

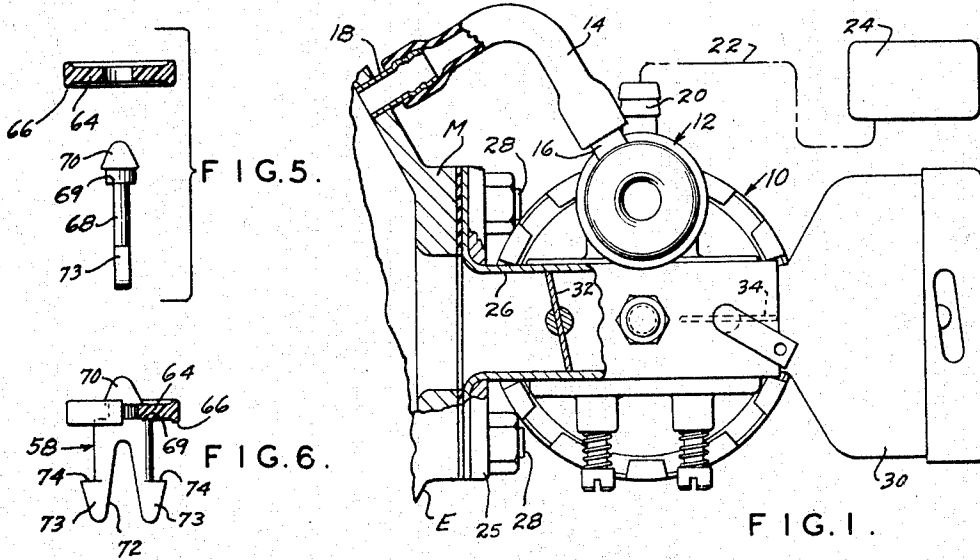
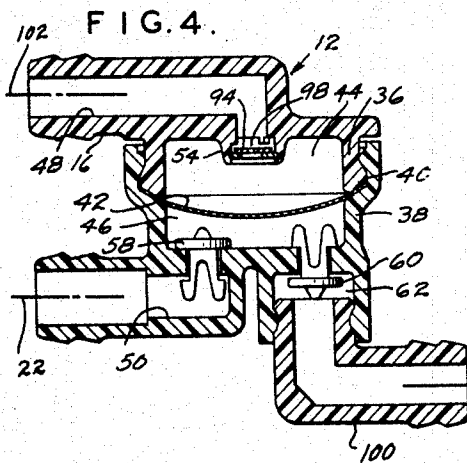
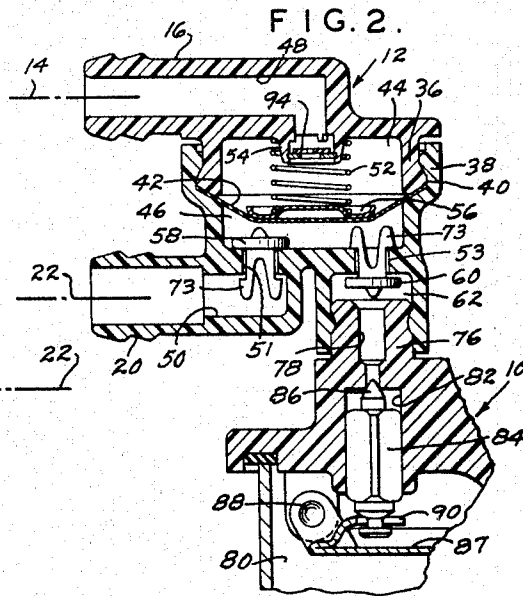
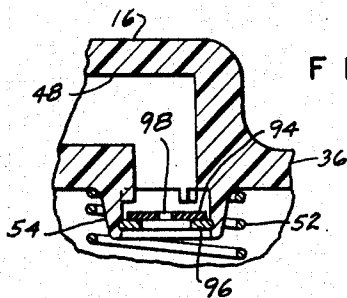
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VALVE STRUCTURE

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VALVE STRUCTURE

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Original application Nov. 26, 1962, Ser. No. 239,898, now Patent No. 3,182,601, dated May 11, 1965. Divided and this application Jan. 11, 1965, Ser. No. 424,862
1 Claim. (Cl. 137—533.17)

This is a division of application Serial Number 239,898 filed November 26, 1962, now Patent No. 3,182,601, dated May 11, 1965.

The invention is directed to a fuel pumping device for small carburetors, and particularly to valve means for regulating the flow of fuel through the pumping device.

