Jan. 26, 1937. L. L. VIEL 2,068,938

REGULATOR FOR THE FUEL PRESSURE IN INTERNAL COMBUSTION ENGINES

Filed April 28, 1931

Fig. 1.

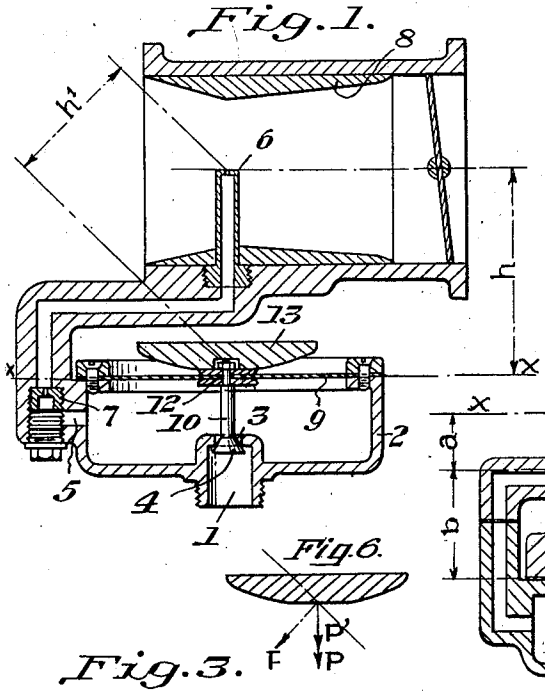


Fig. 2.

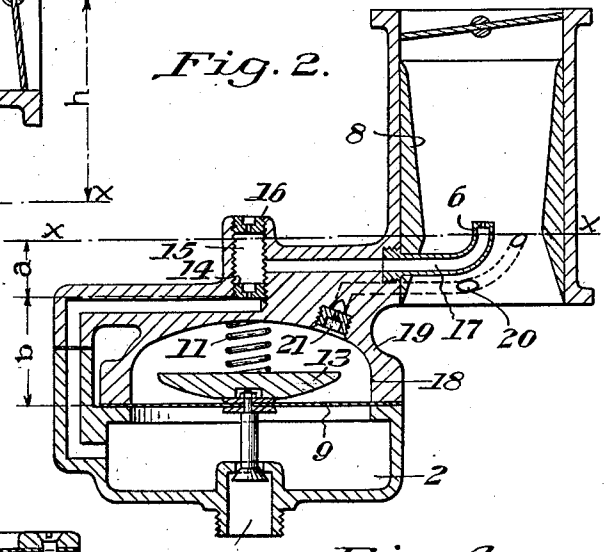


Fig. 6.

Fig. 3.

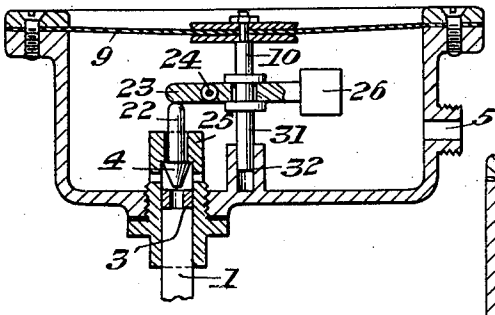


Fig. 4.

