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FUEL PUMP FOR SUPERCHARGED ENGINES

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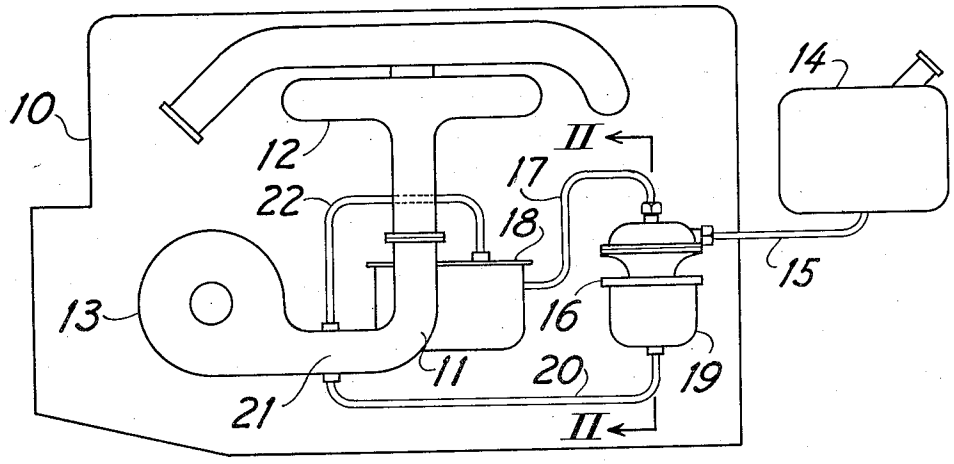


Fig. 1

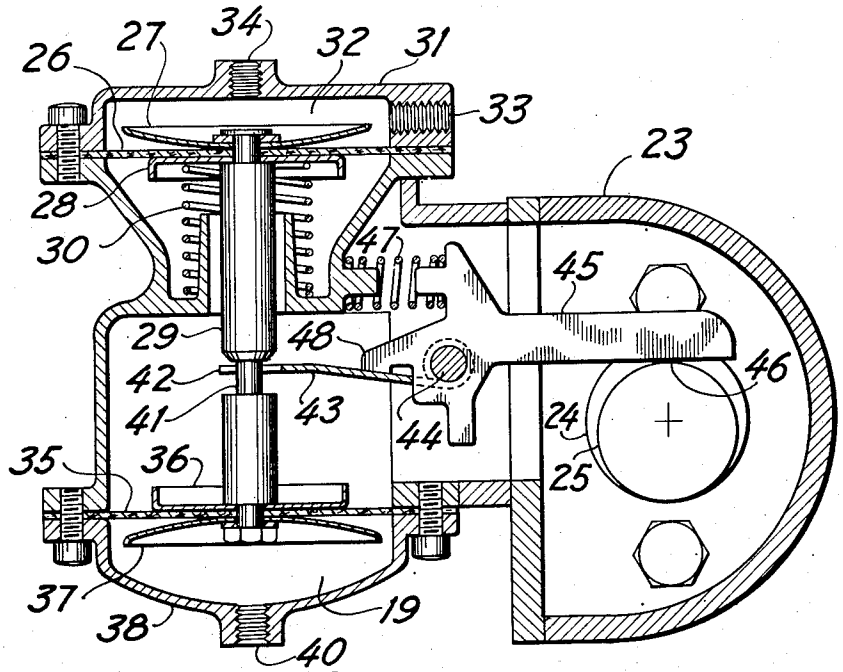


Fig. 2

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FUEL PUMP FOR SUPERCHARGED ENGINES

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3 Claims. (Cl. 123—139)

This invention relates to a fuel pump for internal combustion engines, and particularly to one adapted to supply fuel to a float type carburetor which is operated under the pressure of supercharged air supplied to said engine.

There are two general types of supercharging systems as applied to gasoline engines. The most common at the present time is that in which the carbureted mixture of gasoline and air is compressed after leaving the carburetor. In the other type the air is compressed before reaching the carburetor.

The first type utilizes the ordinary atmospheric carburetor and has certain constructional advantages as regards mounting of equipment, especially in connection with radial aircraft engines. However, due to the difficulty encountered in dissipating the heat of compression in the limited space available there is some loss of volumetric efficiency which is undesirable.

