Nov. 7, 1950 A. W. ORR, JR 2,529,100

AIRCRAFT CARBURETOR

Filed April 27, 1946

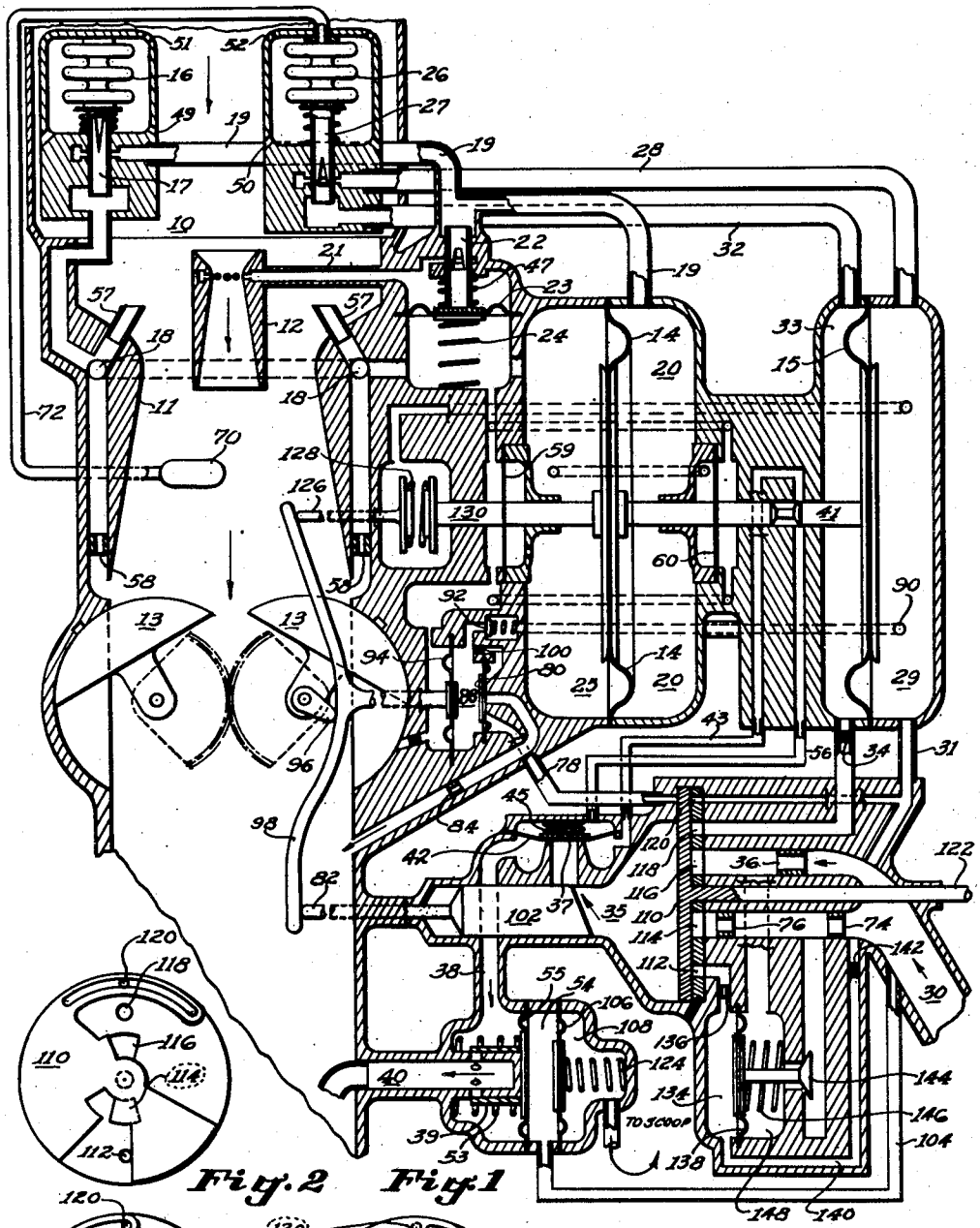


Fig. 1

Fig. 2

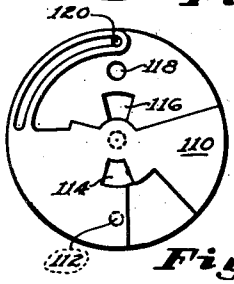


Fig. 3

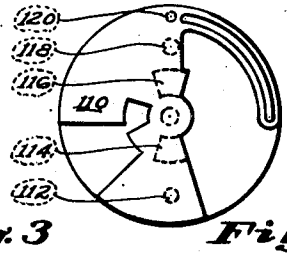


Fig. 4

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AIRCRAFT CARBURETOR

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12 Claims. (Cl. 261—39)

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The object of this invention is to control the fuel/air ratio by the quantity of air and also by the temperature and the pressure of the air flowing through a carburetor. One object is to separate the temperature responsive means from the means responsive to pressure.