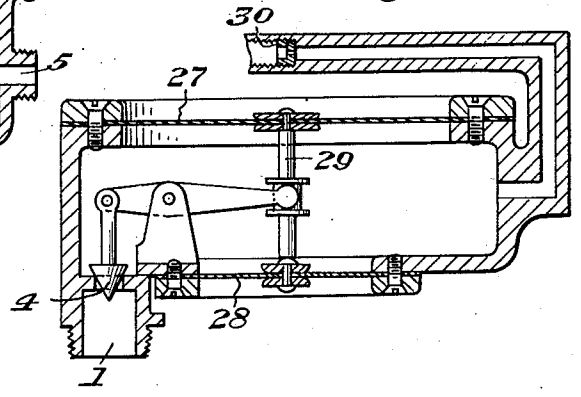
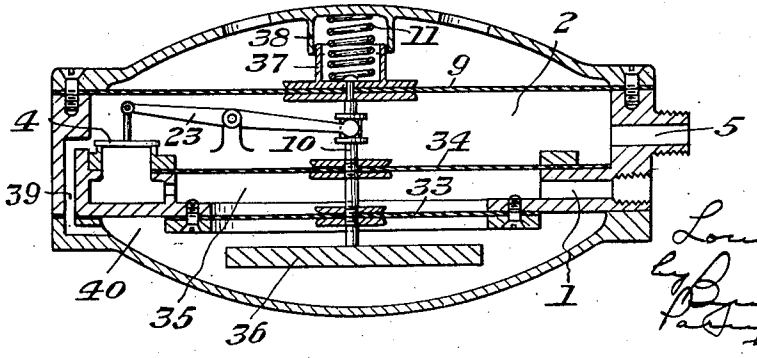


Fig. 5.



INVENTOR

Louis-Leon Viel

by Byrnes, Stiffler, Blume & Lawless

his attorneys

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REGULATOR FOR THE FUEL PRESSURE IN INTERNAL COMBUSTION ENGINES

Louis Léon Viel, Ville d'Avray, France, assignor to Société Générale des Carburateurs Zenith, Levallois-Perret, France

Application April 28, 1931, Serial No. 533,457
In Belgium May 1, 1930

5 Claims. (Cl. 137—153)

The invention relates to certain new and useful improvements in fuel reservoirs for carburetors used with internal combustion engines, and more particularly to that kind of fuel reservoir within, a portion of the wall of which is constituted by a deformable membrane connected to a fuel valve and adapted to be subjected on its external face to a regulating pressure, for example the atmospheric pressure.

Fuel reservoirs of the kind referred to have been proposed for replacing the customary float chamber of the carburetor, but, in the known devices, the load at a jet or at the fuel outlet varies when the carburetor is tilted.

The principal object of this invention is therefore to provide means to subject the fuel to a predetermined pressure, independent of the inclination of the carburetor or of the inertia forces to which the carburetor is subjected, and to position the fuel jet or outlet from the fuel reservoir to the induction passage of the carburetor at this point of constant pressure.

The following description considered in connection with the appended drawing, given as an example, will facilitate an understanding of the manner in which the invention may be carried out.

In the drawing:

Fig. 1 is a somewhat diagrammatical vertical section of an apparatus for carrying out the invention.

Fig. 2 is a vertical section illustrating the application of the invention to the supply of a submerged jet.

Fig. 3 is a modified form of Fig. 1 in which the membrane does not operate the fuel valve directly.

Figs. 4 and 5 illustrate modified forms of construction of the invention comprising several membranes.

Fig. 6 is a detail view showing the face components acting upon the weight.

In the device represented in Fig. 1, the fuel is brought under a certain load by the passage 1, communicating with the reservoir 2 by the orifice 3 controlled by the valve 4. The reservoir 2 is provided with an outlet passage 5 for the fuel supplying the fuel outlet 6 through the calibrated orifice 7. The fuel outlet 6 is positioned in a mixing chamber 8. The reservoir 2 is closed at its upper portion by a deformable membrane 9, which has no elastic reaction and which is connected at its center by a rod 10 to the valve 4. Preferably the membrane 9 is not extensible. The external face of the membrane 9 is subjected to the atmospheric pressure, the internal face being bathed by the fuel. The membrane 9 is loaded by a weight 13. If fuel is drawn in the mixing chamber 8 through the fuel outlet 6, owing to the suction of the engine, the membrane 9 becomes depressed and opens the needle valve 4. If the fuel tends to rise in the reservoir 2, the membrane 9 lifts and closes the needle valve 4.

