

March 27, 1945.

P. F. ADAIR

2,372,306

FUEL FEEDING DEVICE

Filed June 6, 1942

2 Sheets-Sheet 1

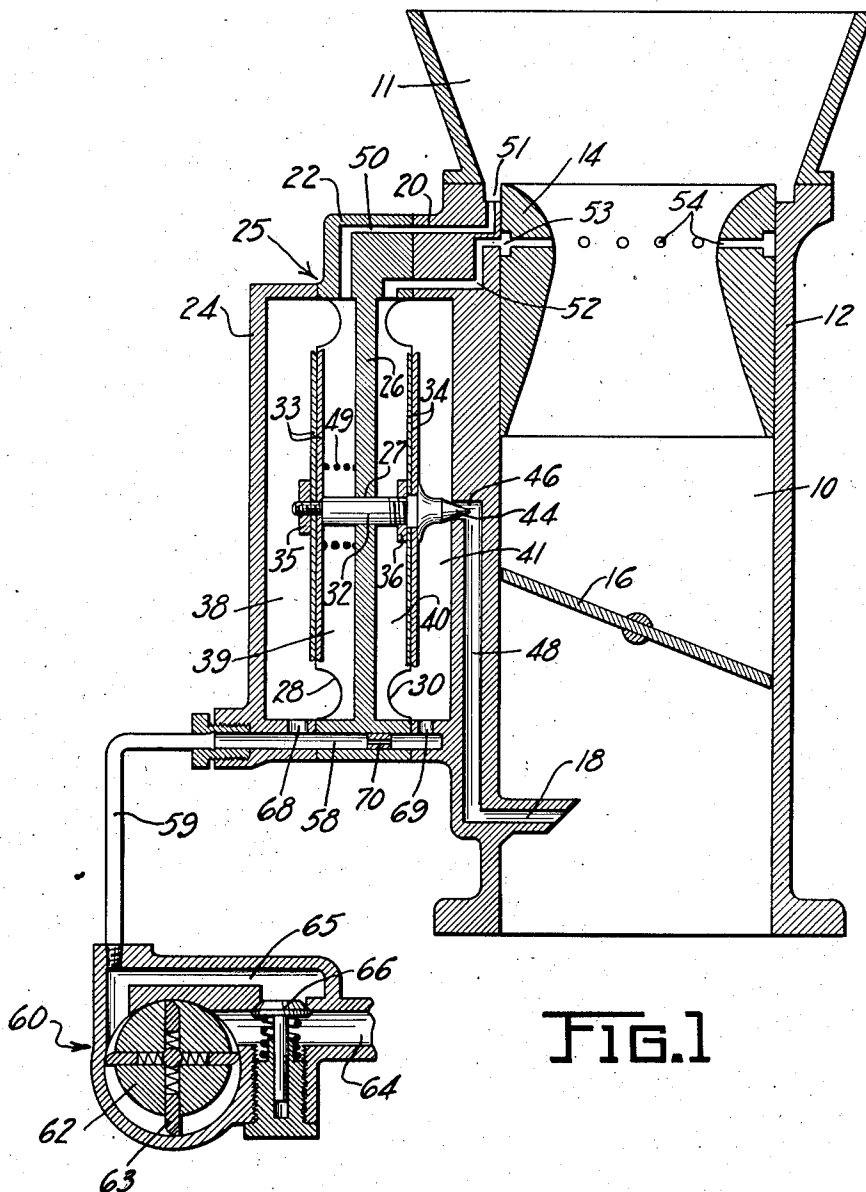


FIG. 1

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2 Sheets-Sheet 2

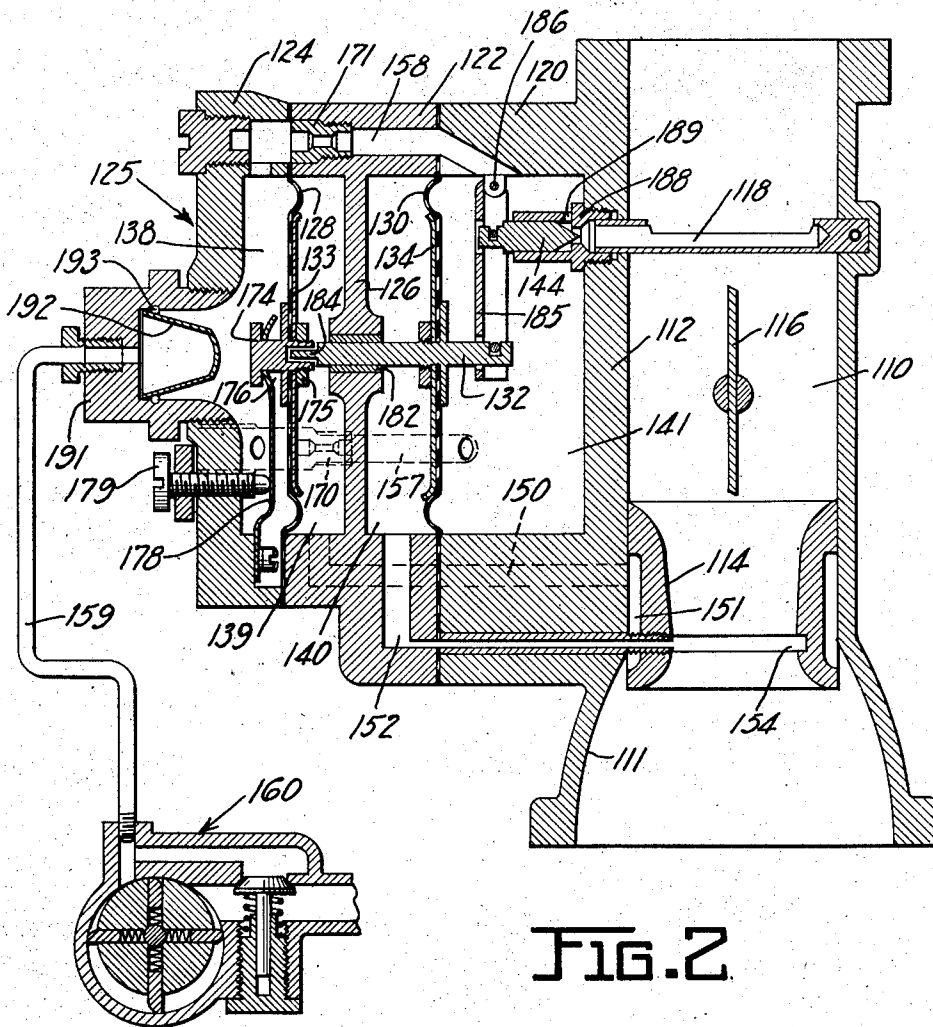


FIG. 2

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FUEL FEEDING DEVICE

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6 Claims. (Cl. 261—69)

This application relates to charge forming devices and more particularly to charge forming devices of the pressure feed type.

It is an object of the invention to provide a simple and compact pressure feed type of charge forming device.

Another object of the invention is to provide a charge forming device of the pressure feed type in which vapor forming tendencies are reduced to a minimum.

It is a still further object of the invention to provide a pressure feed type of carburetor in which vapor formed within the carburetor is automatically eliminated.

Another object of the invention is to provide a simplified pressure feed type of carburetor which may be automatically filled with fuel and in which vapor will automatically be eliminated whenever it forms.

Another object of the invention is to maintain the fuel under as high a pressure as possible until after it has been metered.

A still further object of the invention is to provide a simplified pressure feed carburetor of the anterior throttle type whereby induction passage icing is reduced to a minimum.

Another object of the invention is to provide an improved anterior throttle carburetor.

Other objects and advantages of the invention will be readily apparent to one skilled in the art from the following description taken in connection with the attached drawings wherein:

Figure 1 is a diagrammatic sectional view of one embodiment of the invention; and

Figure 2 is a similar view of another embodiment of the invention.