Additional objects are to vary the enrichening fuel both as to quantity and as to the value of the main fuel flow above which it is desirable to add the enrichening fuel and to vary the idle fuel supply empirically after first temporarily disabling the automatic fuel/air ratio device. This application is a continuation in part of my application Serial No. 648,301, filed February 18, 1946, now Patent No. 2,465,550, issued March 29, 1949, which in its turn was a continuation in part of my application filed April 14, 1945, Serial No. 588,359, now abandoned.

Fig. 1 shows all the essential elements of my invention.

Fig. 2 shows the position of the control valve for a normal mixture ratio, commonly known as cruising lean.

Fig. 3 shows the position of the control valve for a rich mixture.

Fig. 4 shows the position of the control valve for the idle-cut-off position.

This carburetor consists of the ordinary air flow responsive diaphragm 14 which responds to the suction in the small venturi 12 and opposes the fuel flow responsive diaphragm 15 which diaphragm responds to the drop in fuel pressure at a fuel restriction 36, fuel being supplied through the passage 30 under pressure.

When the throttle 13 is opened the airflow is out of balance and more fuel is required. This extra fuel is supplied by the servomotor valve 41 which is moved to the right and opens the valve 37, which valve has a small hole in the middle. The pipe 56 allows the pressure above the valve 37 to escape through the pipe 43. This manner of regulating fuel flow in response to an increase or decrease in air flow is in almost universal use today for the control of the fuel/air ratio as the air throttle 13—13 is opened and shut. Barometric means 16 and temperature responsive means 26 correct for barometric and air temperature changes as will be described in greater detail hereafter. At extreme altitudes and air flows the valve 22 maintains the fuel/air ratio constant.

Manually operated (empirical) means are used to "take over" when the air flow is too feeble to make the automatic control device function, that is, when the throttle 13 is almost closed.

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These manual means include the throttle operated cam 96 and the fuel valve 102. A load is simultaneously imposed on the diaphragm 14 because the spring 128 is compressed which causes the valves 41 and 37 to open.

There is also a manual means to furnish the engine with both a cruising lean and with a cruising rich mixture ratio. This consists of the manually operated shaft 122 and the two restrictions 74 and 76 in series with each other and in parallel with cruising lean fuel restriction 36. This manually operated shaft rotates the disc valve 110 which also acts to cut off all fuel when the engine is stopped.

More specifically, in the Fig. 1, the air enters at 10 through venturi 11, flows past a small venturi 12, past a pair of throttles 13, which are geared together, and then the air passes on to the inlet of the supercharger. An air diaphragm 14 is provided with sealing diaphragms 59 and 60 of a well-known type, and is balanced against a fuel diaphragm 15 in a well-known manner. In an equally well-known manner, a partially evacuated chamber 16 controls a valve 17, which valve 17 admits a limited amount of air at the pressure of the air entrance 10 from an annular air chamber 18 through a pipe 19 to the chamber 20 to the right hand side (suction side) of the diaphragm 14. Impact tubes 57 and drain holes 58 are provided for the reason that the full atmospheric pressure of the air entrance 10 must be applied to the left hand side of the air flow responsive diaphragm 14. The drain holes 58 remove drops of water which would otherwise accumulate and permit the entire mechanism to freeze solid.

A passage 21 is connected to the throat of the small venturi 12 and to the passage 19 through a valve 22 which admits suction to the chamber 20 and is controlled by a diaphragm 23, a spring 24 and an opposing spring 47. At high suction in the venturi 12 there is automatically an increase in the area of the valve 22 between the pipe 21 and the passage 19. The chamber 18 communicates directly with the pressure chamber 25 to the left-hand side of the diaphragm 14. The diaphragm 14 thus responds to air flow, and the effect of air flow is corrected for changes in air density by reason of the evacuated bellows 16, which expands at high altitudes and pushes the valve 17 down and the valve 17 is adjusted to cooperate with valve 22. High airflow causes diaphragm 23 to rise and valve 22 increases its port area so that the Venturi suction has more and more effect on the right hand side of diaphragm 14 and thus calls for more

and more fuel flow. At high altitude, when the air flow approaches the critical value, there is a tendency for the mixture to become lean because the valve 17 descends so far that the pressure in chamber 20 is higher than it should be to maintain a constant fuel/air ratio. Although the density of the air falls the velocity increases greatly and the product of velocity squared times density increases. For a given air flow measured in pounds per hour there is thus an upward movement of the diaphragm 23 at the highest altitudes. This upward movement of the valve 22 counteracts the tendency of the altitude bellows 16 to "over compensate" at the highest altitudes.

At moderate altitudes the bellows 16 is the major control of the fuel/air ratio and the valve 22 plays only a very minor part in the regulation of the fuel/air ratio.