Many inexpensive small internal combustion engine installations comprise a source of fuel consisting of a fuel tank supported above the engine in order that the fuel to the engine can be gravity fed. However, since this is not an entirely satisfactory manner to supply fuel to the engine because of variations in fuel level, small diaphragm fuel pumps have been devised which can be added to the fuel system by mounting the pump wither on the carburetor or somewhere in the fuel line between the carburetor and the source of fuel. Such fuel pumps consist of a small diaphragm forming a pair of chambers within a housing, one on either side of the diaphragm. One chamber is connected directly to the crankcase of the internal combustion engine, if it is a two cycle engine, or to the intake manifold in a four cycle engine installation. The other chamber in the housing is the pumping chamber for the fuel and is connected through check valve passages to the source of fuel and to the carburetor. Pulsations provided by the engine during operation reciprocate the pump diaphragm to pump fuel from the source into the carburetor.

In four cycle engine installations of such a pump, it has been found that when the air chamber of the pump is connected to the engine manifold, the suction or negative pressures provided by the engine are ample, but the positive pressures provided to the pumping diaphragm under certain operating conditions are relatively small. For example, in four cycle engines as the speed increases so does the positive pressure, but at low speeds the positive pressure is of a small value, in the order of one inch of water pressure. It is desirable in pumps and fuel systems of this type that the fuel furnished to the carburetor be maintained at a constant pressure in the fuel line so that, with proper adjustments at the carburetor, the supply of fuel will be constant and will not be dependent upon the speed of operation of the engine. Because of low positive pressure at low speeds in four cycle operation, it is necessary to provide an additional means for aiding the pump to maintain a constant fuel pressure at all speeds.

In two cycle installations of a small diaphragm pump, the air chamber is normally connected to the engine crankcase and the air pressure pulsations created in the crankcase by movement of the piston backward and forward provide the positive and negative pressures in the pumping chamber. For example, on the intake stroke of the piston, the air in the crankcase is compressed and provides a positive pressure to drive the pump. Upon the exhaust and compression stroke of the engine, negative pressure is created in the crankcase and provides the suction required to move the pump diaphragm in a suction stroke. The value of the pressures created in the crankcase is related to the position of the carburetor choke and throttle.

The positive pressures in the crankcase of two cycle engines may vary from three pounds to ten pounds per

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square inch, while the negative pressure applied to the pump diaphragm vary from two inches of water pressure at wide open throttle to four to six inches of water pressure at low speeds. Because of the great differences between the positive and negative engine pressures, the pump action is erratic in that the negative pressure often is insufficient to pull the diaphragm in a fuel suction stroke before the high positive pressures drive the pump in a pumping stroke. This results in inefficient pump operation since the suction strokes are small and little fuel is pulled from the source through the pump.

It is thus an object of the invention to provide a small diaphragm fuel pump for an internal combustion engine and having valve means therein, which will provide a constant positive pumping stroke in a four cycle installation.

It is another object of this invention to provide a diaphragm fuel pump embodying a novel valve arrangement to control the flow of fuel therethrough.

Other objects not specifically set forth will be clear to those skilled in the art from the accompanying description and the claim appended thereto.

The installation is in a small diaphragm pump for both four cycle and two cycle operation. When the pump is used in a four cycle engine, a spring is provided in the air chamber of the pump to drive the pump in a pumping stroke. The spring is loaded by the negative pressures in the intake engine manifold which are sufficient to fully load the spring. Because the positive pressures in the intake manifold are small and variable, these pressures are effectively eliminated from pump operation and the spring is utilized to provide a uniform pumping stroke. In two cycle operation of the pump, a valve structure is provided having a controlled aperture therein so that the high positive pressures available in two cycle operation are reduced and the variation in positive pressure is evened out under all conditions of engine operation. This provides an operative positive pressure for the pump and one which is not excessive to adversely affect pump operation. In two cycle engine operation as the negative pressures are relatively less, the valve structure opens completely to provide the full application of the negative pressures to operate the pump diaphragm during engine operation.

FIGURE 1 is a plain view of a fuel system comprising a carburetor attached to the manifold of an engine with the fuel pump installed on the carburetor and connected to a source of fuel.

FIGURE 2 is a partial sectional view of the novel pump structure and the associated carburetor of FIGURE 1.

FIGURE 3 is an enlarged partial sectional view of the pump structure shown in FIGURE 2.

FIGURE 4 is a sectional view in elevation of a modification of the pump of FIGURE 2 for two cycle installation.

