PRESSURE REDUCING DEVICES IN PARTICULAR FOR CARBURATION SYSTEMS

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Fig. 1.

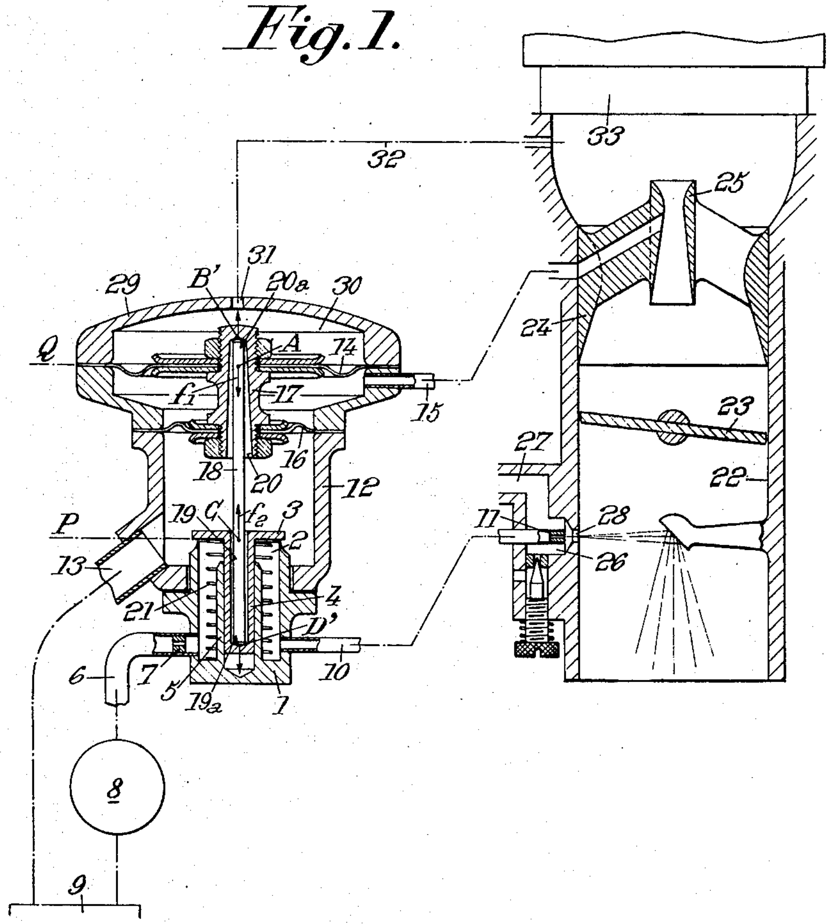


Fig. 2.

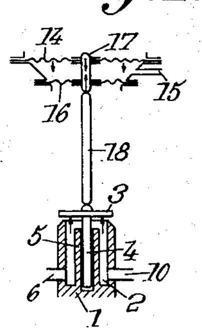
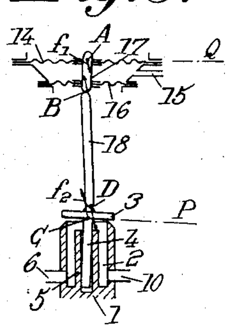


Fig. 3.



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PRESSURE REDUCING DEVICES IN PARTICULAR FOR CARBURATION SYSTEMS

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The present invention relates to pressure reducing devices especially for use in carburation systems working normally by continuous injection of fuel through at least one fuel injection orifice opening into the air intake pipe of the system—downstream of the throttle—provided in said pipe.

Such carburation systems comprise a pressure reducing device interposed between a source of fuel under pressure and said injection orifice so as to reduce to a value suitable for injection through said orifice the pressure of the liquid supplied by said source.

The pressure reducing device comprises a chamber having an inlet fed from said source, an outlet leading to said injection orifice and a by-pass port controlled by a by-pass valve having an active portion extending across said port to control the outflow of fuel therethrough in such manner as to reduce the fuel pressure in said chamber to the desired value. This by-pass valve is subjected to the opposed actions of the fuel pressure in said chamber tending to open said valve and of a movable member tending to close said valve, this member being actuated, in a direction coinciding with the direction of movement of said valve, by control means, responsive to variations of a factor of operation of the engine. Generally said control means are diaphragm means carrying said member and subjected to the action of a pressure which constitutes the above mentioned factor of operation of the engine, this pressure being that existing in a venturi located in the carburetor air intake pipe upstream of the throttle. Said control means are operatively connected to said movable member at points located in an annular region thereof transverse to the above mentioned direction.

In pressure reducing devices of this type such as known up to now, the pressure obtained at the outlet is not quite accurately determined because undesirable frictions occur in the transmission of the action of said control means to said by-pass valve.

The object of the present invention is to provide a pressure reducing device which obviates this drawback.

For this purpose, according to the invention, the action of the movable member is transmitted to the by-pass valve exclusively by a push-rod bearing at its ends respectively against said valve and against said movable member, the length of said rod being greater than the distance between said valve active portion and said annular region of said member, said valve and said member being shaped to accommodate said push-rod so that the only contact of said rod with said valve is on the other side of said valve active portion from said member and the only contact of said rod with said member is on the other side of said member annular region from said valve.

