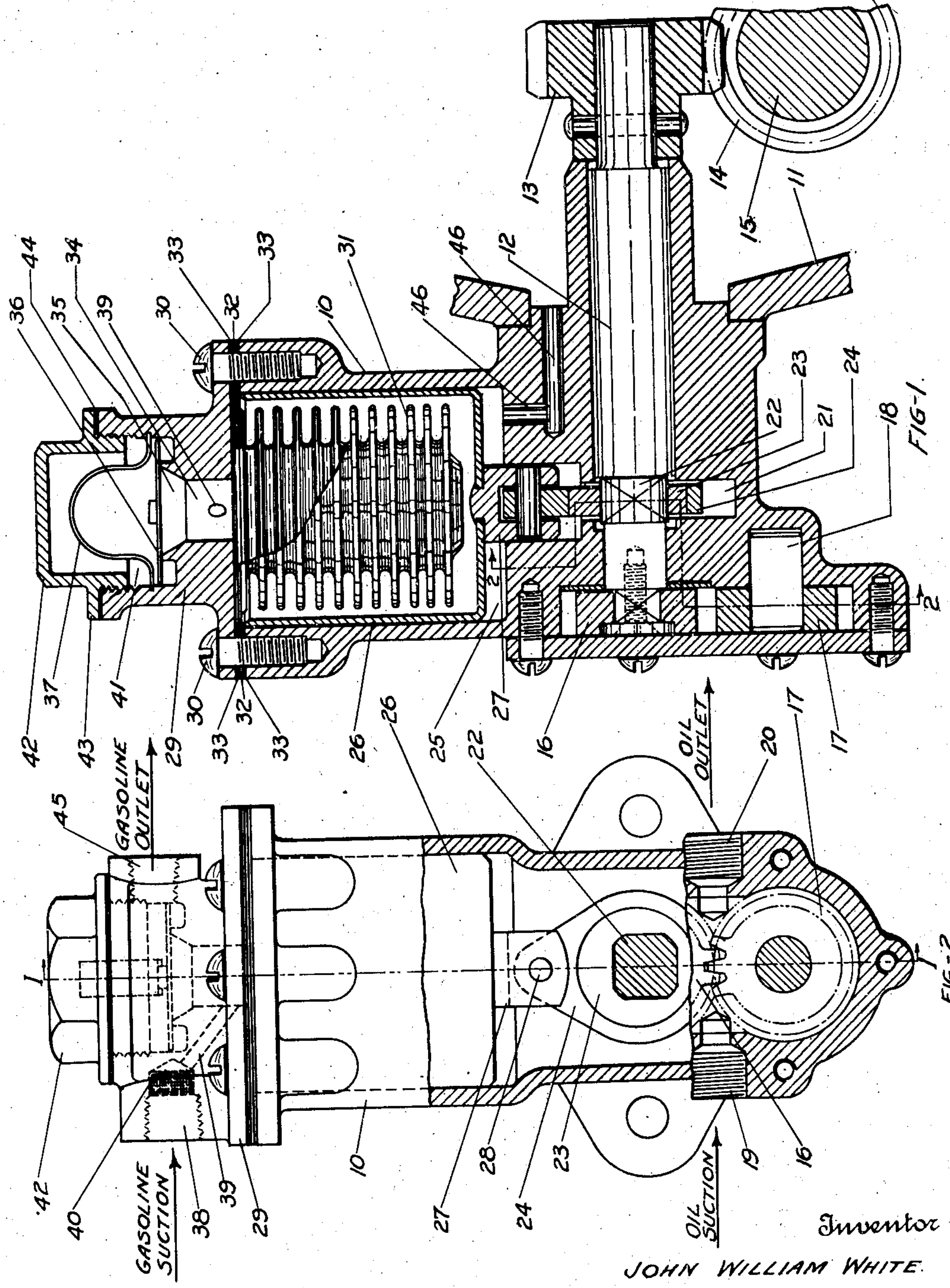
Dec. 25, 1928. 1,696,825

J. W. WHITE

FUEL PUMP

Filed Feb. 19, 1924 3 Sheets-Sheet 1



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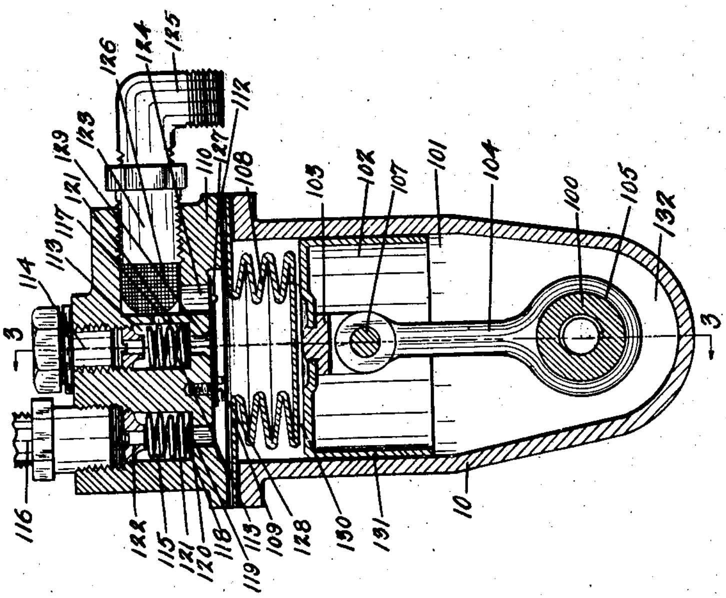