With reference to Figure 1 there is shown an induction passage 10 having a flared air inlet section 11 and a main body section 12 which includes a venturi 14, a pivotally mounted manually actuated throttle 16 and a fuel discharge nozzle 18 in series relation. If desired the air inlet section 11 may be bent at right angles and arranged to open in the direction of travel, in which case it is generally referred to as an air scoop.

The body section 12 is provided with a cylindrical recess surrounded by an annular attaching flange 20 to which sections 22 and 24 of a regulator indicated generally at 25 are secured by bolts, not shown, the center section 22 being provided with a web 26 having a central aperture 27. A pair of diaphragms 28 and 30, preferably having preformed annular grooves therein, are clamped at their outer edges between the

sections 24 and 22, and between section 22 and the flange 20 and are secured at their center portions to a rod 32, extending through the aperture 27, by means of diaphragm supporting plates 33 and 34 and lock nuts 35 and 36. The diaphragms 28, 30, web 26, and section 12 thus divide the interior of the regulator into four chambers 38, 39, 40 and 41. The rod 32 extends through and is freely slidable in the aperture 27, a relatively close fit being provided to minimize air leakage between the chambers 39 and 40. If desired, a sealing diaphragm may be provided between the rod 32 and web 26 to eliminate the air leakage. The rod 32 is provided at its right end with a valve 44 controlling a port 46 coaxially related to the chamber 41 and to rod 32 and communicating with a passage 48 leading to the nozzle 18. An idle spring 49 urges the rod 32 to the left in a direction to open the valve 44 and is preferably arranged to become effective as the valve 44 approaches a closed position.

A passage 50 connects chamber 39 to an annular groove 51 formed between the body section 12 and the venturi 14 which opens in the direction of air flow so as to be subjected to the impact of entering air in the inlet 11. A passage 52 connects the chamber 40 with an annular Venturi groove 53 in communication with the throat of the venturi by means of a plurality of ports 54. The chambers 39 and 40 are thus subjected to air inlet pressure and Venturi pressure respectively whereby a differential in these pressures resulting from air flow through the induction passage 10 will tend to move the rod 32 to the left and open the valve 44.

Fuel is supplied to a fuel passage 58 in the regulator through a pipe 59 by a fuel pump 60 which may be of any desired type, the one shown being of the sliding vane type having an engine driven rotor 62, sliding vanes 63, a fuel inlet 64 and a by-pass 65 controlled by a fuel pressure responsive valve 66 whereby fuel under substantially constant pressure is supplied to pipe 59. Ports 68 and 69 connect the chambers 38 and 41 with the passage 58 anterior and posterior to a metering element 70 respectively. The chambers 38 and 41 are thus subjected to unmetered and metered fuel pressures respectively whereby a differential in these pressures resulting from fuel flow through the metering element 70 will tend to move the rod 32 to the right and close the valve 44. The metering element 70 has been shown as an orifice of fixed size for convenience and simplicity; however, it will be apparent that the element may be of a variable area

type well known in the art whereby the fuel metering area may be increased if desired to provide a richer mixture under conditions of high power output, as well as at other times when a richer mixture may be desirable.

During operation the air flowing through the venturi 14 creates a differential in the pressures in the entrance 11 and in the venturi 14 which varies in accordance with the rate of air flow through the induction passage. These pressures being transmitted to the chambers 39 and 40 act upon the diaphragms 28 and 30 and urge the rod 32 to the left, in a direction to open the valve 34, with a force which likewise varies in accordance with the air flow.

Fuel discharged by the pump 50 flows through pipe 59, passage 58, orifice 70 and port 69, into chamber 41, past valve 44 and through passage 43 to the nozzle 10 from which it discharges into the air flowing through the induction passage 10. The flow of fuel through the orifice 70 creates a differential in fuel pressures anterior and posterior to the orifice which varies in accordance with the rate of fuel flow through the orifice. These pressures being transmitted to chambers 39 and 41 act upon the diaphragms 28 and 30 and urge the rod 32 to the right, in a direction to close the valve 34, with a force which likewise varies in accordance with the fuel flow.