A preferred embodiment of the present invention will be hereinafter described, with reference to the accompanying drawings, given merely by way of example and in which:

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FIG. 1 is an axial sectional view of a carburation system comprising a pressure reducing device according to this invention;

FIGS. 2 and 3 are diagrammatical views of known devices given to indicate the drawbacks obviated by the present invention.

The carburation system shown by FIG. 1 comprises an intake pipe **22** through which air supplied through an air filter **33** flows in the downward direction. This pipe **22** is provided, upstream of an air throttle **23**, with a venturi **24** for measuring the flow rate of the air sucked in by the engine. In order to increase sensitivity, a second venturi **25** is disposed inside venturi **24**, coaxially therewith. A conduit **15** opens into the throat of venturi **25**.

Fuel is injected through calibrated orifice **11** into pipe **22** at a point thereof downstream of throttle **23**. This orifice **11** opens into a chamber **26** fed with air through a duct **27** and in which the pressure is close to atmospheric pressure. This chamber **26** opens into intake pipe **22** through an orifice **28** the cross section area of which is smaller as compared with that of duct **27** so that orifice **11** is not subjected to the suction which may exist in pipe **22** downstream of throttle **23**.

Fuel is supplied to orifice **11** from a pump **8** which delivers this fuel at a pressure higher than the desired pressure to be obtained at said orifice **11**.

The pressure reducing device with which the present invention is concerned is interposed between the delivery conduit **6** of pump **8** and a conduit **10** leading to injection orifice **11** to supply this orifice with fuel at the desired pressure.

This pressure reducing device comprises a cylindrical casing **1** forming a chamber **2** having, at its lower part, on the one hand, an inlet communicating with the pump delivery conduit **6** through a calibrated metering orifice **7** and on the other hand, an outlet communicating with conduit **10** which leads to injection orifice **11**.

Chamber **2** is open at the top to form a by-pass port the degree of opening of which is controlled by a by-pass valve **3** and through which an excess of fuel flows out into a body **12** to return therefrom through a conduit **13** to the fuel tank **9** serving to feed pump **8**. By-pass valve **3** comprises, at the top thereof, an active portion in the form of an annular disc cooperating with the edge of the by-pass port formed at the top of chamber **2**. By-pass valve **3** further comprises a stem **4** extending downwardly from said active portion and slidably guided in a sleeve **5** integral with casing **1** and coaxial therewith.

The pressure in chamber **2**, and therefore the pressure at which fuel is fed through the outlet conduit **10**, depends upon the degree of opening of by-pass valve **3**. This valve is urged upwardly by the fuel pressure in chamber **2** and downwardly by a push-rod **18** operated as it will be hereinafter explained. The force with which rod **18** pushes valve **3** downwardly therefore determines the pressure at the outlet **10** of chamber **2**.

The force acting on push-rod **18** is exerted by a diaphragm **14** itself subjected to the suction transmitted thereto through conduit **15** which opens into the throat of venturi **25**. In order to prevent this suction from acting upon valve **3**, there is interposed between said valve and diaphragm **14** a second gas-tight diaphragm **16** of an area substantially smaller than that of diaphragm **14**. A member **17** is carried by the central portions of these diaphragms **14** and **16** so that said member is movable in a direction coinciding, at least approximately, with the direction of the displacements of valve **3**. In view of the difference between the areas of diaphragms **14** and **16**, a suction transmitted through conduit **15** to the space between said diaphragms produces a downward displacement of member **17**. As said member is connected with valve **3** through rod **18**, this suction constitutes the factor of operation which determines the force with which valve **3** is urged downwardly and therefore the pressure of the fuel fed at the outlet **10** of chamber **2** of the pressure reducing device.

Now, in view of the fact that obviously all causes of friction between parts of the device should be avoided, the obvious arrangement is that illustrated by FIG. 2 where rod **18**, of a length just a little smaller than the distance between diaphragm **16** and the disc portion of valve **3** bears directly at its ends upon said parts **17** and **3**, respectively.

Such an arrangement indeed eliminates frictions as would exist if the transmission included hinges, but it introduces another cause of friction which will be explained with reference to FIG. 3. The suction forces acting on diaphragms **14** and **16** have a resultant f_1 the point of application of which is A, located substantially in the plane Q of diaphragm **14**. At point B where rod **18** is in contact with member **17**, a reaction force, equal and opposed to f_1 is exerted by rod **18** on member **17**. In a likewise manner, the fuel pressure applies an upward force f_2 on valve disc **3** at point *c* thereof located at the center of the under face of said disc **3** (the plane of this face being designated by P), and at point D where rod **18** is bearing upon valve **3** a reaction force equal and opposed to f_2 is exerted by said rod **18** upon valve **3**.