The weight 13, by distributing its pressure on the whole of the membrane 9, balances the pressure of a liquid column of height h. The membrane being supposed to be horizontal, the height h is substantially the vertical distance from the end 6, which it is desired to protect from variations of load, to the membrane 9. In the case of an inclination of the apparatus, the component p' of the weight 13 perpendicularly to the membrane 9 and the height h' of the outlet 6 above the centre of gravity 12 of the membrane will vary in the same ratio and consequently the load at the outlet 6 does not vary. The outlet 6, however, should be positioned on the normal to the membrane 9, passing through the centre of gravity 12 of the surface of the membrane.

The device of Fig. 1 therefore provides a zero load at a given point, which on the figure is the opening of the outlet of the fuel passage, whatever may be the direction of inclination of the apparatus.

If in addition to the weight 13, a spring loads the membrane 9, one may obtain, at a given point, a constant load which is not zero, independent of the inclination. Such a device is shown in Fig. 2. In this figure, the membrane 9 is loaded at the same time by the weight 13 and by the spring 11. The fuel from the reservoir 2 supplies, by a submerged jet 14, a well 15 open to the atmosphere 16. The air coming from the opening 16 atomizes the fuel coming from the jet 14, and the atomized fuel is delivered through the passage 17 to the mixture outlet 6 positioned in the mixing chamber 8.

If it is desired that the jet 14 be supplied under a constant load, equal to the height a of the horizontal plane X—X passing through 6 above the jet 14, when the membrane is horizontal, the weight 13 is so proportioned that the pressure which it exerts on the liquid, balances a column of height b equal to the vertical distance of the jet 14 to the horizontal plane of the membrane 9, and the spring 11 is calibrated so that it exerts on the liquid a pressure balancing a liquid column the height of which is a.

In these conditions, the device will work exactly as if the jet 14 was fed by a float chamber

the level of which is X—X. If the jet 14 is situated on the normal to the membrane 9 passing by the centre of gravity of the latter, the jet 14 will be supplied under a constant load represented by a liquid height *a*, whatever may be the direction of the device and whatever may be the inertia forces acting on this device. Particularly, the influence of centrifugal force in any direction is completely eliminated.

Most frequently it is sufficient to eliminate the effect on the load of the inclinations or of the inertia forces parallel to a given vertical plane, without it being necessary to eliminate the effect of any inclination. Particularly, in the case of the supply of an aeroplane engine, it is sufficient to eliminate the effect of the inclinations parallel to the longitudinal of the aeroplane. The large inclinations in this plane correspond to the "zooming" or to diving flight. At the same time the effect of vertical accelerations due to aerial swell is eliminated. The inclinations or the accelerations transverse to the apparatus are generally negligible or very momentary.

If it is desired to eliminate only the influence of the inclinations and of the inertia forces parallel to a given vertical plane, one can move the jet 14 (more generally, the point where it is desired to obtain a load independent of the said inclinations) on a horizontal perpendicular to the said vertical plane. In the case of inclinations parallel to the said plane, the membrane will turn round a horizontal contained in its plane and perpendicular to the said vertical plane. In this manner a wider margin is available for the mounting, which very often is valuable.

As in a float chamber, it is possible to vary the pressure which acts in the reservoir on the free surface of the fuel. To modify the load in this way one can vary the pressure acting on the membrane 9, the result being identical to that obtained with a float chamber.

As an example, there is represented in Fig. 2 a device permitting to transmit to the membrane a fraction of the fall of pressure which exists in the body of the carburetter. The reservoir 2 is surmounted by a chamber 18 communicating with the atmosphere by a calibrated orifice 19 and communicating with the restricted section of the mixing chamber 3 by a passage 20 provided with a calibrated orifice 21. The load on the jet 14 varies then in the same manner as the fall of pressure in the chamber 18.

It is evident that Figs. 1 and 2 are purely diagrammatic and that the diagrams which they represent may be modified in many ways in detail without departing from the invention.