My invention consists in supplementing the action of bellows 16 by means of a temperature responsive bellows 26. The openings 49 and 51 insure a circulation of air around the elements 16. The openings 50 and 52 insure the circulation of air around the element 26. This bellows responds to the temperature variation in the air flowing through the venturi 11. This feature is partially described in my previously mentioned Patent No. 2,465,550. To accomplish this there is a bulb 70 which is located in the middle of the air stream and is connected through the pipe 72 to the bellows 26 so that at high temperature the valve 27 is in a more restricted position than it is at low temperature, at which position it is shown. The effect of high temperature is to restrict the connection through the valve 27 between pipes 32 and 28. Pipe 32 is connected to the chamber 33. Pipe 28 is connected to the chamber 29. Hence, the pressure difference between these two chambers is reduced at low temperature and is increased at high temperature. Fuel enters at 30 and normally passes through the restriction 36 thereby creating a pressure drop. Pipe 31 is connected to the fuel entrance 30 and transmits the pressure in the fuel entrance to the chamber 29. The restricted passage 34 is connected to the chamber 35 downstream of the restriction 36. This restriction 36 is uncovered when valve 110 is in the position shown in Fig. 2. Hence, fuel flow through the passage 30 causes a pressure drop at the restriction 36 which is reflected in the two chambers 29 and 33. When the valve 110 is in the position shown in Fig. 2 the mixture ratio corresponds to a normal mixture ratio.

Valve 110 controls the ports 112, 114, 116, 118, and 120. Rod 122 controls the position of valve 110. When the valve 110 is moved 40° counterclockwise into the position shown in Fig. 3 the port 114 is uncovered. In this event fuel flows through the two restrictions in series numbered 74 and 76. 74 is quite large relative to 76. The function of 74 is to limit the fuel added by valve 144. The area of 74 is 3 or 4 times as large as 76. 76 is relatively small as compared with 36. If the area of restriction 36 is 100 area of 74 is approximately 62 and area of 76 is approximately 20. For a given pressure drop there is a greater flow and therefore the fuel/air ratio is richer when the valve 110 is in the position shown in Fig. 3 when the ports 114 and 116 are open. When port 118 is open the chamber 35 is connected with the diaphragm chamber 33 through the restriction 34. Hence the fuel/air ratio is controlled by the temperature responsive bellows 26 and the barometric responsive element 16.

In both Figs. 2 and 3 port 120 is open. This port 120 permits high pressure fuel from the fuel entrance 30 to apply its pressure through a pipe 78. This pressure tends to unseat a valve 80 supported by a diaphragm. This fuel that flows by the valve 80 descends past the restriction 84 through the passage 82 to the downstream side of the throttles 13.

A chamber 88, to the left of the diaphragm valve 80, is connected to the chamber 29 through the passage 90. A spring loaded check valve 92 admits fuel flow from the chamber 88 to the chamber 29 but not from the chamber 29 to chamber 88. A diaphragm 94 forms the left hand wall of chamber 88.

The diaphragm 94 is operated by the cam 96 which is mounted on the shaft of the throttles 13. This cam 96 engages with a lever 98 which in turn engages with the diaphragm 94 so that when the throttles are open the diaphragm 94 moves to the left lowering the pressure in the chamber 88 and permits the valve 80 to move to the left. This provides a small quantity of fuel for acceleration purposes. A restricted passage 100 provides communication between the chamber 88 and the pipe 78. This port 120 is open in Figs. 2 and 3 and is closed in Fig. 4 which is the idle-cut-off position.

A low speed valve 102 controls the flow at low speed when the throttles 13 approach the closed position. Valve 102 restricts the flow from the chamber 35 to the passage 38. The perforated valve 37 supported by the diaphragm 42 and seated by the compression spring 45 regulates the flow from the chamber 35 to the passage 38. This regulation is accomplished by the servo-valve 41 and the passages 43 and 56. Passage 56, when the diaphragm 15 moves to the right, is in free communication with the passage 43 so that the only force seating the valve 37 is the compression spring 45. The pressure acting upwards on the diaphragm 42 is the pressure in the outlet passage 38 which fuel pressure is lower than the pressure in chamber 35. This low pressure acting through the passages 56 and 43 and valve 41 (when open) reduces the pressure above the diaphragm 42 and counteracts the effect of the perforation in the middle of the valve 37 which admits high pressure to the upper side of the diaphragm 42. The valve 37 rises and fuel flows by the valve 37 to the fuel outlet 40 past the valve 39. The valve 39 is supported by the diaphragm 55 and the spring 53 tends to open the valve 39.

Chamber 54, to the right of the diaphragm 55, is connected through the pipe 104 to the fuel entrance 30. The diaphragm 106, to the right of chamber 54, forms the left hand wall of the air chamber 108 which is connected to the air entrance 10. A compression spring 124 in the chamber 108 supports the fuel pressure in the chamber 54 and supports the right hand side of the diaphragm 106.

The idle spring 128 adds a force additional to that of the venturi throat differential pressure across diaphragm 14. This additional force increases the fuel differential across the main fuel metering jets 74, 76 and 36; the fuel flow is now decreased by the restriction imposed by the idling valve 102 which restriction is in series with the jets 74, 76 and 36. The combination of these two elements, the spring 128 and the valve 102, provides the carburetor with the desired fuel/air ratios. In the low cruising and all higher power

ranges both of these elements are almost completely removed from action.