The rod 32 and its valve 34 will position itself under the influence of the aforementioned air and fuel differential pressures to regulate the fuel flow so as to maintain the fuel and air differential pressures equal or proportional whereby constant fuel to air proportioning is maintained, unless the balance between these differential pressures is disturbed by some extraneous force such as idle spring 49. If the air flow increases, as by manual opening of the throttle 16, the differential between the pressures in chamber 39 and 40 will increase and open the valve 34 an additional amount whereby the fuel flow will be increased to compensate for the increase in air flow. A decrease in air flow will similarly result in a corresponding decrease in fuel flow.

The idle spring 49 urges the rod 32 in the same direction as the air differential force. As a consequence the fuel flow differential must be slightly increased to balance not only the air differential pressure but also the force of spring 49. At low rates of air flow, such as at idle, the air differential pressure is relatively small and as a consequence the force of spring 49, even though quite small, requires an appreciable percentage increase in the fuel flow to balance it. A rich mixture is thus produced at idle, as is desired. As the air flow and consequently the air differential pressure increase, the force of spring 49 becomes of decreasing effectiveness for enriching the mixture and becomes substantially negligible at air flows corresponding to cruising operation.

Figure 2 discloses another embodiment of the invention in which parts corresponding to similar parts of Figure 1 have been given corresponding reference numerals with the addition of 100. The carburetor of Figure 2 is an updraft carburetor in contrast to the downdraft carburetor of Figure 1 and includes an induction passage 110 having a flared air inlet 111, a venturi 114, a pivotally mounted manually actuated throttle 116, and a hollow tube nozzle bar 118 having its downstream portion cut away to form a slot through which the fuel discharges into the air

stream. The fuel regulator indicated generally at 125 includes an end section 124 and a center webbed section 122 secured by bolts not shown to an annular attaching flange 120 provided on the side of the induction passage body 112. Diaphragms 128 and 130 and web 126 divide the regulator into four chambers 138, 139, 140 and 141 in a manner similar to Figure 1.

The center portion of diaphragm 128 is supported by a plate 133, the diaphragm and plate being secured together by a bolt member 170 and nut 175. The member 174 is provided with an annular groove 176 in which is received the bowed end of a leaf type idle spring 178 adapted to be adjusted by means of an adjustment screw 179. The center portion of diaphragm 130 is supported by a plate 134, the diaphragm and plate being secured to a rod 132 slidably in a bearing member 182 mounted in the web 126. The rod 132 is provided at its left end with a reduced diameter portion loosely received within a cylindrical recess 184 in the end of the bolt member 174. The right end of rod 132 is connected, by means of a pin and groove connection, to a lever 185 pivoted at 186 and connected to a fuel control valve 144 slidable within a valve guide and seat member 188 having a fuel inlet port 189.

A passage 150 connects the air chamber 139 with an annular groove 151 provided in venturi 114 and in communication with the air inlet whereby chamber 139 is subjected to entering air pressure. A passage 152 leads from the air chamber 140 to an annular groove 154 located substantially at the throat of the venturi 114 whereby chamber 140 is subjected to the pressure in the venturi. Fuel chambers 138 and 141 are intercommunicated adjacent their bottoms and tops by passages 157 and 158, respectively, containing metering elements 170 and 171. Fuel is supplied to chamber 138 by a pump 160 through a pipe 159 connected to a fuel inlet fitting 191 threadedly mounted in the end section 124 and provided with a fuel straining screen 192 secured in the fitting by a snap ring 193.