Particularly the mechanical connection between the membrane 9 and the needle valve 4 may be modified, this connection being obtained, for example, by means of a system of levers; it can also be uni-lateral, the membrane controlling only the closure of the valve. This mechanical connection may also be as varied as the connections between the float and the valve in the float chamber which are known; it suffices that this connection be such that the displacements of the membrane which corresponds to an increase of volume of the reservoir causes the closure of the valve.

The arrangement of the details such as guiding of the valve, guiding of the membrane, etc., have not been shown either.

In Fig. 3 there has been represented as an example a variation of the device of Fig. 1 in which the membrane 9 is not directly connected to the valve 4. In this figure, the membrane actuates the end of the tail 22 of the valve 4 which passes through the guide 25, by means of the rod 10 and of the lever 23 pivoted around the axis 24. The extension 31 of the rod 10 is guided at 32. When the membrane lifts, it causes the closure of the valve; the opening of the valve is caused by the pressure of the fuel supplied by the passage 1.

The membrane 9 is loaded by a weight 26; this weight acts indirectly on the said membrane; it is placed for example at one of the ends of the lever 23; the reduction which is allowed by the lever 23 leads to a smaller weight than that which, directly applied on the membrane 9, would be necessary to obtain the same force.

Finally, the single membrane 9 may be replaced by several partial membranes connected mechanically to each other and controlling the valve 4 by their combined action. The different arrangements described above may be applied to each of the partial membranes.

One can also in this case, eliminate the effect of the inclinations and of the inertia forces, parallel to a given vertical plane, or also the effect of the inclinations and of the inertia forces acting in any direction at the point where will be, for example, placed a jet.

As an example, there has been represented in Fig. 4 a device where the fuel valve is controlled by the combined action of two parallel membranes 27 and 28, the centers of gravity of which are connected by a rod 29. It is easy to see that in this device the point which is unaffected by the acceleration is situated at a point 30 of the axis 29 such that the products of its distance to each of the membranes by the surface of the latter are equal.

In a more general manner, in a system of parallel membranes bathed on one of their faces by the fuel and on the other by a gaseous fluid, such for example as the atmosphere, the inertia of which is negligible, the displacements of the membranes taking place simultaneously, the point which plays the part of centre of gravity of the single membrane of Fig. 2 is still the centre of gravity of the whole of the surfaces of the different membranes, taking care to count positively the surfaces of the membranes bathed by the fuel on their face turned in one direction, and negatively the faces of which are turned in the opposite direction, are bathed by the fuel.

If more complicated mechanical connections are used (levers, etc.), the point unaffected by the accelerations in any directions or also the locus of the points unaffected by the accelerations parallel to a given vertical plane will be ascertained in each particular case. One will place at that point or at one of these points a jet, or more generally, an orifice fed with pure fuel and at the outlet of which the fuel is mixed with air.

When several membranes are used, every one can be subjected to the pressure existing in the fuel either up-stream of the valve or down-stream of the valve.

In Fig. 5, 1 is a fuel inlet. 33 and 34 are two membranes being a part of the wall of the chamber 35. The inner faces of the membranes 33 and 34 are subjected to the pressure up-stream of the valve 4. 9 is a membrane being a part of the wall of the chamber 2, and its upper face is subjected to the atmospheric pressure. The

three membranes **33**, **34** and **9** are connected by the rod **10**. They are loaded by the weight **36** and by the spring **11**, guided by the member **37** sliding in the slide **38**. The pressure existing in the chamber **2**, down-stream of the valve **4**, is transmitted by a passage **39** and a chamber **40** to the lower face of the membrane **33**. For example, the membranes **33** and **34** are adapted to eliminate the effect of the inlet pressure on the valve **4**.

In this device, the inclinations and the inertia forces transmit to the inner faces of the membranes **33** and **34**, variations of load which are independent from the opening of the valve **4**, provided that this valve is not entirely closed. From the point of view of the effect of the inertia forces and of the inclinations, everything happens therefore as if the valve did not exist and everything which has been said about the devices described above is applicable to the device of Fig. 5.