When in the normal lean position port 112 is open. When in the rich position this port 112 is closed. This port 112 communicates with the chamber 134 through a restriction 136. A diaphragm 138 forms the right hand wall of the chamber 134 which chamber is connected through the passage 140 through the restriction 142 with the fuel entrance 30. An enrichening valve 144 is provided so that when the fuel flow exceeds a predetermined value then the drop in pressure downstream from the fuel restriction 36 (resulting from the predetermined fuel flow) causes the fuel/air ratio to depart from the constant value established by the opposing air and fuel diaphragms, the servomotor valve 41 and the valve 37, controlled by this servomotor valve 41.

The valve 144 is controlled by the diaphragm 138. Valve 144 is seated by the spring 146 and by the low pressure existing in the chamber 134. The chamber 148, to the right hand side of the diaphragm 138, is connected to the downstream side of restriction 36.

Operation

When the port 112 is open (Fig. 2 cruising lean) then the pressure in 134 is low and the opening of the valve (the enrichening valve) is delayed. However when valve 144 does open it opens quickly as the pressure drop through the single restriction 36 is greater than through the multiple restrictions 36, 74 and 76 (Fig. 3 cruising rich) because the restrictions 74 and 76 are in parallel with the restriction 36. It follows that although the enrichening valve opening is delayed by a low pressure in chamber 134 (Fig. 2) when it does open it makes up for lost time so that the ultimate mixture ratio at maximum air flow is the same both for cruising lean (Fig. 2) and cruising rich (Fig. 3).

The fact that restriction 74 feeds the fuel enrichening valve 144 when the mixture control 110 is in the lean position (Fig. 2) and feeds both 144 and the enrichening restriction 76 when the mixture control 110 is in the rich position (Fig. 3) means that the flow through 36 plus flow through 74 is the maximum fuel flow, so that the maximum attainable fuel flow is the same whether valve 110 is in rich or lean position, that is, in Fig. 3 or Fig. 2 position. When the throttle is moved towards its closed position the cam 96 gradually closes the valve 102 and also imposes a spring load (128) on the diaphragms 14—15 so that the servomotor valve 41 is opened and the pressure above and below the diaphragm 42 is equalized. The valve 37 is opened by the pressure in chamber 35 and the fuel flow is controlled by the restricted area past the low speed fuel valve 102. During the transition period, between empirical and automatic control, both the diaphragms gradually take over the control of the fuel flow as the valve 102 moves into its wide open, that is, into its inoperative position.

One or more of the following elements, barometric element 16, thermostatic elements 70 and 26, air flow responsive elements 22 and 23, can be dispensed with especially when the carburetor is applied to a marine engine. In that event the diaphragm 14 responds to the difference in suction between the air entrance 10 and the throat of the venturi 12, also the diaphragm 15 responds to the drop in pressure across the restriction 36 when the control is in the position shown in Fig. 2 and to the drop across restrictions 36 and 76 when the control is in the position shown in Fig. 3.

What I claim is:

1. In a carburetor having an air entrance and a venturi therein, an air chamber, an air diaphragm dividing the air chamber into two halves, a passage connecting the throat of said venturi to a low pressure side of said diaphragm, an automatic valve normally unseated and located in said passage adapted to be further opened by an increase in venturi suction, a second passage connecting the low pressure side of the diaphragm to the air entrance, a barometric responsive valve in said second passage, said valve being responsive to pressure of the air in the air entrance and being adapted to admit more air at air entrance pressure into the low pressure side of said diaphragm as the pressure in the air entrance decreases, a passage transmitting the air entrance pressure to the high pressure side of the air diaphragm, a fuel chamber, a diaphragm therein, dividing the fuel chamber into two halves, said diaphragm being arranged to oppose the movement of the air diaphragm, a fuel entrance, a fuel passage, a fuel restriction therein, a passage connecting the pressure side of said fuel diaphragm with the pressure on the upstream side of said fuel restriction, a passage connecting the low pressure side of said fuel diaphragm with the downstream side of said fuel restriction, an automatic fuel control valve, means inter-connecting the air and fuel diaphragms with said automatic fuel control valve so as to vary the fuel flow and maintain the two diaphragms in equilibrium so as to maintain a fuel/air ratio at an approximately constant value, a bypass from the high pressure side to the low pressure side of said fuel diaphragm, a valve in said bypass, a temperature responsive element connected to said valve being located so as to respond to the mean temperature of the air flowing through the air entrance, said temperature responsive valve being adapted to be moved to a relatively less restricted position at low temperature and to a relatively more restricted position at high temperature.