FIGURES 5 and 6 are detailed views of the valve structures used in the pumps of FIGURES 1 through 3.

FIGURE 1 discloses a fuel system utilizing the invention. A carburetor indicated at 10 is mounted upon the intake manifold M of an internal combustion engine E, which in this particular showing is a four cycle engine. A fuel pump 12, in accordance with the invention, is mounted on the carburetor and is connected by a flexible tubing 14 from a nipple structure 16 to a fitting 18 to provide an air conduit between the engine intake manifold and the pump 12. Another laterally extending nipple structure 20 is connected by a fuel line 22 to a source of fuel, such as a fuel tank 24 schematically shown. The carburetor is of a known type and consists mainly of a tubular air and fuel mixture conduit 26 attached by a flanged end 25 to the engine manifold, such as by stud 28 extending from the engine block. At the other end, an

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air filter housing 30 provides an opening to the mixture conduit 26. Within the filter housing 30 is a porous filter for removing dust and other particles from the air entering the carburetor. Within the carburetor are rotatably mounted a throttle valve structure 32 and a choke valve structure 34 to control the flow of air through the carburetor. Other details of the carburetor are well known and are not shown nor need be described at this time.

Carburetor 10 is operated in a conventional manner to permit air flow into the engine manifold and to mix with the air a controlled amount of fuel to provide the proper combustible air and fuel mixture. Details of the fuel pump 12 are shown more specifically in FIGURE 2. The pump 12 consists essentially of a pair of cylindrical cups 36 and 38 whose rims are telescoped together with a groove and rim connection. When the rim of cup 36 has a rib 40 fitted into a groove formed around the rim of cup 38, rib 40 snaps into the groove of cup 38 to provide a tight fit. A diaphragm 42 is positioned between cups 36 and 38 so that when they snap together the peripheral edge of diaphragm 42 is sealed between the adjacent cup portions as shown in FIGURE 2. Diaphragm 42 is of any appropriate material such as a fabric coated with a fuel resistant synthetic rubber material to provide sufficient flexibility and strength. Diaphragm 42 forms with cup 36 an air chamber 44 and with cup 38 a fuel pumping chamber 46. Nipple 16 extends laterally from the top of cup 36 while the nipple 20 extends laterally from the bottom portion of cup 38. Nipple 16 is formed with a passage 48 therethrough which connects air chamber 44 with a flexible tubing 14 to the manifold M of the engine. In a similar manner, a fuel inlet passage 50 extends through the nipple 20 to connect the fuel chamber 46 with the fuel line 22 leading from the fuel tank 24. A spring 52 is positioned between a short hollow boss structure 54 extending from the top of cup 36 at one end and at the other fits in a dished plate 56 supported by the diaphragm 42.

An inlet valve structure 58 is inserted in a short portion 51 of passage 50 leading into the chamber 46, and in a similar manner an outlet valve structure 60 is fitted within a short outlet passage 53 through the bottom of cup 38 connecting the chamber 46 with an outlet chamber 62.

The valve structures are shown in detail in FIGURES 5 and 6 and consist of a small disk 64 made of synthetic fuel resistant material, such as an acetal resin. Disk 64 has a central aperture therethrough and a rim structure 66 extending from the two flat surfaces thereof. A plastic molded valve stem 68 has a rounded conical head 70 at one end having a flanged portion abutting one surface of disk 64. A flanged shoulder portion 69 of stem 68 abuts the other surface of disk 64 to tightly hold disk 64 to stem 68. The stem 68 is bifurcated at 72 by an elongated slot extending longitudinally of the stem and opening at the end thereof opposite to said disc to form a pair of legs 73. Each of the legs 73 is deflectible into the elongated slot and is formed with a projecting surface 74 extending radially from the stem longitudinal axis and overlying the shoulder formed at the chamber inlet port. The valves are mounted within the pump structure by inserting the valve washer 64 over the respective fuel passage 51 or 53 and then inserting the head 70 of the valve stem 68 through the fuel passage and the aperture of the valve washer 64. The flanged portions of head 70 lock the valve stem 68 to the washer on one side, while the projecting leg portions 74 of the valve stem project beyond the diameter of the fuel passage to lock the valve structure within the fuel passage at the other end. FIGURE 2 shows the assembled position of the valve in the inlet passage 51 and outlet passage 53 of the fuel pump.

