May 8, 1951 A. W. ORR, JR 2,552,056

CARBURETOR PRIMING MEANS

Filed Dec. 21, 1946 3 Sheets-Sheet 1

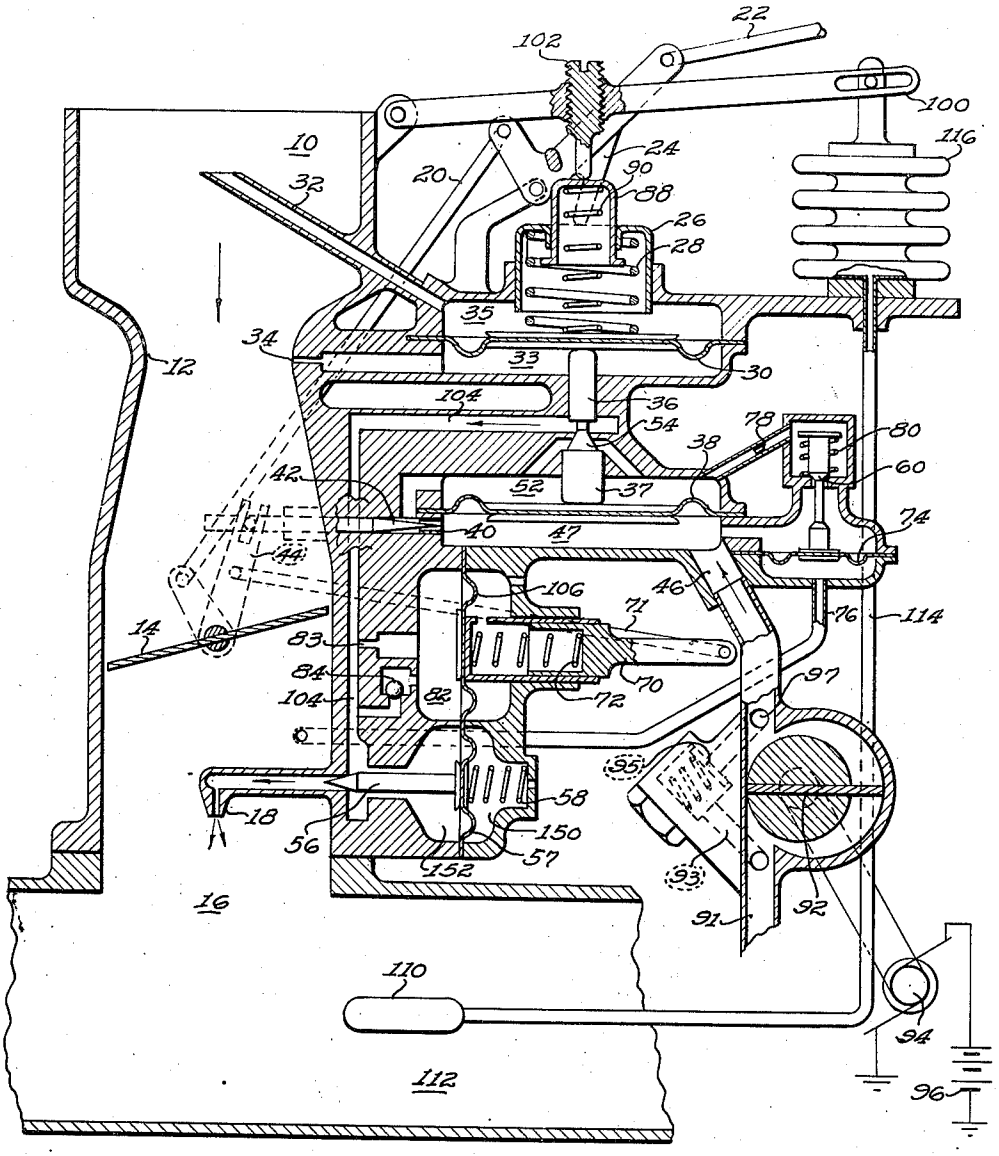