FIG. 4

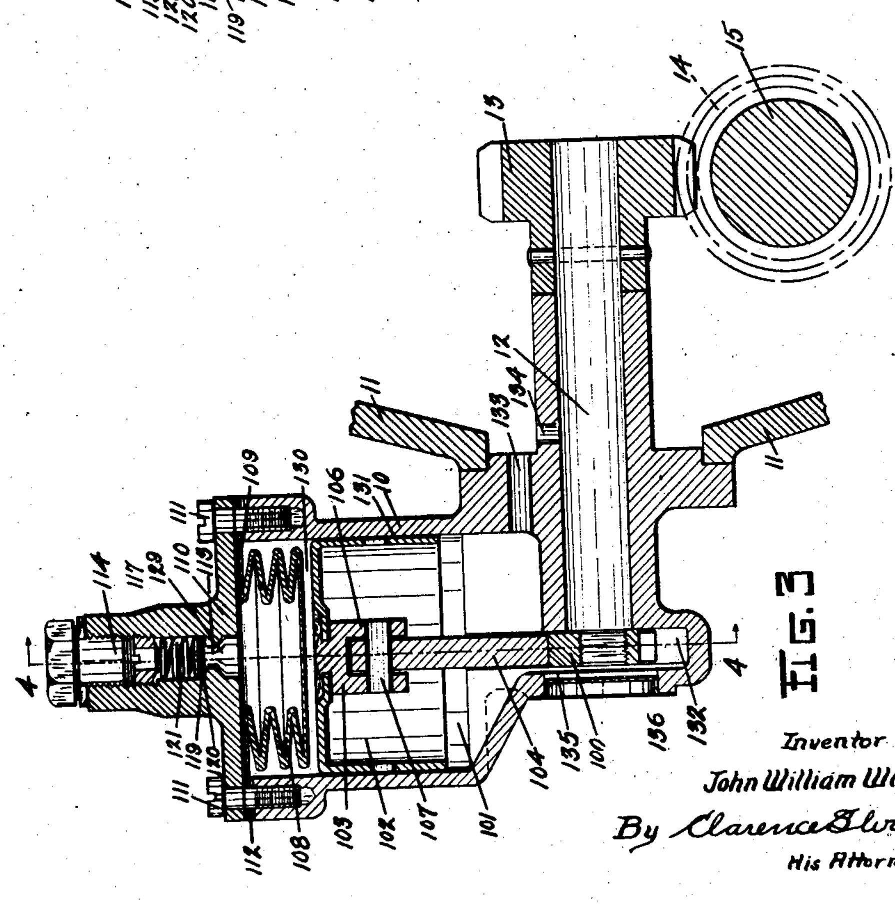

FIG. 3

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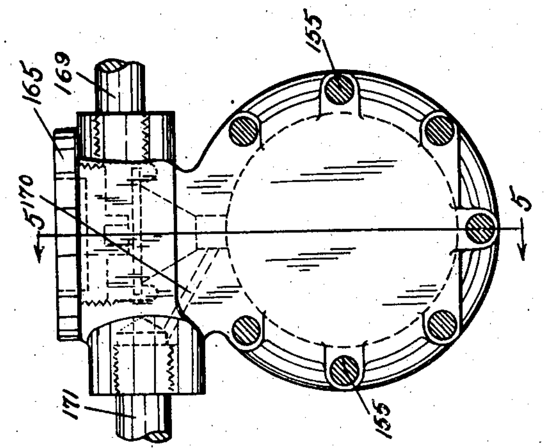

FIG. 6

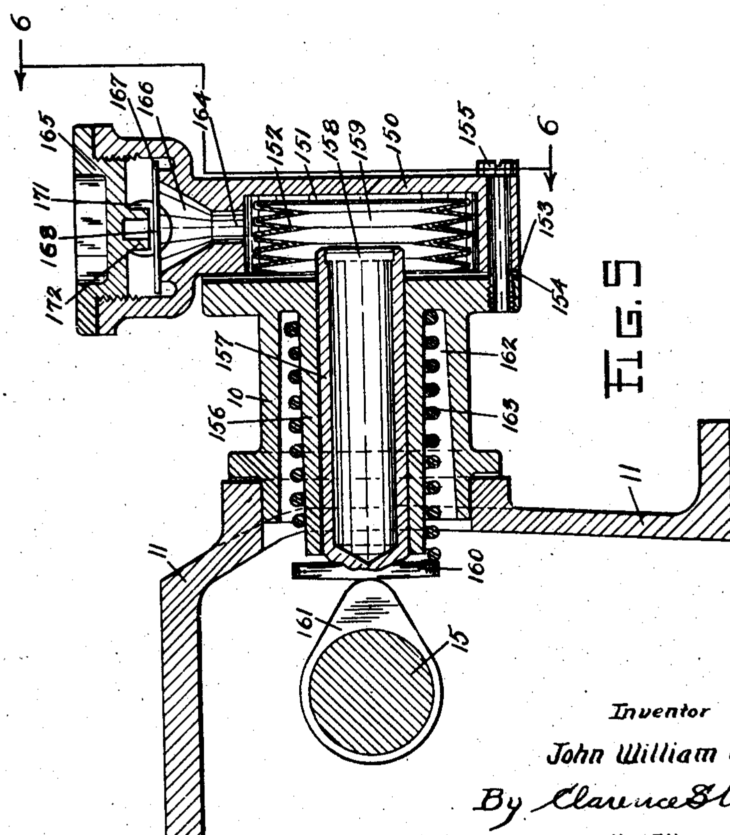

FIG. 5

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UNITED STATES PATENT OFFICE.

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FUEL PUMP.

Application filed February 19, 1924. Serial No. 693,929.

This invention relates to an improvement in a fuel pump, and particularly one adapted for use on hydrocarbon engines and combined with the oil pump, both pumps being operated from the cam shaft of the hydrocarbon engine.

The chief object of this invention is to provide in a fuel pump a flexible bellows into which the fuel is fed and from which the fuel is driven by the expansion and contraction of the bellows.

Another object of this invention is to provide in a fuel pump means for heating the fuel before it is fed into the carburetor.