If valve **3** and member **17** constantly remained perfectly in line with each other, there would be no trouble. But in practice this is impossible and the two couples of forces (f_1 and the corresponding reaction force, f_2 and the corresponding reaction force) brought into play tend to produce the maximum possible misalinement between the axis of piece **17**, the axis of push-rod **18** and the axis of the stem **4** of valve **3**. The consequences are frictions, in particular between valve stem **4** and its guiding sleeve **5**, and strains in diaphragms **14** and **16**, which are distorted. Thus the pressure reducing device loses most of its sensitivity because the frictions and strains due to the above mentioned misalinement are considerable in regard of the accuracy to be obtained from the device.

In order to obviate this drawback, according to the present invention, valve **3** (with its stem **4**), member **17** and push-rod **18** are arranged in such manner that said rod **18** bears against valve **3** only at a point located on the other side of plane P from member **17** and that said rod **18** bears against member **17** only at a point located on the other side of plane Q from valve **3**.

For this purpose, the stem **4** of valve **3** is provided with an axial blind hole **19** extending downwardly from plane P and piece **17** is provided with an axial blind hole **20** extending upwardly from the lower end of said piece **17** to some distance above plane Q, and push-rod **18** is of a length greater than the distance between planes P and Q so that the ends of said rods bear respectively against the bottoms $\mathbf{19}_a$ and $\mathbf{20}_a$ of these holes **19** and **20**.

Thus each of the above mentioned couples of forces (f_1 and the corresponding reaction force on the one hand and f_2 and the corresponding reaction force on the other hand), instead of tending to increase misalinement between parts **17**, **18** and **3**, tends on the contrary to maintain alinement. Any risk of increased friction between valve stem **4** and its guide **5** and of distortion of diaphragms **14** and **16** is thus eliminated.

Holes **19** and **20** are made of slightly greater diameters than the respective portions of rod **18** engaged therein. Furthermore the bottom surfaces $\mathbf{19}_a$ and $\mathbf{20}_a$ and the ends of rod **18** are made of curved axial section, the radius of curvature of each rod end being smaller than the radius of curvature of the corresponding bottom surface $\mathbf{19}_a$ or $\mathbf{20}_a$.

Preferably, as shown, a spring **21** is interposed between the bottom of chamber **2** and the annular disc portion of valve **3** so as to balance the weight of the movable structure actuated by diaphragms **14** and **16**.

Owing to this spring, valve **3** is in wide open position when no suction is transmitted through conduit **15**, i.e. when the pressure on both sides of diaphragm **14** is the atmospheric pressure. The relative pressure in outlet conduit **10** is then zero and there is no fuel injection, which is correct since there is no air flow through intake pipe **22**. On the contrary, if there was not a spring such as **21**, the sensitivity of the device would produce a small relative pressure in outlet conduit **10** and fuel would be injected at **11** into intake pipe **22**.

In order to protect diaphragm **14**, a cover **29** is provided above it and the chamber **30** formed between said diaphragm **14** and cover **29** is placed in communication with the atmosphere through a hole **31**, either directly or preferably through a conduit **32** opening into intake pipe **22** just downstream of air filter **33**.

In a general manner while the above description discloses a preferred embodiment of the invention, it should be well understood that said invention is not limited to this embodiment as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of said invention as comprehended within the scope of the appended claims.

What I claim is:

1. For use in connection with a carburation system comprising an air intake pipe, a throttle in said pipe, a fuel injection orifice opening into said pipe downstream of said throttle, a venturi in said pipe upstream of said throttle, and a fuel pump for delivering fuel under pressure, a pressure reducing device for lowering the fuel pressure supplied by said pump to a value suitable for fuel injection through said orifice, which pressure reducing device comprises, in combination, a body, means in said body forming a vertical axis cylindrical chamber, said chamber having, at the bottom thereof, an inlet connected with the delivery of said fuel pump and an outlet connected with said fuel injection orifice, said chamber being open at the top to form a circular upper edge, a by-pass valve having a top portion in the form of a disc extending over said edge to control the gap between said edge and said disc, said valve further comprising a stem extending downwardly from said disc coaxially therewith, means in said chamber for guiding said valve stem coaxial with said chamber, a member in the form of a body of revolution about its axis, two horizontal annular diaphragms disposed one above the other in said body, said diaphragms having their outer peripheries fixed to said body above said chamber and their inner peripheries fixed to said member to hold it with its axis in line with the axis of said chamber, the upper diaphragm having an area greater than that of the lower one, conduit means for connecting the space between said two diaphragms with the throat of said venturi, said valve stem being provided with a blind hole extending axially therein from the top of said valve disc to some distance below it, said member being provided with a blind hole extending axially therein from the bottom end thereof to some distance above the plane of the upper diaphragm, and a push-rod of a length greater than the distance between said valve disc and the upper diaphragm, said rod having its ends applied respectively against the bottoms of said blind holes and being otherwise out of contact with said valve and said member.

2. A pressure reducing device according to claim 1

in which the ends of said rod are rounded and the bottoms of said holes are of curved concave shape, the radius of curvature of each rod end being smaller than that of the hole bottom against which it is bearing.

3. A pressure reducing device according to claim 1 further comprising a spring interposed between the bottom of said chamber and the disc portion or said by-pass valve, this spring being capable of balancing the total weight of the movable structure consisting of said valve, said stem and said member.

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