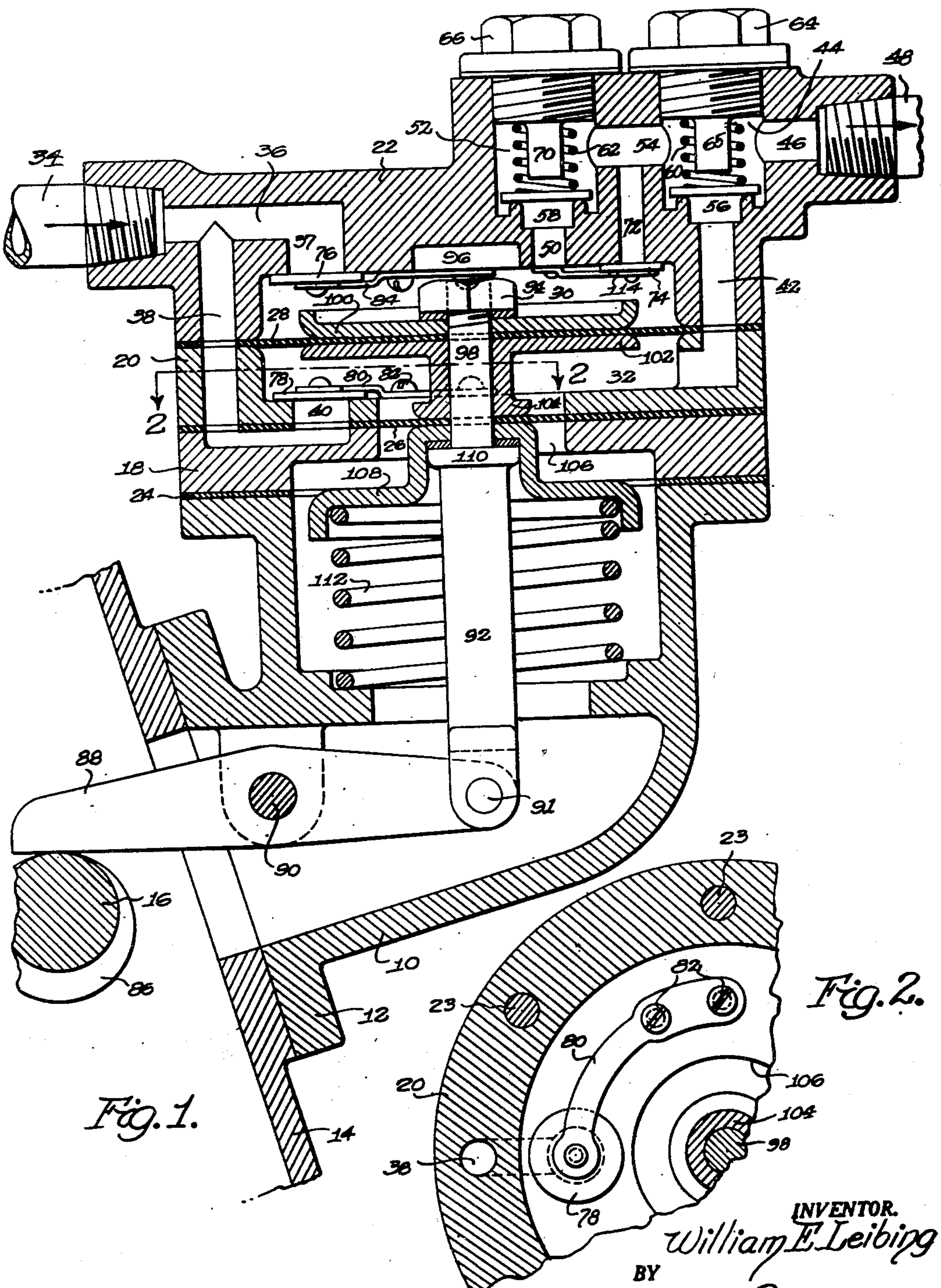

Fig. 1.

Fig. 2.

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FUEL PUMP

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9 Claims. (Cl. 103—150)

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This invention relates to fuel pumps, and more particularly to a fuel pump driven by an internal combustion engine for supplying gasoline or other fuel to the carburetor of the engine.

The invention is disclosed in the form of a fuel pump attached to an automobile or aircraft engine and actuated in one direction by the camshaft thereof, and in the other direction by means of a compression spring. The pump is so constructed as to pump fuel when operating in either direction, so as to maintain a constant flow of fuel even when the engine is operating at low speeds, as at cranking.

An object of the present invention is to provide a pump which supplies a constant flow of fuel at substantially constant pressure at all speeds of the engine.