A further object of this invention is to provide in a single casing a combined fuel and oil pump having a single shaft which operates both pumps and which is driven from the cam shaft of a hydrocarbon engine, or by any other suitable means, thus insuring a constant supply of fuel to the carburetor of the engine without the use of a vacuum supply system, at a rate directly proportioned to the speed of the engine.

Other objects will appear from an examination of the specification taken in connection with the drawings which form a part thereof, and in which

Fig. 1 is a longitudinal cross section taken along the lines 1—1 of Fig. 2 of one embodiment of this invention;

Fig. 2 is a side elevation, a part being taken in section along the line 2—2 of Fig. 1;

Fig. 3 is a longitudinal cross section of another embodiment taken along the line 3—3 of Fig. 4;

Fig. 4 is a transverse cross section taken along the line 4—4 of Fig. 3;

Fig. 5 is longitudinal cross section of a third embodiment taken along the line 5—5 of Fig. 6; and

Fig. 6 is a side elevation of such embodiment.

The pump casing indicated by the numeral 10 is adapted to be mounted upon the side of the cylinder block 11 and is provided with a shaft 12, which extends into the cylinder block and is provided with a gear 13 which meshes with a gear 14 on the cam shaft 15 of the hydrocarbon engine.

On the outer end of the shaft 12 is mounted a gear 16 which meshes with a gear 17 mounted upon a stud 18 carried by the casing. The gears 16 and 17 intermesh, as shown particularly in Fig. 2, the oil being fed into the pump through the inlet 19 and passing out through the outlet 20. Referring to Fig. 2, it will be noted that this pump is of the well known gear type, the oil, entering the inlet 19, being drawn through the intermeshing gears 16 and 17 to the outlet 20.

In the casing 10 is provided a transverse pocket 21, the portion 22 of the shaft passing across the pocket being squared as shown in Fig. 2. Eccentrically mounted upon the squared portion 22 is a ring 23 and surrounding and closely engaging the ring 23 is a strap 24. These parts are so formed that the ring has a slip fit in the strap 24, so that as the ring is rotated the strap is caused to rise and fall.

In the upper portion of the casing 10 is provided a cylinder 25, in which is mounted a piston 26. This piston is in the form of a cup and carries at its lower surface a forked block 27 between the forks of which the upper end of the strap 24 projects. A pin 28 through the forks of the block 27, and the upper end of strap 24 causes any motion of the strap to be transmitted to the piston 26. The cylinder 25 is closed at the top by a head 29 which is securely bolted to the casing by means of the bolts 30 and provided with certain valve mechanism to be described later.

Mounted in the piston 26 out of contact with the walls thereof is a bellows or diaphragm 31, shown particularly in Fig. 1. This bellows is made of very thin material and terminates at its upper edge in an annular flange 32 which extends between the head 29 and the casing 10. Suitable gaskets 33 are provided between the flange 32 and the casing and head so that when the bolts 30 are tightened, the piston 26 is sealed against the entry of air.

At the center of the head 29, above the bellows 31 is formed a vertical passage 34, which terminates in a flared opening 35 normally closed by a valve plate 36, which rests under the force of gravity upon the mouth of the passage. A spring 37 acts as a limit stop when the valve is raised, under certain conditions to be described later. The fuel is fed into the head 29 through an inlet 38 and an inclined passage 39, which enters the vertical passage 34, a strainer 40 in the intake 39 preventing the passage of any impurities.

The top of the head 29 is recessed to provide a chamber 41 in which the valve 36 and spring 37 are mounted. This chamber is internally threaded and is preferably closed by a cap 42 having external threads and an annular flange 43 which bears against the top of the head 29, a suitable gasket 44 being provided to seal this connection. From the chamber 41 an outlet 45 is provided as shown in Fig. 2. The cylinder 26 is filled with a non-compressible medium such as for example oil or air so that as the piston rises and falls, the motion thereof is transmitted by the medium to the bellows. A drain 46 from the chamber 25 is provided so that any oil which may escape from the oil pump into the chamber will be returned to the crank case of the engine.