Fig. 1

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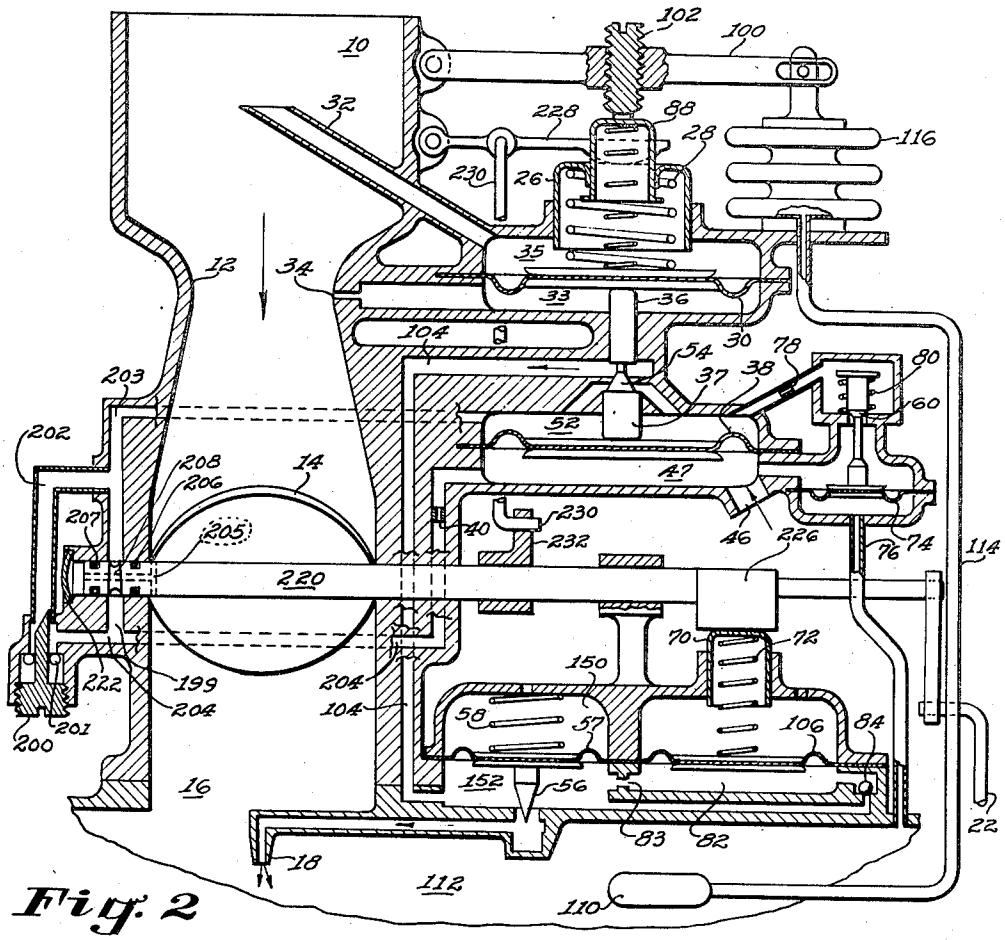