2. A device as set forth in claim 1 in which there is a mixture control valve and a second fuel passage in parallel with the first fuel passage and having a second fuel restriction therein quite small compared with the first mentioned fuel restriction, said second restricted fuel passage being adapted to be opened by said mixture control valve so as to give a somewhat richer mixture than when the first restricted fuel passage is used alone.

3. A device as set forth in claim 1 in which there is a bypass around the first mentioned fuel restriction, an automatic enrichening valve in said bypass, a third diaphragm operatively connected to said enrichening valve on the downstream side thereof, a chamber on the opposite side of said third diaphragm, an increase of pressure in said chamber being adapted to open said valve, means for varying the pressure in this chamber comprising a restricted bypass leading from the fuel entrance around said first mentioned fuel restriction and connecting with this said chamber associated with this third diaphragm, a port for varying the flow through said bypass, a second main fuel passage and a second fuel restriction in parallel with the first mentioned restriction, said second fuel restriction

being small compared with the first mentioned fuel restriction, a mixture control valve adapted when in the rich position to simultaneously open the second fuel passage and second fuel restriction therein and to control the port in said third diaphragm bypass so as to increase the pressure in the chamber on the valve opening side of said third diaphragm whereby the enrichening valve is caused to open at a less pressure difference across the first mentioned fuel restriction than when the mixture control is in its lean position so that the mixture begins to get richer than that given by the automatic means at a lower pressure difference when the control is in the rich position and the mixture stays leaner for greater fuel flows when the control is in its lean position.

4. In a device as set forth in claim 1 in which there are idling means to override the normal mixture ratio control means comprising mechanism operated by the throttle as the throttle approaches the idling position, to impose a yieldable load on the pressure side of the air diaphragm so as to increase the fuel flow and an additional fuel restriction inserted in series with the first mentioned fuel restriction so as to positively control the resulting increased fuel flow.

5. In a carburetor having an air entrance and a double venturi therein, an air chamber, an air diaphragm dividing the air chamber into two halves, a passage connecting the throat of said venturi to a low pressure side of said diaphragm, an automatic valve normally unseated and located in said passage adapted to be further opened by an increase in venturi suction, a second passage connecting the low pressure side of the diaphragm to the air entrance, a barometric responsive valve in said second passage, said valve being responsive to pressure of the air in the air entrance and being adapted to admit more air at air entrance pressure into the low pressure side of said diaphragm as the pressure in the air entrance decreases, a passage transmitting the air entrance pressure to the high pressure side of the air diaphragm, a fuel chamber, a diaphragm therein, dividing the fuel chamber into two halves, said diaphragm being arranged to oppose the movement of the air diaphragm, a fuel entrance, a fuel passage, a fuel restriction therein, a passage connecting the pressure side of said fuel diaphragm with the pressure on the upstream side of said fuel restriction, a passage connecting the low pressure side of said fuel diaphragm with the downstream side of said fuel restriction, an automatic fuel control valve, means inter-connecting the air and fuel diaphragms with said automatic fuel control valve so as to vary the fuel flow and maintain the two diaphragms in equilibrium so as to maintain a fuel/air ratio at an approximately constant value, idling means to override the normal mixture ratio control means comprising mechanism operated by the throttle as the throttle approaches the idling position, to impose a yieldable load on the pressure side of the air diaphragm so as to increase the fuel flow and an additional fuel restriction inserted in series with the first mentioned fuel restriction so as to positively control the resulting increased fuel flow.

6. In a carburetor having an air entrance and a double venturi therein, an air chamber, an air diaphragm dividing the air chamber into two halves, a passage connecting the throat of said venturi to a low pressure side of said diaphragm, an automatic valve normally unseated and located in said passage adapted to be further opened by an increase in venturi suction, a second passage connecting the low pressure side of the diaphragm to the air entrance, a barometric responsive valve in said second passage, said valve being responsive to pressure of the air in the air entrance and being adapted to admit more air at air entrance pressure into the low pressure side of said diaphragm as the pressure in the air entrance decreases, a passage transmitting the air entrance pressure to the high pressure side of the air diaphragm, a fuel chamber, a diaphragm therein, dividing the fuel chamber into two halves, said diaphragm being arranged to oppose the movement of the air diaphragm, a fuel entrance, a fuel passage, a fuel restriction therein, a passage connecting the pressure side of said fuel diaphragm with the pressure on the upstream side of said fuel restriction, a passage connecting the low pressure side of said fuel diaphragm with the downstream side of said fuel restriction, an automatic fuel control valve, means inter-connecting the air and fuel diaphragms with said automatic fuel control valve so as to vary the fuel flow and maintain the two diaphragms in equilibrium so as to maintain a fuel/air ratio at an approximately constant value, a bypass around the first mentioned fuel restriction, an automatic enrichening valve in said bypass, a third diaphragm operatively connected to said enrichening valve on the downstream side thereof, a chamber on the opposite side of said third diaphragm, an increase of pressure in said chamber being adapted to open said valve, means for varying the pressure in this chamber comprising a restricted bypass leading from the fuel entrance around said first mentioned fuel restriction and connecting with this said chamber associated with this third diaphragm, a port for varying the flow through said bypass, a second main fuel passage and a second fuel restriction in parallel with the first mentioned restriction, said second fuel restriction being small compared with the first mentioned fuel restriction, a mixture control valve adapted when in the rich position to simultaneously open the second fuel passage and second fuel restriction therein and to control the port in said third diaphragm bypass so as to increase the pressure in the chamber on the valve opening side of said third diaphragm whereby the enrichening valve is caused to open at a less pressure difference across the first mentioned fuel restriction than when the mixture control is in its lean position so that the mixture begins to get richer than that given by the automatic means at a lower pressure difference when the control is in the rich position and the mixture stays leaner for greater fuel flows when the control is in its lean position.