In FIGURE 2, the fuel pump 12 is installed on the carburetor 10. The outlet chamber 62 of the fuel pump consists of a cylindrical recess which can be snapped

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over a projecting apertured boss 76 extending upwardly from the body of the carburetor 10. The boss 76 has an inlet passage 78 which is connected with the inside of a fuel chamber 80 through a valve passage 82. A carburetor needle valve 84 is positioned within the valve passage and has a tapered end 86 for blocking fuel flow from the inlet passage 78. The valve 84 of the carburetor may have a triangular or rectangular section and is mounted for sliding movement in the cylindrical passage 82. Valve 84 is operated by a lever 87 pivoted at 88 and has a lever arm 90 locked to the inlet valve 84 for its operation. Lever 87 can be moved by either a float structure or a diaphragm in the fuel chamber 80 to open and close the valve 84.

In the installations shown in FIGURES 1 and 2, the pump 12 is connected to the manifold of a four cycle internal combustion engine. The effective positive pressures within the manifold of such an engine during operation are not of such value to be relied upon for pump operation. The negative pressures are those provided during the intake stroke of the piston and may vary from a negative pressure of 8 to 10 inches of mercury at closed and partially open throttle to a negative pressure of two to ten inches of water at wide open throttle. During engine operation at low speeds, the negative pressure will move the diaphragm 42 upwardly in a fuel suction stroke and thus load the diaphragm. However, the positive pressures, at any speed, are normally so small that insufficient pressures are provided to force the diaphragm downwardly in a pumping stroke, as viewed in FIGURE 2. Therefore, in accordance with this invention, a spring 52 is provided in the air chamber 44 of the fuel pump to aid in the pumping stroke of the engine. Since the negative pressures are more than sufficient to pull the diaphragm upwardly in a suction stroke the spring 52 is selected so that it may be adequately loaded by the negative pressures. The action of the spring then is such that, during the positive cycle of the pump, the spring will aid in the positive pressures available to force the diaphragm downwardly in a pumping stroke. The spring provides at all times a constant pumping pressure for the fuel in chamber 46 so that at no time during engine operation will the pumping stroke be deficient in forcing fuel to the carburetor.

An alternate structure is shown in the pump of FIGURES 2 and 3 in the form of a small valve disk 94, which rests on a valve seat 96. A small central aperture 98 is formed through the valve disk 94. The purpose of the valve 94 is to substantially eliminate positive pressures from acting on the pump diaphragm because of their undependability and thus rely for pump action only on the negative pressures and the spring bias. The operation of the modification of FIGURES 2 and 3 is such that under negative pressures the valve 94 opens and allows the chamber 44 to be partially evacuated. The negative pressure is sufficient to draw the diaphragm upwardly, as viewed in FIGURES 2 and 3 and to load the spring 52. Upon application of positive pressures, however, the valve 94 is closed and the positive pressures have little or no value in aiding the diaphragm in its downward or pumping stroke. This is provided by the spring 52 alone, although it is within the concept of this invention that the aperture 98 in the valve disk 94 may be adjusted to enable the positive pressures to aid the spring, if desired. Otherwise, the presence of the aperture 98 enables the flow of air into the chamber 44 as the diaphragm is pressed downwardly in the pumping stroke. In this case aperture 98 should be large enough to not retard the diaphragm in the discharge stroke.

FIGURE 4 shows a modification of the pump disclosed in FIGURES 2 and 3. Structures identical to those in FIGURES 2 and 3 are given the same reference numerals. The pump of FIGURE 4 is shown as mounted on a fitting 100 instead of on a carburetor. Fitting 100 may be placed anywhere in the line 22 from the tank 24 to the

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carburetor 10. For example, the pump could be mounted directly on the engine for ease of installation. In this modification of FIGURE 4, the spring 52 of the pump of FIGURE 2 is eliminated and the valve disk 94 is retained. For operation with a two cycle engine, the air passage 48 is connected by a flexible air conduit, schematically shown at 102, to the crankcase of the engine. In two cycle operation, the positive pressures provided in the crankcase occur during the downward stroke of the piston in its power and intake stroke. The pressures in the crankcase build up from a value around three pounds per square inch, for example, at low speed operation of the engine around 2,000 r.p.m. to ten pounds per square inch pressure at high engine speeds around 10,000 r.p.m. These pressures are more than sufficient to operate the pump diaphragm 42 in its pumping stroke. However, if the variable high positive crankcase pressures are applied directly to the fuel through the diaphragm 42, the corresponding variable fuel pressures, which result, are difficult to control by the fixed adjustments in the carburetor. For example, excessively high positive pressures in the pump chamber 44, at high speed operation of the engine, would force an excessive amount of fuel into the carburetor chamber 80 causing the carburetor to go rich. This would result either an inefficient operation of the engine or to stop the engine completely. A constant fuel pressure at the carburetor is one which can be adjusted for by the manual carburetor adjustments to provide a consistent flow of fuel to the engine at all speeds of engine operation. Accordingly, it is desirable that these variable high positive pressures be reduced to a substantially constant positive pressure so that fuel delivered to the carburetor will also remain substantially at a fixed value for all conditions of engine operation.