The second type avoids the loss of volumetric efficiency but requires the use of a pressure type carbuetor. In such a carburetor the float bowl is carried at the induction line pressure so that metering is still dependent on depression in the Venturi tube. Such a carburetor must be supplied with fuel at a pressure sufficiently high to produce flow into the float bowl, but not so high that the float valve cannot shut off against it. The limit is reached when the float cannot produce enough buoyant force to hold the valve closed. It is evident that any variation in the differential pressure between the float bowl and fuel line pressures will result in a corresponding change in the fuel level in the float bowl which in turn will result in a change of mixture ratio.

It is an object of this invention to provide a fuel pump construction which will automatically maintain a predetermined differential pressure between the carburetor float bowl and the fuel line of an internal combustion engine for any variation or degree of pressure on the intake to said carburetor, as for example that caused by a supercharger.

Another object is to provide a fuel pump construction that will maintain a predetermined relation between the fuel line pressure and the operating characteristics of a given carburetor so that changes in mixture ratio may automatically be made with change in absolute pressure due to change in altitude.

Another object is to provide a fuel pump of this nature that is simple and economical to fabricate and that will be interchangeable with other types without extensive alterations to the engine structure.

These and other objects and advantages will be more fully apparent from the following description, and from the attached drawing, which forms a part of this specification and illustrates a preferred embodiment of the invention.

In the drawing, Figure 1 is a diagrammatic side elevation view of a supercharged engine, with an improved fuel pump in place thereon.

Figure 2 is a detail sectional view on line II—II of Figure 1 illustrating the details of a fuel pump embodying this invention.

Referring to the drawing, and particularly to the diagram of Figure 1, the reference numeral 10 generally designates an internal combustion engine with a float type carburetor 11 attached to the conventional intake manifold 12 and supplied with air by a supercharger or blower generally designated 13. A fuel tank 14 is provided with an outlet line 15 leading to the fuel pump generally designated 16, from which the liquid fuel is forced through line 17 to the float bowl or its equivalent 18 on carburetor 11. A pressure balancing diaphragm chamber 19 in the lower part of the pump 16, to be described in more detail below, is fitted with a pressure line 20 connecting it to the supercharger outlet 21 which is also the air inlet to carburetor 11, as shown. The usual pressure compensating line 22 is provided from supercharger outlet 21 to the top of the float bowl 18.

Referring now to Figure 2, which shows the details of one form of fuel pump embodying this invention, the reference numeral 23 designates generally a part of the engine structure to which the fuel pump 16 may be secured by any suitable means so that it is in operative relation to a rotating or otherwise moving part of the engine, for example shaft 24 provided with a cam or eccentric surface 25. In the upper part of pump 16 is a conventional pump diaphragm 26 with follower plates 27 and 28 secured to a central stud 29. A spring 30 supported in the body of pump 16 normally urges the stud 29 and diaphragm 26 upwardly. A cover plate 31 is secured to the top of the pump body above diaphragm 26 to form a pump chamber 32 and is provided with a tapped inlet 33 and outlet 34 for the fuel to be pumped. Conventional inlet and discharge valves of any suitable type are provided in the inlet line 15 and outlet line 17 to chamber 32 so that liquid will be drawn into chamber 32 on a down-stroke and expelled therefrom on an up-stroke.

At the lower end of stud 29 is a second diaphragm 35 with follower plates 36 and 37, se-

cured to the bottom of pump 16 by cover plate 38 to form the pressure balancing chamber 18 previously mentioned. A tapped connection 40 provides a means of communication from chamber 19 to the pressure line 20 leading to the carburetor inlet 21, for a purpose which will be explained in detail below.