The operation of this device may be briefly stated as follows: As the cam shaft 15 rotates, the oil pumping gears 16 and 17 are set in motion in the regular way, and the oil transmitted to the various parts of the engine. At the same time the piston 26 is caused to rise and fall in the chamber 25 and the medium in the piston to be expanded or compressed, the motion being thereby transmitted to the bellows 31. By filling the chamber 25 with a non-compressible medium and transmitting the movements of the piston to the bellows therethrough the latter flexes as a unit. In other words, the transmitting medium coacts with all the layers of the bellows, whereas if pressure be positively applied to the bottom of the bellows as in my co-pending application, Serial #635,747, filed April 30, 1923, practically all the flexing of the bellows would be in the lowest layers.

When the bellows 31 are allowed to expand by the lowering of the piston, fuel is drawn through the inlet 38, and passages 39 and 34 into the hollow center of the bellows. Upon the upward motion of the piston 26, the bellows are compressed and the fuel therein is forced up through the passage 34, raising the valve 36 into contact with the spring 37, and through the outlet 45 into the carburetor not shown. The inlet for the fuel is open under all conditions, but it has been found that when the bellows are compressed and the fuel is forced out, the rush of fuel past the mouth of the passage 39 will act to close it, and the flow of fuel will be through the valve 36 to the outlet 45.

Since the oil which passes the pump gears 16 and 17 is at substantially the temperature of the cylinder block, a certain amount of the heat therefrom is absorbed by the casing 10 and the casing in turn raises the temperature of the fuel. The temperature of the oil varies directly with the performance of the engine and consequently the temperature of the fuel fed from the pump bellows 26 varies accordingly. This warming of the fuel befor it reaches the carburetor improves its atomization in the carburetor and is directly dependent upon the performance of the engine so that at high speed where the most complete atomization is essential, the fuel will be the warmest.

The embodiments illustrated in Figs. 3, 4, 5 and 6 differ from that shown in Figs. 1 and 2 in several respects, one being that they are not combined oil and fuel pumps but are pumps for fuel only, other pumping means not shown being provided for the oil.

The embodiment shown in Figs. 3 and 4 comprises a casing 10 mounted upon the cylinder block 11 and provided with a shaft 12 which extends into the block and is actuated by a gear 13 which meshes with a gear 14 on the engine cam shaft 15. Eccentrically mounted upon the outer end of the shaft 12 is a ring or collar 100.

In the casing at right angles to the shaft 12 is formed a cylindrical chamber 101 in which reciprocates a piston 102. The piston 102 is in the form of an inverted cup and carries at its under side a forked block 103. The piston 102 is connected to the shaft 12 by a strap 104 having at its lower end a circular hole 105 in which the ring 100 rotates. The upper end of the strap enters the space between the forks 106 and is held in place by a cross pin 107. The ring 100 has a slip fit in the hole 105 so that the rotation of the shaft causes the piston 102 to reciprocate in the chamber 101.

Mounted in the chamber 101 above the piston 102 is a bellows or diaphragm 108. This bellows is of very thin material and terminates at its upper edge in an annular flange 109. The chamber 101 is closed by a head 110 removably secured to the casing 10 by bolts 111. The flange 109 lies between the upper edge of the casing 10 and the head 110 and is clamped in place, suitable gaskets 112 being provided to seal the chamber against the entry of air.

At the center of the head 110 is formed a vertical passage 113 closed at the top by a tap bolt 114. Parallel to the passage 113 is a similar passage 115 from which leads an outlet tube 116. The entry to each of these passages 113 and 115 is normally closed by valves 117, 118. Each valve comprises a plate 119 normally held to its seat 120 by a spring 121 the upper end of which bears against an annular collar 122 threaded into the passage. By shifting the collars 122 the tension of the springs 121 can be regulated as desired.