In a device comprising membrane elements subjected to the pressure up-stream of the valve and membrane elements subjected to the pressure down-stream of the valve, one can therefore by loading the movable parts by the simultaneous action of a spring and of a weight, one of these two members being done away with in particular cases, obtain, at a given point of the outlet passage, an outlet pressure independent from the inertia forces and the inclinations. One may place at that point a jet or, more generally, an orifice supplied with pure fuel and at the outlet of which the fuel is mixed with air. The supply from this orifice will be in this way protected from the effects of the inclinations and of the inertia forces. One can, besides place the discharges orifice at a point where the effect of the inertia forces only is eliminated or of the inclinations parallel to a given plane (in the case of an aviation engine, for example, parallel to the plane of symmetry of the aeroplane).

What I claim is:

1. A regulator for the pressure of the fuel feeding an internal combustion engine, which comprises a fuel passage, a reservoir receiving fuel therefrom, a valve controlling fuel flow from said passage into said reservoir, a membrane element forming a partial closure for said reservoir and responsive to fluid pressures, said membrane being connected with said valve, a fuel outlet from said reservoir at a point lying in a line normal to said membrane and passing through the center of gravity thereof, and means for predeterminately loading said membrane, said means comprising a weight and a spring cumulatively effective on said membrane.

2. A regulator for feeding fuel to an internal combustion engine, comprising a fuel passage, a reservoir receiving fuel therefrom, a valve controlling the fuel flow from said passage into said reservoir, a flexible membrane forming a partial closure for said reservoir and subjected on one side to a determinable air pressure and on the opposite side to the pressure of the fluid within said reservoir, said membrane being operable for closing said valve for restricting fuel flow into said reservoir, a fuel outlet from said reservoir at a point lying in a line normal to said membrane and passing through the center of gravity thereof, and means for predeterminately loading said membrane, said means comprising a weight and a spring cumulatively effective on said membrane.

3. In a regulator for the fuel feeding an internal combustion engine, a fuel passage, a deformable unit comprising a valve controlling said fuel passage, a plurality of membrane elements, certain of said elements having portions responsive to the fuel pressure upstream of said valve and other of said elements having portions responsive to the fuel pressure downstream of said valve, connections between said membrane elements and said valve, and combined weight and spring means effective for predeterminately loading said unit.

4. In a regulator for the pressure of liquid fuel supplied to an internal combustion engine, a fuel passage, a valve controlling said fuel passage, a membrane element responsive to the fuel pressure on the inlet side of said valve, a membrane element responsive to the fuel pressure on the outlet side of said valve and connections between said membrane elements and said valve, and a weight and a spring adapted to load said membranes, said weight being further adapted to balance the head of liquid existing in both said fuel chamber and a pipe connecting said fuel chamber with a fuel outlet receiving fuel from said regulator whenever the apparatus is inclined parallel only to a given vertical plane.

5. In a regulator for the pressure of liquid fuel supplied to an internal combustion engine, a fuel passage, a valve controlling said fuel passage, a membrane element responsive to the fuel pressure on the inlet side of said valve, a membrane element responsive to the fuel pressure on the outlet side of said valve and connections between said membrane elements and said valve, and a weight and a spring adapted to load said membranes, said weight being further adapted to balance the head of liquid existing in both said fuel chamber and a pipe connecting said fuel chamber with a fuel outlet receiving fuel from said regulator whenever the apparatus is inclined in any direction.

LOUIS LÉON VIEL.

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Patent No. 2,068,938. CERTIFICATE OF CORRECTION. January 26, 1937.

LOUIS LEON VIEL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 5, for the word "within" read wherein; line 41, for "face" read force; and second column, line 37, after "atmosphere" insert at; page 2, second column, lines 28 and 29, for the words "will be, for example, placed a jet" read the fuel jet is placed; line 52, after "the" insert membranes, the; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 26th day of October, A. D. 1937.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.