A further object of the invention is to provide a double acting pump deriving its power from the engine to which it supplies fuel, and capable of maintaining the supply of fuel at very low engine speeds, such as would be developed in cranking a cold engine.

A further object of the invention is to provide an improved fuel pump capable of producing constant outlet pressure at extreme high speeds of the engine.

A further object is to provide a pump less subject to vapor lock than pumps of the prior art, and adaptable to automobiles and aircraft of standard design.

Further objects and advantages of the invention will be apparent from the following description, taken in connection with the appended drawings, in which:

Fig. 1 is a view in vertical section of a fuel pump embodying the invention; and

Fig. 2 is a fragmentary horizontal section taken on the line 2—2 of Fig. 1.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

The pump illustrated in the drawing comprises a casing having a base section 10 adapted to be secured by means of a flange 12 to the apertured wall 14 of an internal combustion engine adjacent a rotating shaft 16 of the engine, which may be the usual camshaft. The casing also comprises intermediate sections 18 and 20 and an upper sec-

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tion 22. The several sections of the casings are secured together by bolts 23, and are separated from each other by a gasket 24, a sealing diaphragm 26, and a pumping diaphragm 28. The diaphragms 26 and 28 are preferably formed of synthetic rubber or the like, and form gaskets between the adjacent casing sections. There are thus formed in the pump casing an upper pumping chamber 30 and a lower pumping chamber 32.

An inlet line 34 conveys fuel from the fuel tank (not shown) to the inlet side of the pump, and communicates with a passage 36 and port 37 leading to the chamber 30. The inlet line 34 also communicates with a passage 38 which extends downwardly through apertures in the diaphragms 28 and 26 to an inlet port 40 leading to the lower chamber 32. From the chamber 32 an outlet passage 42 extends upwardly through the diaphragm 28 to a valve chamber 44 and thence through a passage 46 to the outlet line 48, which leads to the carburetor or other fuel-utilizing device of the engine. Another outlet passage 50 leads from the upper pumping chamber 30 to a valve chamber 52, which communicates with the valve chamber 44 by means of a horizontal passage 54. The outlet passages 42 and 50 are controlled by check valves 56 and 58, yieldingly held in seated position by means of compression springs 60 and 62. The compression springs are held in compressed and alined position by means of plugs 64 and 66 threaded into the upper wall of the casing section 22, and provided with extensions 68 and 70 which extend within the springs 60 and 62 and limit the opening movement of the valves 56 and 58. A bypass 72 leads from the passages 54 to the upper chamber 30, and is controlled by a clapper valve 74.

The inlet ports 37 and 40 are controlled by clapper valves 76 and 78, which are similar, so that a description of one will serve for both. As shown in Fig. 2, the valve comprises a disc, indicated at 78, which is urged into a position to close the port 40 by means of a leaf spring 80 secured to the lower wall of the chamber 32 by means such as screws 82. The corresponding leaf spring of the valve 76 is indicated at 84. The springs 80 and 84 are weak, so as to permit the valves 76 and 78 to be moved to open position by mere vapor pressure when vapor lock occurs in the fuel line, and the valves 76, 78, 56 and 58 have a sufficiently accurate fit against their seats as to prevent substantial leakage of vapor or air, for a purpose hereinafter explained.

The driving mechanism of the pump comprises a cam or eccentric 86 mounted on shaft 16 and actuating a cam follower which consists of a lever 88 pivoted at 90 to the base section of the casing. The other end of lever 88 is pivoted at 91 to the lower end of a bifurcated stem 92 which extends upwardly in the casing and is secured by means of a nut 94 to the pumping diaphragm 28, a recess 96 being provided in the upper surface of the upper pumping chamber to permit vertical movement of the stem 92. The upper portion 98 of stem 92 is of reduced diameter and is threaded to receive the nut 94 as well as to receive a disc 100 and a hub member 102 which are mounted on opposite sides of the pumping diaphragm 28 to cause the same to move in symmetrical manner, as is known in the art. The lower portion 104 of member 102 extends into a central aperture 106 formed in sections 20 and 18 of the casing and bears upon the upper surface of the sealing diaphragm 26. A spring retainer 108 is mounted on a shoulder 110 on the stem 92 and is shaped to embrace the upper end of a compression spring 112, the lower end of which is seated in a recess in the base section 10.

The construction of the valve 74 is similar to that described in connection with the valves 76 and 78, except that the leaf spring 114 which controls valve 74 is stiffer, so as to offer considerable resistance to opening movement of the valve, and is so designed with relation to the desired pressure in the outlet line 48 that when the pumping diaphragm 28 is moving downwardly under the force of the eccentric 86, and fuel is flowing upwardly through passage 42 and past valve 56, the valve 74 will not open unless the pressure in the outlet line 48 exceeds a predetermined value for which the pump is set.