Fig. 2

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CARBURETOR PRIMING MEANS

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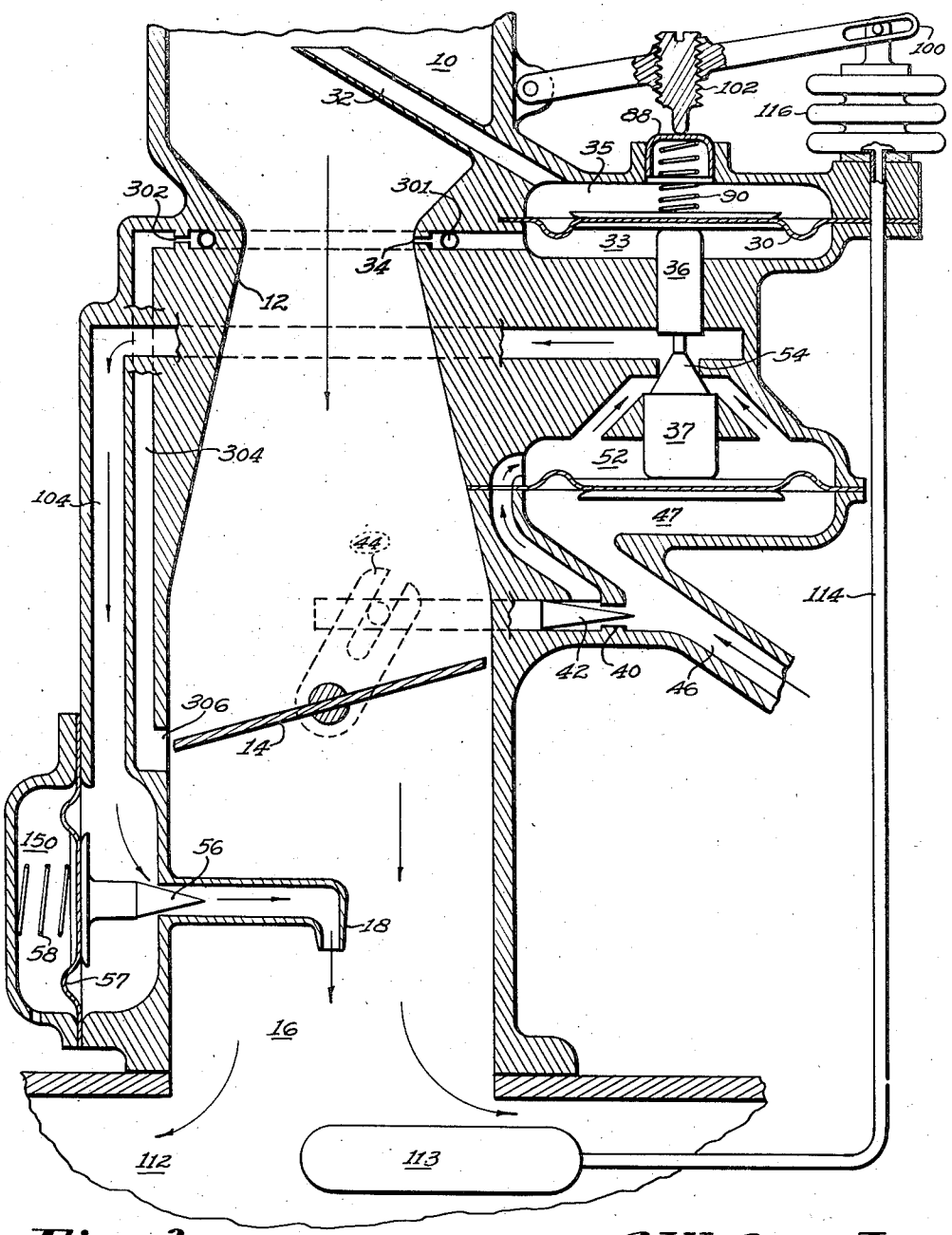

Fig. 3

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Patented May 8, 1951

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UNITED STATES PATENT OFFICE

2,552,056

CARBURETOR PRIMING MEANS

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Application December 21, 1946, Serial No. 717,673

2 Claims. (Cl. 261—39)

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The object of this invention is to incorporate in a small automotive or aircraft carburetor, of the pressure type, automatic priming means to take the place of the standard type of choke in general use for many years.

A further object of this invention is to incorporate in a small automotive or aircraft carburetor, of the pressure type, a cheap, simple, easy to manufacture and easily adjustable idle system.

This application is a continuation in part of my copending application filed August 8, 1946, Serial No. 689,260.

Fig. 1 is a cross-sectional elevation showing the essential elements of my invention.

Fig. 2 shows an alternative construction of my invention.

Fig. 3 shows a second alternative construction of my invention.

In Fig. 1 10 is the air entrance, 12 is the venturi, 14 is a throttle located downstream from the venturi 12, 16 is a mixture outlet into which the fuel nozzle 18 discharges.

20 is a link connecting the throttle 14 with a cam 24, a link 22 is the manual throttle control link. The cam 24 engages with a cap 26, which engages with a spring 28, which engages with a diaphragm 30. By this means increased pressure is applied to the diaphragm 30 as the throttle 14 approaches its idling position.

32 is a passage through which the pressure in the air entrance 10 is applied to chamber 35 and thus to the upper surface of the diaphragm 30, which diaphragm thereby responds to air flow because a restriction 34, which is an opening in the throat of the venturi 12, applies Venturi suction to the chamber 33 and thus to the lower side of the diaphragm 30.