During the carburetor fuel filling operation, the passage 157 permits the fuel chambers 138 and 141 to fill simultaneously. If the fuel chambers were not connected adjacent their lower portions, fuel entering chamber 138 would urge the diaphragm 128 to the right and close the valve 144 thereby trapping air in the chambers 138 and 141 and preventing automatic filling. The passage 158 has been located adjacent the uppermost portion of chamber 138 so that any small particles of air or vapor which are entrained in the fuel entering the chamber will be eliminated as quickly as they are received and cannot accumulate and so interfere with the operation of the device, as would be the case if only the passage 157 connected to the lower portion of chamber 138 were provided. For similar reasons of vapor elimination, the fuel valve 144 is located in the uppermost portion of chamber 141 and lever connected with the rod 132 in contrast to the coaxial valve and rod arrangement of Figure 1.

The floating connection between rod 132 and the bolt member 174 of diaphragm 128 eliminates binding or excessive bearing friction in the event the two diaphragms are not perfectly coaxially aligned, and permits angular rotation of one diaphragm relative to the other for aligning bolt holes and the like to facilitate assembly. Since the fuel pressure in chamber 138 is always great-

er than the air pressure in chamber 139 there is no tendency for the bolt member 174 and rod 132 to move away from each other. A similar connection may be provided at diaphragm 130 and in such case a stub rod slidable within bearing 182 and in abutting relation with the diaphragm bolt members would be used.

During normal operation, after filling, the modification of Figure 2 functions in the same manner as was previously described in connection with Figure 1.

In both modifications the main fuel control valve is positioned posterior to the metering orifice. Fuel under full pump pressure is thus supplied to the metering orifice and reaches the control valve at a pressure but moderately reduced due to the pressure drop through the metering orifice. As a consequence, the tendency for the fuel to vaporize prior to the point of metering, in which case it would severely interfere with the operation of the device, has been minimized. Since the chamber 38 (Figure 1) is subjected to full fuel pump pressure, any variations in supply pressure are transmitted undiminished to the regulator chamber and would necessitate a change in the position of valve 44 for each change in fuel supply pressure to maintain constant fuel proportioning. Although the regulator will maintain constant fuel proportioning, perhaps subject to a slight lag in reaction, even though the fuel supply pressure varies widely, it is preferable to eliminate such fuel supply pressure variations, and I consequently provide a fuel pump of the constant supply pressure type.

Although the invention has been described with reference to the particular embodiments disclosed in the drawings, it will be apparent that many changes or rearrangements of the parts may be made without departing from the spirit of the invention. For example, a valve coaxially related to the control rod, as shown in Figure 1, could readily control a passage connected to the top of the metered fuel chamber whereby at least a portion of the fuel supplied to the nozzle is withdrawn from the top of the chamber to eliminate vapor as in the modification of Figure 2. Many other modifications will likewise be apparent to one skilled in the art from the foregoing description taken in connection with the appended drawings, and it should therefore be understood that the invention is not limited to the particular embodiments disclosed, nor otherwise than in accordance with the subjoined claims.

I claim:

1. A charge forming device comprising an air passage, spaced parallel diaphragms forming movable walls of four chambers, a fuel inlet, a fuel conduit connecting the inlet to one end chamber and having a fuel metering restriction therein, means communicating the other end chamber with the conduit anterior to the restriction, means for subjecting the center two chambers to two pressures the difference of which varies with variation in air flow through the air passage, a fuel discharge passage leading from the upper portion of the said one end chamber, a valve in said passage, means forming an operative connection between the diaphragms, and a lever pivoted within the said one end chamber and forming an operative connection between the diaphragms and the valve.

2. A charge forming device for an internal combustion engine comprising an air induction passage, a fuel conduit for supplying fuel to the engine, means in the air passage for creating a

differential between two air pressures varying with variations in air flow through the passage, means in the fuel conduit for creating a differential between two fuel pressures varying with variations in fuel flow through the conduit, a valve controlling the flow of fuel through the conduit, coaxial parallel diaphragms, means forming operative connections between the diaphragms and between the diaphragms and the valve, said means including an abutting one-way connection intermediate the diaphragms adapted to permit relative angular displacement of one diaphragm with respect to another for purpose of alignment and to facilitate assembly, means for subjecting the diaphragms to the two air and two fuel pressures and so arranged that the pressures maintain the one-way connection in abutted relation whereby the diaphragms are shiftable as a unitary assembly and tend to move the assembly and valve in a direction to increase the fuel flow upon increase in the air pressure differential and in a direction to decrease the fuel flow upon increase in the fuel pressure differential.