Intermediate the ends of stud 29 is a reduced section 41 of sufficient length to allow the forked end 42 of intermediate lever 43 to engage the stud and yet to have a certain degree of lost motion, for a purpose which will be apparent. Intermediate lever 43 is hinged on a stationary pin 44, and is actuated by a cam follower lever 45, also pivoted on pin 44, and adapted to bear at 46 on cam 25 of shaft 24. A spring 47 serves to maintain lever 45 in contact with its cam 25. Cam follower lever 45 is provided with a transverse projection or arm 48, on the opposite end from cam 25, which projection loosely contacts the upper side of intermediate lever 43 between its support on pin 44 and its connection to stud 29 at fork 42. Thus, as cam 25 is rotated to lift the outer end 46 of its follower lever 45, projection 48 will force intermediate lever 43, and also stud 29 and diaphragms 26 and 35 downwardly against the spring 30 drawing liquid fuel into chamber 32. As cam 25 turns to its lowest position, as shown, spring 47 causes cam follower lever 45 to maintain contact with cam 25, and leaves intermediate lever 43, stud 29 and diaphragms 26 and 35 carried thereby, free to be urged upwardly through a limited travel by the resultant of the forces exerted by spring 30 and the pressure on diaphragm 35 in chamber 19, to force fuel from chamber 32 through line 17 to float bowl 18 on carburetor 11.

If diaphragms 26 and 35 were of equal area, it is evident that the pressure in the fuel line 17 will exceed that at point 21 and hence, through line 22, in float chamber 18, by an amount produced by the force exerted by spring 30, neglecting the pressure drop through the discharge valve of chamber 32. Since the force exerted by spring 30 is substantially unvarying, the differential pressure between the fuel line 17 and the carburetor intake 21 will be a constant regardless of variations in their absolute values due to supercharging, change in altitude or other causes.

By making the diaphragms 26 and 35 of different areas, it would be possible to make the pressures in the fuel and air lines differ by a constant amount plus an amount proportional to the absolute values of pressure in those lines. This may be expdessed mathematically as follows:

Let P_f = fuel pressure—absolute
P_a = air pressure—absolute
P_o = pressure in space between diaphragm—absolute
A_f = area of fuel diaphragm
A_a = area of air diaphragm
F = force exerted by the spring

$$P_aA_a - P_oA_a + F = P_fA_f - P_oA_f$$

or

$$P_f = P_a\frac{A_a}{A_f} + \frac{\{F + P_o(A_f - A_a)\}}{A_f}$$

In addition to the above, it is obvious that variations in carburetor characteristics with changes in absolute pressure, for example due to altitude, may be utilized to advantage with this invention to alter air-fuel mixture ratios and similar conditions well known to those skilled in the art. Consequently, although a specific embodiment of this invention is described and illustrated as applied to a supercharged internal combustion engine, it is obvious that changes in application, as well as modifications in structure and arrangement can be made without departing from the invention, and all such as are within the scope of the appended claims are embraced thereby.

I claim:

1. A pumping device comprising a pump chamber having a movable wall and resilient means adapted to move said wall to decrease the capacity of said chamber, mechanical means for continuously intermittently urging said wall to increase the capacity of said chamber, means forming a pressure balancing chamber having a movable wall, means positively connecting said wall with the movable wall of said pump chamber to space them an unvarying distance apart, and means adapted to provide an unresticted passage between said pressure balancing chamber and a source of fluid pressure acting on the discharge of said pump, so constructed and arranged that variations in said fluid pressure will act in a predetermined manner to modify the force exerted by said resilient means upon the movable wall of said pump chamber.

2. In combination with an internal combustion engine having an air intake conduit subject to variable pressure, a continuously mechanically actuated reciprocating fuel pump for said engine, said pump including a resilient pump diaphragm, a pressure balancing chamber, a diaphragm forming one wall of said chamber, means positively connecting said diaphragms to space them an unvarying distance apart, and means providing a passage connecting said pressure balancing chamber and said air intake conduit, so constructed and arranged that variations in pressure in said air intake conduit will modify the discharge pressure of said fuel pump in a predetermined manner.

3. In combination with an internal combustion engine having an air intake conduit subject to variable pressure, a carburetor including a float bowl, and a continuously mechanically actuated reciprocating pump adapted to discharge fuel into said float bowl, said pump including a resilient pump diaphragm, a pressure balancing chamber, a diaphragm forming one wall of said chamber, means positively connecting said diaphragms to space them an unvarying distance apart, and means providing an unrestricted pressure connection between said pressure balancing chamber, said float bowl, and said air intake conduit.

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