A fuel control element 37 is engaged by the element 36 which in its turn is engaged by the air flow responsive diaphragm 30 and the element 37 is also engaged by a diaphragm 38. This element 37 engages with the diaphragm 38 and controls the flow of fuel past a conical valve 54 which is an integral part of the element 37.

An idle needle 42, connected through a lever 44 with the throttle 14, provides the low speed fuel control means. When the throttle 14 is opened any appreciable amount the needle 42 is withdrawn entirely and offers thereafter no resistance whatever to the flow of fuel. The resistance to the flow of fuel is then that due to the restriction 40 without the needle 42. Normally, therefore, the fuel flow through restriction 40 causes a pressure drop across fuel diaphragm 38 which

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balances the impressed air differential across air diaphragm 30 plus the pressures exerted by the two springs 28 and 90. The conical valve 54 regulates fuel flow so that such balance is maintained. The fuel is admitted to chamber 47 from the fuel entrance 46 under approximately constant pressure. The fuel flows to the upper side of diaphragm 38, to the chamber 52 through the restriction 40 and (when the throttle is closed) past the needle 42. The fuel leaves the chamber 52 past the conical valve 54 to the passage 104.

The pressure in the outlet passage 104 is maintained by a constant pressure discharge valve 56. Valve 56 is attached to diaphragm 57 and its opening is opposed by spring 58. Chamber 150 is exposed to atmospheric pressure so that the resulting pressure in chamber 152, to the left of diaphragm 57, and passage 104 is determined by the loading of spring 58. This system holds approximately constant fuel discharge pressure at any air flow or fuel flow. Acceleration is provided by the throttle lever 44, piston rod 70, link 71, spring 72 and diaphragm 106. A check valve 84 insures the prompt refilling of the chamber 82, to the left of diaphragm 106, whenever the throttle is closed. When the throttle is opened suddently the spring 72 is compressed so that fuel continues to discharge after the throttle 14 has ceased to move. A restriction 83 acting in conjunction with the spring 72 prolongs the discharge of accelerating fuel after the rotation of throttle shaft 220 and plate 14 has ceased.

One of the novel features of this invention resides in the means of priming the engine when starting, the description of which is as follows: 110 is a heat responsive bulb located in the inlet manifold 112. 114 is a pipe connecting temperature bulb 110 with a flexible bellows 116. Bellows 116 engages with a lever 100 which carries an adjustable stop 102. Stop 102 engages with a cap 88 enclosing a spring 90 which spring engages with the diaphragm 30. By this means the temperature of the mixture in the inlet manifold 112 regulates the mixture strength by varying the pressure on the spring 90. The fuel is supplied from a source (not shown) through a pump 92, driven by the electric motor 94 and a storage battery 96. Fuel enters at 91, flows through the pump 92 and is returned to the fuel entrance 91 by the passages 93 and 97. The pressure regulating valve 95 is spring loaded to maintain an approximate constant pressure in the chamber 47. The fuel is discharged by the pump 92 through passage 46 and flows below the diaphragm 38, through the restriction 40, past the idle restric-

tion 42, past the metering element 54, down the passage 104, past the valve 56 to the fuel outlet 18.

When the throttle is wide open a richer fuel/air ratio is desired. To obtain this richer fuel/air ratio a pipe 76 connects the underside of the diaphragm 74 with the inlet passage on the engine side of the throttle 14. A valve 60, unseated by a spring 80, admits fuel from the inlet 46 past a restriction 78 whenever the pressure below the throttle 14 rises, which it always does when the throttle is opened. Hence, the fuel/air ratio is temporarily increased whenever the throttle 14 is opened far enough to give manifold pressure sufficient to open valve 60.