3. A fuel and air proportioning device comprising an air supply passage, a fuel supply passage, means in the air passage for creating a differential between two air pressures which varies with variations in air flow through the air passage, means in the fuel passage for creating a differential between two fuel pressures which varies with variations in fuel flow through the fuel passage, a valve in one of said passages for controlling the flow therethrough, coaxial parallel diaphragms, means forming an operative connection between the diaphragms including an abutting connection adapted to accommodate misalignment of the diaphragms and to permit relative angular displacement of one diaphragm with respect to another during assembly, means forming an operative connection between one of the diaphragms and the valve, means for subjecting the diaphragms to the two air and two fuel pressures and so arranged that the pressures maintain the connection between the diaphragms in abutted relation whereby the diaphragms are shiftable as a unitary assembly and tend to move the valve to increase and decrease the flow through the valve controlled passage upon increase and decrease respectively in the flow through the other passage.

4. In a charge forming device for an internal combustion engine, an air induction passage, a fuel conduit for supplying fuel to the engine, a valve for varying the flow through the conduit, a casing, substantially coaxial parallel diaphragms in the casing forming movable walls of four chambers, means for subjecting the center two chambers to two air pressures the differential of which varies with variations in the air flow through the air passage, means for subjecting the outer two chambers to two fuel pressures greater than the air pressures, the difference between the two fuel pressures varying with variations in fuel flow through the fuel passage, means forming an operative connection between the diaphragms including an abutting connection for accommodating misalignment of the diaphragms and for allowing angular displacement of one diaphragm relative to another during assembly and adapted to be maintained in abutting relation under the influence of the pressures in the chambers whereby the diaphragms are shiftable as a unitary assembly in response to variations in said pressures, and a mechanical two-way connection between one of said diaphragms and the valve.

5. In a charge forming device for an internal combustion engine, an air passage, a fuel conduit for supplying fuel to the engine, a valve for varying the flow through the conduit, a casing, coaxial parallel diaphragms in the casing forming movable walls of four chambers, a member secured to the central portion of one of the diaphragms and positively connected to the valve, an operative connection between the diaphragms including parts in telescoping abutting connection for allowing angular displacement of one diaphragm relative to another diaphragm during assembly, one part being supported by a guide in the casing, means for subjecting the center two chambers to two air pressures having a differential which varies with variations in the air flow through the air passage, and means for subjecting the end two chambers to two fuel pressures having a differential which varies with variations in the fuel flow through the fuel conduit, said two fuel pressures being greater than the air pressures whereby the telescoping connection is maintained in abutting relation and the diaphragms are shiftable as a unitary assembly.

6. In a charge forming device for an internal combustion engine, a throttle-controlled air supply passage, a fuel supply passage, means in the air passage for creating a differential between two air pressures which varies with variations in air flow through the air passage, means in the

fuel passage for creating a differential between two fuel pressures which varies with variations in fuel flow through the fuel passage, a valve controlling the flow of fuel through the fuel passage, a casing, substantially coaxial parallel differential-pressure diaphragms mounted in said casing, a substantially rigid partition interposed between said diaphragms and in conjunction with the latter and the casing providing four chambers, two of said chambers being subjected to the air differential pressures and the other two chambers being subjected to the fuel differential pressures, means forming an operative connection between the two diaphragms and between the diaphragms and said valve including a member movably supported by said partition and connecting the central portion of one of said diaphragms to the valve for movement therewith and another member connected to the central portion of the other of said diaphragms and having an abutting cylindrical pin and socket connection with said first-named connecting member to permit movement of one diaphragm independently of the other, the arrangement being such that the differential air pressures and the differential fuel pressures act in opposition on said diaphragms to balance fuel flow against air flow for a given position of the throttle.

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