7. In carburetor having an air entrance and a double venturi therein, an air chamber, an air diaphragm dividing the air chamber into two halves, a passage connecting the throat of said venturi to a low pressure side of said diaphragm, an automatic valve normally unseated and located in said passage adapted to be further opened by an increase in venturi suction, a second passage connecting the low pressure side of the diaphragm to the air entrance, a barometric responsive valve in said second passage, said valve being responsive to pressure of the air in the air entrance and being adapted to admit more air at air entrance pressure into the low pressure side of said diaphragm as the pressure in the air entrance decreases, a passage transmitting the air entrance pressure to the high pressure side of the air diaphragm, a fuel chamber, a diaphragm therein, dividing the fuel chamber into two halves, said diaphragm being arranged to oppose the movement of the air diaphragm, a fuel entrance, a fuel passage, a fuel restriction therein, a passage connecting the pressure side of said fuel diaphragm with the pressure on the upstream side of said fuel restriction, a passage connecting the low pressure side of said fuel diaphragm with the downstream side of said fuel restriction, an automatic fuel control valve, means inter-connecting the air and fuel diaphragms with said automatic fuel control valve so as to vary the fuel flow and maintain the two diaphragms in equilibrium so as to maintain a fuel/air ratio at an approximately constant value, a bypass around the first mentioned fuel restriction, an automatic enrichening valve in said bypass, a third diaphragm operatively connected to said enrichening valve on the downstream side thereof, a chamber on the opposite side of said third diaphragm, an increase of pressure in said chamber being adapted to open said valve, means for varying the pressure in this chamber comprising a restricted bypass leading from the fuel entrance around said first mentioned fuel restriction and connecting with this said chamber associated with this third diaphragm, a port for varying the flow through said bypass, a second main fuel passage and a second fuel restriction in parallel with the first mentioned restriction, said second fuel restriction being small compared with the first mentioned fuel restriction, a mixture control valve adapted when in the rich position to simultaneously open the second fuel passage and second fuel restriction therein and to control the port in said third diaphragm bypass so as to increase the pressure in the chamber on the valve opening side of said third diaphragm whereby the enrichening valve is caused to open at a less pressure difference across the first mentioned fuel restriction than when the mixture control is in its lean position so that the mixture begins to get richer than that given by the automatic means at a lower pressure difference when the control is in the rich position and the mixture stays leaner for greater fuel flows when the control is in its lean position.

phragm as the pressure in the air entrance decreases, a passage transmitting the air entrance pressure to the high pressure side of the air diaphragm, a fuel chamber, a diaphragm therein, dividing the fuel chamber into two halves, said diaphragm being arranged to oppose the movement of the air diaphragm, a fuel entrance, a fuel passage, a fuel restriction therein, a passage connecting the pressure side of said fuel diaphragm with the pressure on the upstream side of said fuel restriction, a passage connecting the low pressure side of said fuel diaphragm with the downstream side of said fuel restriction, an automatic fuel control valve, means inter-connecting the air and fuel diaphragms with said automatic fuel control valve so as to vary the fuel flow and maintain the two diaphragms in equilibrium so as to maintain a fuel/air ratio at an approximately constant valve, a bypass around the first mentioned fuel restriction, a second restriction therein somewhat smaller than the first mentioned restriction, an automatic enrichening valve arranged in said bypass downstream from said second restriction, a third diaphragm operatively connected to said automatic enrichening valve on the downstream side thereof, a chamber on the opposite side of said third diaphragm, yielding means adapted to close said valve, an increase of pressure in said chamber being adapted to open said valve, means for maintaining a pressure in said chamber intermediate between the pressures above and below the first mentioned restriction comprising a restricted bypass leading from the fuel entrance to the downstream side of first mentioned fuel restriction, and connected with the said chamber, the opposite side of said diaphragm from said chamber being in free communication with the downstream side of said valve and of said first mentioned restriction, whereby the valve is opened when the drop in pressure across said first mentioned restriction increases and a considerable quantity of fuel is admitted but less than that admitted through the first mentioned restriction because the second fuel restriction is smaller than the first mentioned restriction.