In the head 110 is formed a horizontal passage 123 the end of which is connected to the interior of the bellows 108 by a vertical passage 124. An inlet tube 125 enters the mouth of the passage 123 and a suitable strainer 126 is provided for the fluid flowing through the passages 123 and 124. The mouth of the passage 124 is normally closed by a flap valve 127, one end of which is secured to the upper side of the head 110 by suitable means such as a bolt 128. An orifice 129 connects the passage 113 to the passage 123 for a reason pointed out below.

The operation of this pump is as follows: The rotation of the cam shaft 15 is transmitted by the gears 14, 13, shaft 12, ring 100 and strap 104 to the piston 102. The upper face of the piston 102 is preferably spaced from the lower face of the bellows 108 an appreciable distance 130, so that they do not at any time come into contact. The skirts 131 of the piston bear closely against the walls of the chamber 101 so that any air or other fluid by which the space between the piston and the bellows may be filled cannot escape easily. The fluid in the space 130 surrounds the bellows 108, and thus the pressure upon the fluid by the upward stroke of the piston is transmitted to the bellows causing it to contract and expel any fluid therein through the valve 118 of the passage 115 into the float tank of the carburetor. Should the tank be full and the feed cut off in the usual way, the valve 117 will be raised and the excess fuel will escape through the passage 114 and orifice 129 until a sufficient amount is discharged. During this action the valve 127 seals the passage 124.

Upon the downward stroke of the piston 102 the bellows 108 expands opening the valve 127 and drawing a fresh supply of fuel through the passages 123, 124. Since the passage 113 is closed by the bolt 114 any fuel forced through the valve 117 by-passes through the orifice 129 into the passage 124 and re-enters the pump, when the piston retracts and the valve 127 is opened. The valve 117 is adjusted to open less freely than the valve 118 and thus acts as a relief valve in case the outlet tube 116 cannot take care of all the fuel.

The lower end or sump 132 of the chamber 101 which receives the ring 100 is filled with oil and a bypass 133 is provided from the chamber 101 into the crank case of the cylinder block. An opening 134 is also formed through the bearing of the shaft 12 to permit the lubrication of the shaft. In the casing 10 in front of the shaft 12 is formed an aperture 135 normally closed by a cap 136 through which aperture access may be had to the ring 100 and the sump 132.

The embodiment shown in Figs. 5 and 6, like the one just described, pumps fuel only and is actuated by the cam shaft of a hydrocarbon engine. This pump comprises a casing 10 mounted upon the cylinder block 11 and actuated from the cam shaft 15 by means to be set forth below. At the end of the casing 10 is mounted a head 150 having a cylindrical depression therein at the side adjacent the casing. This depression forms a chamber 151 within which is mounted an open mouthed bellows or diaphragm 152 preferably of the sylphon type. The bellows is supported in the chamber by an annular flange 153 which lies between the head 150 and the casing 10. Suitable gaskets 154 are provided so that the chamber is completely sealed by the bolts 155.

Within the casing 10 is mounted a sleeve 156 in which reciprocates a piston 157, a slip fit being provided between piston and sleeve. The outer end 158 of the piston 157 projects into the interior 159 of the bellows 152. At the inner end of the piston is formed a head 160 which bears against a cam 161 on the shaft 15. Between the sleeve 156 and the casing wall is provided an annular pocket 162 in which is mounted an expansion coil spring 163, one end of the spring bearing against the base of the pocket and the other bearing against the head 160 holding it at all times in contact with the cam 161.

The piston 157 is hollow and in communication with the interior 159 of the bellows, these parts being filled with heavy oil or other suitable fluid which is put under pressure as the piston advances. Since the bellows 152 are flexible, it must follow that when the piston is advanced the bellows are, by the fluid pressure, expanded and when the piston is retracted the bellows will return to its normal condition.