In operation, the shaft 16 will be rotated at a speed proportional to the engine speed, say one-half engine speed if the shaft is the engine camshaft, and the eccentric 86 will upon each rotation of the shaft produce clockwise rotation of the lever 88 about the pivot 90, drawing the stem 92 downwardly and causing the diaphragm 28 to force fuel out of the chamber 32 and into the valve chamber 44, unseating the valve 56. Of the fuel displaced from chamber 32, a sufficient quantity will enter the outlet line 48 to maintain the predetermined pressure therein, and any excess will pass through passages 54 and 72, forcing the check valve 74 open, and will flow into the upper pumping chamber 30. Such additional fuel as may be necessary to fill the expanding chamber 30 will flow from the inlet line 34 through passage 36 and past valve 76 into the chamber. When the stem 92 has completed its downward stroke, the eccentric 86 permits it to move upwardly under the influence of spring 112. This results in valve 76 closing and valve 78 opening, and the fuel is forced out through outlet passage 50, past valve 58, and through passages 54 and 46 to the outlet line 48. The valve 74 remains closed during upward movement of the stem 92, since the pressures on opposite sides of the valves are approximately equal. The pressure in the outlet line 48 is controlled by the stiffness of compression spring 112, which is so designed as to coordinate with leaf spring 114 in providing the desired pressure at the carburetor or other fuel utilizing device of the engine. The stem 92 and diaphragm 28 will continue to move upwardly until the eccentric 86 has returned to a position wherein it again contacts lever 88, whereupon the direction of movement of the stem and diaphragm is reversed. Normally this reversal will occur before the stem has completed its upward stroke, with the result that the movement in each direction will be less than the full stroke for which the pump is designed. However, by reason of the construction of the diaphragm and the driving mechanism therefor there is very little lost motion involved in a reversal in the direction of the pump, and the pump will continue to operate even at very high speeds of the engine and very short strokes of the stem.

When the engine is cold and is being cranked preparatory to starting, the action of the pump is critical because a considerable excess of fuel is required to produce a starting condition, while the ouput of the pump in quantity of fuel per unit time is under these conditions at a minimum. However, a pump constructed in accordance with the disclosure herein will supply adequate quantities of fuel under such conditions, since it produces a flow of fuel continuously while moving in either direction, and because of the absence of lost motion or hysteresis upon reversal in the direction of movement of the stem 92. Another factor is the fact that the force required to actuate the stem 92 in the upper direction does not vary greatly with extremely low temperatures, since there are no bearings involved in the pump proper, and the sealing diaphragm 26 does not vary greatly in its resistance to movement with decrease in temperature.

As above noted, the springs 80 and 84 holding valves 78 and 76 in seated position are weak, so that the valves will be opened and closed by gaseous pressures even through the inlet line 34 contains not liquid but only fuel vapor or air, as will be the case where vapor lock develops or where the engine has exhausted its fuel supply before the fuel tank is refilled. However, by reason of the form of the valves 76 and 78 and 56 and 58 the pump will function to pump air or vapor until fuel, drawn through the inlet line 34 by suction, again enters the pumping chambers.

It is contemplated that the pump disclosed herein may be used in supplying fuel to a carburetor of the type disclosed in the application of William E. Liebing and Robley D. Fageol, Serial No. 489,882, filed June 7, 1943, now Patent 2,443,464, issued June 15, 1948, in which fuel is supplied to a carburetor under constant pressure, and admitted to the induction passage of the carburetor at a rate controlled by a valve which is opened and closed in accordance with the rate of air flow through the induction passage.

Although the invention has been described with particular reference to a single embodiment thereof, it may be modified in various forms within the skill of artisans in this art, and is therefore not to be limited to the form disclosed nor otherwise except in accordance with the terms of the following claims.

I claim:

1. A fuel pump for an internal combustion engine comprising a casing formed of a plurality of superposed metallic sections forming a recess, a flexible member interposed between adjacent sections and dividing said recess into two pumping chambers, an aperture leading from one of said chambers to the exterior of the casing, a flexible diaphragm of less cross sectional area than said flexible member closing said aperture, an actuating member extending through said aperture and secured to said flexible member and said diaphragm, means energized by the engine for moving said actuating member positively in one direction and yieldingly in the opposite direction to alternately decrease the volume of the

respective chambers, an inlet and an outlet line each having connections to each of said chambers, and a pressure controlled bypass from the outlet line to one of said chambers.