In two cycle operation, the negative pressures in the crankcase provided by the compression and exhaust stroke of the engine are relatively small in comparison to the positive pressures. For example, at low engine speeds around 2,000 r.p.m. the negative pressures may be between five or six inches of mercury. At high engine speed around 10,000 r.p.m., the negative pressure falls to less than 2 inches of mercury at wide open throttle. These low negative pressures are often insufficient to properly load the diaphragm 42 for its intake stroke when high positive pressures must first be eliminated from the pumping chamber and the pumping diaphragm pulled upwardly to its fullest extent.

Therefore, also in accordance with the invention, the valve disk 94 of FIGURE 4 operates to close the air passage 48 of the pump during the positive pulse of engine operation in the manner described above relative to the pump of FIGURES 2 and 3. The aperture 98 in the disk 94 is provided with a size such that sufficient air will flow through the valve 94 into the air chamber 44 to provide the positive pumping stroke of the diaphragm 42. The size of the aperture, for example, may be around $\frac{1}{32}$ ". The action of the valve 94 is such as to level off and dampen the positive pulses applied to the diaphragm chamber 44 so that for most of the engine operation, the positive pressure in pump chamber 44 is at a consistent four or five pounds per square inch. This pressure is not excessive and the negative pulse then is able to clear the chamber 44 quickly enough to permit fuel pressure in chamber 46 to return the diaphragm 42 to its uppermost position for a pumping stroke.

Thus, by eliminating the high positive pressures applied to the diaphragm a more efficient pump action is provided, since the negative pressures are now sensed to

a greater degree within the air chamber 44 than when coupled with excessively high positive pressures. Furthermore, by providing a consistently constant positive pressure for the pumping stroke of the pump, the fuel pressure delivered from the pump is at a constant pressure. This permits the carburetor inlet valve control to operate consistently and retain fuel within the carburetor fuel chamber 80 at a constant value.

What is claimed is:

For use in a pump having an elongated valve chamber with opposed port openings including a port having a peripheral stop and an opposite port having an annular valve seat,

(A) a plastic valve assembly received in said elongated chamber for limited reciprocable movement therein including:

- (1) a resilient disc having opposed surfaces,
- (2) a central aperture formed through said disc, and
- (3) a rim at the peripheral edge of said opposed surfaces,
- (4) a valve member including an elongated valve stem having a flat body portion and an integral conical head having a maximum diameter slightly greater than the central aperture in said disc,
- (5) a cylindrical section inward of and adjacent said conical head having a diameter less than said head maximum diameter, and extending coaxially from said head thereby forming a peripheral annular step,
- (6) shoulders extending outwardly at diametrically opposite sides of said valve member and at the juncture of said cylindrical section and said flat body portion, said shoulders being spaced longitudinally from said step,
- (7) an elongated slot formed in said flat body and opening at the opposite end thereof remote from said conical head, thereby defining a pair of spaced apart legs,
- (8) a lateral projection formed at each outer end of each of said respective legs and extending outwardly thereof,
- (9) said disc being received on said valve stem, having its central aperture in registry with said cylindrical section of said stem, whereby opposed surfaces of said disc are in abutment with said step and said shoulder to position said disc on said valve stem,
- (10) said valve stem being slidably guided in said elongated valve chamber whereby said disc rim is in overlying relationship with said valve seat and said lateral projections formed at the outer surface of each respective leg, overlies the peripheral stop, thereby slidably retaining said valve assembly in said elongated valve chamber.

References Cited by the Examiner

UNITED STATES PATENTS

60	141,309	7/1873	Barnes	137—533.17
	548,835	10/1895	Lafferty	137—533.17
	1,920,146	7/1933	Hueber et al.	103—150 X
	2,039,933	5/1936	Rupert	251—233
	2,564,023	8/1951	Miller	137—533.17
65	2,980,032	4/1961	Schneider	103—150

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