Fig. 2 shows the preferred type of idle system actually used on my carburetor. All fuel except economizer fuel passes through a slot in the throttle shaft, a description of which follows: 40 is the main fuel metering jet. From 40 fuel passes through line 204, into a contoured slot 208, cut in throttle shaft 220. Slot 208 matches with a hole 199, from the passage 204. At small throttle openings, the basic idle mixture ratios are determined by the intersection of the contour of slot 208 with passage 199. From slot 208 the fuel passes through line 203, to chamber 52, which is the metered fuel pressure side of fuel diaphragm 38. Packing rings 206 and 207 are used to prevent fuel leaking along the throttle shaft. In case of slight fuel leakage past 207, drain passage 205 is provided. This passage is mostly vented to the pressure existing above rather than below the throttle 14 to maintain substantially atmospheric pressure on the left end of the throttle shaft 220. The Welsh plug 222 closes the throttle shaft bore in the throttle body casting to prevent leak. Idle fuel mixture adjustment is secured by a bypass fuel line 202 around the contoured slot 208 in the throttle shaft 220. In bypass line 202 is idle adjustment 200 which increases or decreases the amount of fuel bypassed around slot 208 giving idle fuel/air ratios. Packing ring 201 is provided to eliminate leakage across idle adjustment 200. The calibration of the idle system consists in contouring the closed throttle portion of slot 208 with hole 199.

The rotation of throttle shaft 220, to close the throttle 14 to the idle range, increases the load on spring 28 because the cap 26 is engaged by the lever through the link 228, which link 228 is rotated clockwise by the link 230 connected to the throttle shaft 220 by the lever 232. The cam 226, on the end of the throttle shaft 220, engages with the piston 70 operating the acceleration diaphragm 106, as before, through the spring 72. The valve 60 operates, as before, through the diaphragm 74 and passage 76. The valve 56 is operated, as before, and is controlled by the spring 58, as before. Fuel is discharged, as before, through a nozzle 18.

Temperature in the bulb 110 is transmitted to a bellows 116, and a stop 102 engages with a cap 88. The cap 88 engages with a spring enclosed therein. As before, an element 37 controls the flow past a needle 54. The element 37 engages an element 36 which engages the air responsive diaphragm 30. When the throttle 14 opens beyond the idle range the path from the passage 199 to the passage 203 is free and the metering orifice 40 thereafter regulates the mixture fuel/air ratio.

The other parts are numbered as in Fig. 1 and have the same function.

Fig. 3 shows a second alternative in which when the throttle 14 is moved to its idling position and the needle 42 assumes the position, as shown, the flow through the restriction 40 is limited by the needle 42.

The pressure differential acting on the diaphragm 30 is increased because of an opening 306, located mostly on the engine side of the throttle 14 (when the throttle 14 is in its idling position, as shown). This opening 306, which is in the shape of a narrow slot, communicates suction to the chamber 33 through the restriction 302 and the passage 301.

All the other elements have numbers similar to the numbers in Figs. 1 and 2 and have the same function as before.

The slot 306, passage 304, restriction 302 and the passage 301 connecting the restriction 302 with the chamber 33 have the same function as, and replace the elements 20 and 24, spring 28 and the cap 26 in Fig. 1.

Operation

When starting a cold engine the element 110 is cold and the element 116 is contracted. The finger 102 presses down on the spring 90 and imposes a load on the diaphragm 30. The fuel/air ratio is thus increased at all positions of the throttle 14, but proportionately more at the lower airflows and high manifold suctions.

As the engine warms up the lever 100 rises as the element 116 expands with a rise in temperature in passage 112. The load imposed on the diaphragm 30 by the spring 90 is thus reduced. The fuel/air ratio thus becomes progressively less as the temperature of the mixture in the inlet manifold 112 rises. The needle 42 in the restriction 40, creates a pressure drop in chamber 52 which is opposed by the spring load 28 and 90 acting on the diaphragm 30. The throttle 14, link 29, cam 24 engaging with cap 26, varies this spring load 28 as the throttle moves away from the idle position and at the same time opens the orifice 40 by withdrawing the needle 42. Meanwhile the air flow through venturi 12 is increasing and eventually an appreciable suction is built up in chamber 33 to supplement the spring load 28 and 90. The transition from idle to normal running is thus accomplished smoothly.

The normal operation of the carburetor is as follows: As the air flow increases the depression in the throat of venturi 12 is transferred to the chamber 33. The chamber 35, above the diaphragm 30 is in free communication with the air entrance 10 through the passage 32.