8. In a carburetor having an air entrance and a double venturi therein, an air chamber, an air diaphragm dividing the air chamber into two halves, a passage connecting the throat of said venturi to a low pressure side of said diaphragm, an automatic valve normally unseated and located in said passage adapted to be further opened by an increase in venturi suction, a second passage connecting the low pressure side of the diaphragm to the air entrance, a barometric responsive valve in said second passage, said valve being responsive to pressure of the air in the air entrance and being adapted to admit more air at air entrance pressure into the low pressure side of said diaphragm as the pressure in the air entrance decreases, a passage transmitting the air entrance pressure to the high pressure side of the air diaphragm, a fuel chamber, a diaphragm therein, dividing the fuel chamber into two halves, said diaphragm being arranged to oppose the movement of the air diaphragm, a fuel entrance, a fuel passage, a fuel restriction therein, a passage connecting the pressure side of said fuel diaphragm with the pressure on the upstream side of said fuel restriction, a passage connecting the low pressure side of said fuel diaphragm with the downstream side of said fuel restriction, an automatic fuel control valve, means inter-connecting the air and fuel diaphragms with said automatic fuel control valve so as to vary the fuel flow and maintain the two diaphragms in equilibrium so as to maintain a fuel/air ratio at an approximately constant value, a second fuel supply passage in parallel with the first mentioned fuel restriction, a second and a third restriction in series in said second passage, the second restriction being upstream from the third and the second fuel restriction being between 50% and 70% of the area of the first mentioned restriction and the third restriction being between 10% and 30% of the area of the first mentioned restriction, a passage leading out of the second passage between the second and third restriction to the downstream side of said first mentioned fuel restriction, an automatic valve in said passage, means responsive to the pressure drop across first mentioned fuel restriction to open said automatic valve yieldable means opposing said opening, mixture control means for simultaneously closing the outlet from the third restriction and increasing the pressure drop across the first mentioned restriction necessary to open said automatic valve.

9. In a carburetor having an air entrance and a double venturi therein, an air chamber, an air diaphragm dividing the air chamber into two halves, a passage connecting the throat of said venturi to a low pressure side of said diaphragm, a passage transmitting the air entrance pressure to the high pressure side of the air diaphragm, a fuel chamber, a diaphragm therein, dividing the fuel chamber into two halves, said diaphragm being arranged to oppose the movement of the air diaphragm, a fuel entrance, a fuel passage, a fuel restriction therein, a passage connecting the pressure side of said fuel diaphragm with the pressure on the upstream side of said fuel restriction, a passage connecting the low pressure side of said fuel diaphragm with the downstream side of said fuel restriction, an automatic fuel control valve, means inter-connecting the air and fuel diaphragms with said automatic fuel control valve so as to vary the fuel flow and maintain the two diaphragms in equilibrium so as to maintain a fuel/air ratio at an approximately constant value, a bypass around the first mentioned fuel restriction, an automatic enrichening valve in said bypass, a third diaphragm operatively connected to said enrichening valve on the downstream side thereof, a chamber on the opposite side of said third diaphragm, an increase of pressure in said chamber being adapted to open said valve, means for varying the pressure in this chamber comprising a restricted bypass leading from the fuel entrance around said first mentioned fuel restriction and connecting with this said chamber associated with this third diaphragm, a port for varying the flow through said bypass, a second main fuel passage and a second fuel restriction in parallel with the first mentioned restriction, said second fuel restriction being small compared with the first mentioned fuel restriction, a mixture control valve adapted when in the rich position to simultaneously open the second fuel passage and second fuel restriction therein and to control the port in said third diaphragm bypass so as to increase the pressure in the chamber on the valve opening side of said third diaphragm whereby the enrichening valve is caused to open at a less pressure difference across the first mentioned fuel restriction than when the mixture control is in its lean position so that the mixture begins to get richer than that given by the automatic means at a lower

pressure difference when the control is in the rich position and the mixture stays leaner for greater fuel flows when the control is in its lean position.

10. In a carburetor having an air entrance and a double venturi therein, an air chamber, an air diaphragm dividing the air chamber into two halves, a passage connecting the throat of said venturi to a low pressure side of said diaphragm, an automatic valve normally unseated and located in said passage adapted to be further opened by an increase in venturi suction, a passage transmitting the air entrance pressure to the high pressure side of the air diaphragm, a fuel chamber, a diaphragm therein, dividing the fuel chamber into two halves, said diaphragm being arranged to oppose the movement of the air diaphragm, a fuel entrance, a fuel passage, a fuel restriction therein, a passage connecting the pressure side of said fuel diaphragm with the pressure on the upstream side of said fuel restriction, a passage connecting the low pressure side of said fuel diaphragm with the downstream side of said fuel restriction, an automatic fuel control valve, means inter-connecting the air and fuel diaphragms with said automatic fuel control valve so as to vary the fuel flow and maintain the two diaphragms in equilibrium so as to maintain a fuel/air ratio at an approximately constant value, a second fuel supply passage in parallel with the first mentioned fuel restriction, a second and a third restriction in series in said second passage, the second restriction being upstream from the third and the second fuel restriction being between 50% and 70% of the area of the first mentioned restriction and the third restriction being between 10% and 30% of the area of the first mentioned restriction, a passage leading out of the second passage between the second and third restriction to the downstream side of said first mentioned fuel restriction, an automatic valve in said passage, means responsive to the pressure drop across first mentioned fuel restriction to open said automatic valve yieldable means opposing said opening, mixture control means for simultaneously closing the outlet from the third restriction and increasing the pressure drop across the first mentioned restriction necessary to open said automatic valve.