2. A fuel pump for an internal combustion engine comprising a casing adapted to be secured to the engine and made up of two mating sections forming a recess, a flexible member interposed between said sections and dividing said recess into two pumping chambers, an aperture in one of said sections of smaller cross sectional area than said chambers, a flexible diaphragm closing said aperture, an actuating member in said aperture secured to said diaphragms, means energized by the engine for reciprocating said actuating member positively in one direction and yieldingly in the opposite direction to alternately compress fluid in said chambers, said means including a calibrated compression spring, inlet and outlet connections having branches leading to each of said chambers, and a pressure controlled bypass from the outlet connection to one of said chambers.

3. A fuel pump mechanism for an internal combustion engine comprising a casing formed in three sections with an internal recess, flexible members interposed between said sections to form in said recess a pair of pumping chambers separated from each other by one of said flexible members, the other of said flexible members forming a sealing member for one of said pumping chambers, inlet and outlet passages communicating with each of said pumping chambers, engine driven means for moving said first mentioned flexible member in one direction to decrease the volume of one of said chambers, a calibrated compression spring for moving said first mentioned resilient member in the opposite direction to decrease the volume of the other of said chambers, a bypass leading from the outlet of said one chamber to said other chamber, and a calibrated check valve controlling said bypass.

4. A fuel pump comprising a casing formed of two mating sections forming a recess, a flexible diaphragm interposed between said sections to form a gasket and to divide said recess into two pumping chambers, an aperture in one of said sections, a flexible diaphragm closing said aperture, an actuating member secured to said diaphragms, means for reciprocating said actuating member to alternately compress fluid in said chambers, inlet and outlet connections to each of said chambers, and a bypass from one of said chambers to the other controlled by a check valve.

5. The invention defined in claim 4, including rigid plates secured to said actuating member and embracing the central portion of said first mentioned diaphragm to limit flexing thereof to the portion lying radially outwardly of said plates.

6. A fuel pump for an internal combustion engine comprising a casing made up of two mating sections forming a recess, a flexible member interposed between said sections and dividing said recess into two pumping chambers, an aperture in one of said sections of smaller cross sectional area than said chambers, a flexible diaphragm closing said aperture, an actuating member in said aperture secured to said diaphragms, means energized by the engine for reciprocating said actuating member positively in one direction and yieldingly in the opposite direction to alternately compress fluid in said chambers, inlet and outlet connections to each of said chambers, and a pressure controlled bypass from the outlet connection of one of said chambers to the other of said chambers.

7. A fuel pump for an internal combustion engine comprising a casing formed of a plurality of superposed sections forming a recess, a movable member interposed between adjacent sections and dividing said recess into two pumping chambers, an aperture leading from one of said chambers to the exterior of the casing, a flexible diaphragm closing said aperture, an actuating member extending through said aperture and secured to said movable member and said diaphragm, means energized by the engine for moving said actuating member positively in one direction and yieldingly in the opposite direction to alternately decrease the volume of the respective chambers, inlet and outlet connections to each of said chambers, and a pressure controlled bypass from the outlet connection of one of said chambers to the other of said chambers.

8. A pump mechanism comprising a casing made up of three superposed sections and forming a recess, a movable partition forming a gasket between two of said sections and dividing said recess into two pumping chambers, inlet and outlet passages communicating with each of said chambers, check valves in said inlet and outlet passages, said check valves being designed to be actuated by and to control gaseous flow through said passages, resilient means for moving said partition in one direction to decrease the volume of one of said chambers, positive means for moving said partition in the opposite direction to decrease the volume of the other of said chambers and to store energy in said resilient means, a bypass leading from the outlet of said one chamber to said other chamber, a check valve controlling said bypass, and a flexible member interposed between two of said sections and constituting a sealing member to prevent leakage from said other pumping chamber.

9. A fuel pump comprising a casing provided with a recess having opposite plane parallel walls, a movable partition dividing said recess into two pumping chambers, inlet and outlet passages communicating with each of said chambers and terminating in ports in said walls, leaf springs fixed to said walls, valve members on said springs cooperating with said ports to form check valves for said inlet passages, resilient means for moving said partition in one direction to decrease the volume of one of said chambers, positive means for moving said partition in the opposite direction to decrease the volume of the other of said chambers and to store energy in said resilient means, a bypass leading from the outlet of said one chamber to said other chamber, and a check valve controlling said bypass.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
44,978	Rowe	Nov. 8, 1864
1,811,557	Ove	June 23, 1931
1,982,966	Schweisthal	Dec. 4, 1934
2,139,346	Babitch et al.	Dec. 6, 1938
2,381,259	Coffey	Aug. 7, 1945