The fuel flow is from the pump which is designed to maintain approximately a constant pressure into the chamber 47. At wide open throttle the diaphragm 74 moves up under the influence of the spring 80 (the suction in passage 76 no longer being able to hold valve 60 closed.) The fuel drop for a given fuel flow is less now that fuel flows through both restrictions 40 and 78.

In Fig. 2 the throttle lever rotates the shaft 220 and thus opens the throttle 14 from its closed position. The spring 72 is then compressed and acceleration fuel is ejected from the chamber 82 through the restricted orifice 83. The slot 208 then opens so that fuel flows freely from passage 204 to passage 203, to chamber 52 above the diaphragm 38.

The spring load on the diaphragm 30 from the spring 28 is reduced as the lever 226 is pushed up (counter-clockwise) by the link 230 and lever 232. The lever 232 is rotated by the shaft 220, the throttle lever and the control link 22.

The fuel entering at **46** flows through the chamber **47** below the diaphragm **38**, through the restriction **40**, through passages **204**, **199** and **203** to the chamber **52**.

Otherwise the operation of the device as shown in Fig. 2 is the same as the operation of the device as shown in Fig. 1.

In Fig. 3 the operation is as before with the exception that when the throttle **14** is in the idling position (as shown) suction is imposed on the passage **304**. This suction is greater than the suction in the venturi **12** as applied to the opening **34** so that the suction in chamber **33** is greater than it was before. On the other hand the needle **42** has entered the orifice **40** and thus the fuel/air ratio is maintained within the desired limits.

This arrangement, and the alternative arrangement shown in Figs. 1 and 2, insures that comparatively large forces are always acting on the diaphragms **30** and **38** so that the motion of the metering elements **37—54**, as they move to regulate the fuel/air ratio in the idle range, are certain. If these elements **42—20—24** or elements **42—304** were omitted the forces acting on the diaphragms during idle would be too feeble to be effective. In that event some more arbitrary (that is more empirical) means would be used. The means shown although semi-empirical are also semi-automatic.

What I claim is:

1. A carburetor having an air entrance, a venturi therein, an air exit, a throttle valve therein, a fuel entrance, a chamber connected thereto, a diaphragm forming one wall of said chamber, a fuel exit from said chamber, a restriction in said fuel exit, a second fuel chamber on the other side of said diaphragm connected to said fuel exit, a fuel exit from the second fuel chamber, a metering valve therein, a second diaphragm, two air chambers one on each side of said second diaphragm, a passage connecting the high pressure side of said diaphragm to the air entrance pressure, a passage connecting the low pressure air chamber to the throat of said air venturi, a mechanical connection from said first and second diaphragms to said metering valve, a small bypass leading from the low pressure side of said second diaphragm and terminating in the wall of the air exit in a slot which is so located as to be gradually transferred from the atmospheric side to the engine side of said throttle as said throttle is moved towards its idling position, a fuel metering valve connected to said throttle, said fuel metering valve being adapted to cooperate with the restriction in said first fuel exit so that the pressure differences acting on the fuel responsive diaphragm and on the air responsive diaphragm are both increased gradually as the throttle is moved towards its idling position.

2. A carburetor having an air entrance, a venturi therein, an air exit, a throttle valve therein, a fuel entrance, a chamber connected thereto, a first diaphragm forming one wall of said chamber, a restricted fuel exit from said chamber, a second fuel chamber on the other side of said first diaphragm connected to said fuel exit, a fuel exit from said second fuel chamber, a metering valve therein, a second diaphragm, two air chambers one on each side of said second diaphragm, a passage connecting the high pressure side of said second diaphragm to the air entrance pressure, a passage connecting the low pressure air chamber to the throat of said air venturi, a mechanical connection from the first and second diaphragm to the fuel metering valve so that the drop in fuel pressure at said fuel restriction which acts on the first diaphragm just balances the air pressure drop at said air venturi which acts on the second diaphragm so that the air flow controls the flow of fuel, a movable abutment, a spring biasing the fuel metering valve to open position interposed between said abutment and the second diaphragm, temperature responsive means connected to the abutment so as to move it in the direction to increase the force exerted by the spring at low temperatures.

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