11. In a carburetor having an air entrance and a double venturi therein, an air chamber, an air diaphragm dividing the air chamber into two halves, a passage connecting the throat of said venturi to a low pressure side of said diaphragm, an automatic valve normally unseated and located in said passage adapted to be further opened by an increase in venturi suction, a passage transmitting the air entrance pressure to the high pressure side of the air diaphragm, a fuel chamber, a diaphragm therein, dividing the fuel chamber into two halves, said diaphragm being arranged to oppose the movement of the air diaphragm, a fuel entrance, a fuel passage, a fuel restriction therein, a passage connecting the pressure side of said fuel diaphragm with the pressure on the upstream side of said fuel restriction, a passage connecting the low pressure side of said fuel diaphragm with the downstream side of said fuel restriction, an automatic fuel control valve, means interconnecting the air and fuel diaphragms with said automatic fuel control valve so as to vary the fuel flow and maintain the two diaphragms in equilibrium so as to maintain a fuel/air ratio at an approximately constant value, a bypass around the first mentioned fuel restriction, a second restriction therein somewhat smaller than the first mentioned restriction, an automatic enrichening valve arranged in said bypass downstream from said second restriction, a third diaphragm operatively connected to said automatic enrichening valve on the downstream side thereof, a chamber on the opposite side of said third diaphragm, yielding means adapted to close said valve, an increase of pressure in said chamber being adapted to open said valve, means for maintaining a pressure in said chamber intermediate between the pressures above and below the first mentioned restriction comprising a restricted bypass leading from the fuel entrance to the downstream side of first mentioned fuel restriction, and connected with the said chamber, the opposite side of said diaphragm from said chamber being in free communication with the downstream side of said valve and of said first mentioned restriction, whereby the valve is opened when the drop in pressure across said first mentioned restriction increases and a considerable quantity of fuel is admitted but less than that admitted through the first mentioned restruction because the second fuel restriction is smaller than the first mentioned restriction.

12. In a carburetor having an air entrance and a double venturi therein, an air chamber, an air diaphragm dividing the air chamber into two halves, a passage connecting the throat of said venturi to a low pressure side of said diaphragm, an automatic valve normally unseated and located in said passage adapted to be further opened by an increase in venturi suction, a passage transmitting the air entrance pressure to the high pressure side of the air diaphragm, a fuel chamber, a diaphragm therein, dividing the fuel chamber into two halves, said diaphragm being arranged to oppose the movement of the air diaphragm, a fuel entrance, a fuel passage, a fuel restriction therein, a passage connecting the pressure side of said fuel diaphragm with the pressure on the upstream side of said fuel restriction, a passage connecting the low pressure side of said fuel diaphragm with the downstream side of said fuel restriction, an automatic fuel control valve, means inter-connecting the air and fuel diaphragms with said automatic fuel control valve so as to vary the fuel flow and maintain the two diaphragms in equilibrium so as to maintain a fuel/air ratio at an approximately constant value, a bypass around the first mentioned fuel restriction, an automatic enrichening valve in said bypass, a third diaphragm operatively connected to said enrichening valve on the downstream side thereof, a chamber on the opposite side of said third diaphragm, an increase of pressure in said chamber being adapted to open said valve, means for varying the pressure in this chamber comprising a restricted bypass leading from the fuel entrance around said first mentioned fuel restriction and connecting with this said chamber associated with this third diaphragm, a port for varying the flow through said bypass, a second main fuel passage and a second fuel restriction in parallel with the first mentioned restriction, said second fuel restriction being small compared with the first mentioned fuel restriction, a mixture control valve adapted when in the rich position to simultaneously open the second fuel passage and second fuel restriction therein and to control the port in said third diaphragm bypass so as to increase the pressure in the chamber on the valve opening side of said diaphragm whereby the enrichening valve is

caused to open at a less pressure difference across the first mentioned fuel restriction than when the mixture control is in its lean position so that the mixture begins to get richer than that given by the automatic means at a lower pressure difference when the control is in the rich position and the mixture stays leaner for greater fuel flows when the control is in its lean position.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,361,227	Mock	Oct. 24, 1944
2,367,499	Holley, Jr.	Jan. 16, 1945
2,378,036	Reggio	June 12, 1945
2,394,664	Chandler	Feb. 12, 1946
2,417,304	Kittler et al.	Mar. 11, 1947
2,442,046	Hunt	May 25, 1948