At the top of the head 150 is provided a vertical passage 164 which leads from the chamber 151 to the atmosphere. The upper end of the passage 164 is closed by a tap bolt 165 below which is provided an annular space 166. At the bottom of the space 166 is formed an annular seat 167 which receives a valve disc 168 normally resting upon the seat 167 by the force of gravity. From the space 166 leads an outlet tube 169. Into the passage 164 adjacent the chamber 151 leads a passage 170 from an inlet tube 171. Fuel enters into the chamber 151 through the tube 171, passage 170 and passage 164 and ejected therefrom through the passage 164, space 166 and tube 169. The feeding and ejecting operations are controlled by the bellows 151, as it is expanded and contracted through the reciprocation of the piston 157 pointed out above. The passage 164 is much larger than the passage 170 and consequently, when the fuel is ejected it will rush by the mouth of the passage 170 and raise the disc 168 entering the space 166 and escaping through the tube 169. On the under face of the bolt 165 is formed a boss 172 which limits the rise of the valve disc 168.

The operation of this embodiment is believed to have been set out fully in the description of the various features and will not be described at any length at this time. It is sufficient to state that the advance and retraction of the piston controls through the fluid the expansion and contraction of the bellows 152. This expansion of the bellows 152 expels through the passage 164 the fuel in the chamber 151 and the contraction of the bellows replaces this by sucking fresh fuel into the chamber from the tube 171 through the passages 170 and 164.

While several embodiments of this invention have been shown and described, applicant is not limited thereto, since it is obvious that other embodiments can be made without departing from the spirit and scope of this invention as set forth in the following claims.

Having thus set forth my invention what I claim as new and for which I desire protection by Letters Patent is:

1. A fuel pump comprising a casing, a bellows therein open at one end, which end is rigidly secured to said casing, a cup-like piston in said casing surrounding said bellows and out of contact therewith, said piston containing fluid which fills the space between said bellows and the walls of said piston, and means for reciprocating said piston and thereby through said fluid controlling the expansion and contraction of said bellows.

2. In a fuel pump a cup-shaped piston, a bellows in said piston adapted to receive fuel, an inlet to and an outlet from said bellows, a non-compressible medium in said piston around said bellows and means for reciprocating said piston whereby the medium therein compresses said bellows at intervals said bellows when permitted expanding to its normal condition, the expansion and compression of said bellows drawing fuel through said inlet and expelling it through said outlet.

3. A fuel pump comprising a shaft, a cup-shaped piston, a bellows in said piston, a strap eccentrically surrounding and engaging said shaft, whereby the rotation of said shaft actuates said strap, said strap being so mounted as to transmit motion to said piston, a non-compressible medium in said piston adapted to transmit the motion of said piston to said bellows, means for supplying fuel to said bellows and an outlet valve therefrom whereby the fuel is drawn into and expelled from said bellows as the latter is expanded, and compressed.

4. A fuel pump comprising a cup-shaped piston, a bellows in said piston, said bellows being closed at one end and the open end being at the open end of said piston, a non-compressible medium in said piston surrounding said bellows, means for supplying fuel into said bellows and for permitting the escape of fuel therefrom and means for reciprocating said piston whereby said bellows will be compressed or expanded through the movement of said non-compressible medium.

5. The combination with an engine crank case of a fuel pump mounted thereon and a casing for said pump in communication with said crank case, whereby heat is conducted from said crank case to said pump and to the fuel passing therethrough.

6. The combination with a hydrocarbon motor having a crank case and a cam shaft, of a fuel pump comprising a casing mounted upon said crank case, said casing having a passage opening into said crank case, a piston in said casing and means operating said piston, said means extending into said crank case and actuated by said cam shaft, and a bellows in said casing compressed by said piston and functioning to feed said fuel, said piston being out of contact at all times with said bellows, the space between said piston and bellows being filled with fluid, the passage from said casing to said crank case admitting the heat of the motor to said casing and thus warming the fuel therein.

In testimony whereof I have affixed my signature.

JOHN WILLIAM WHITE.