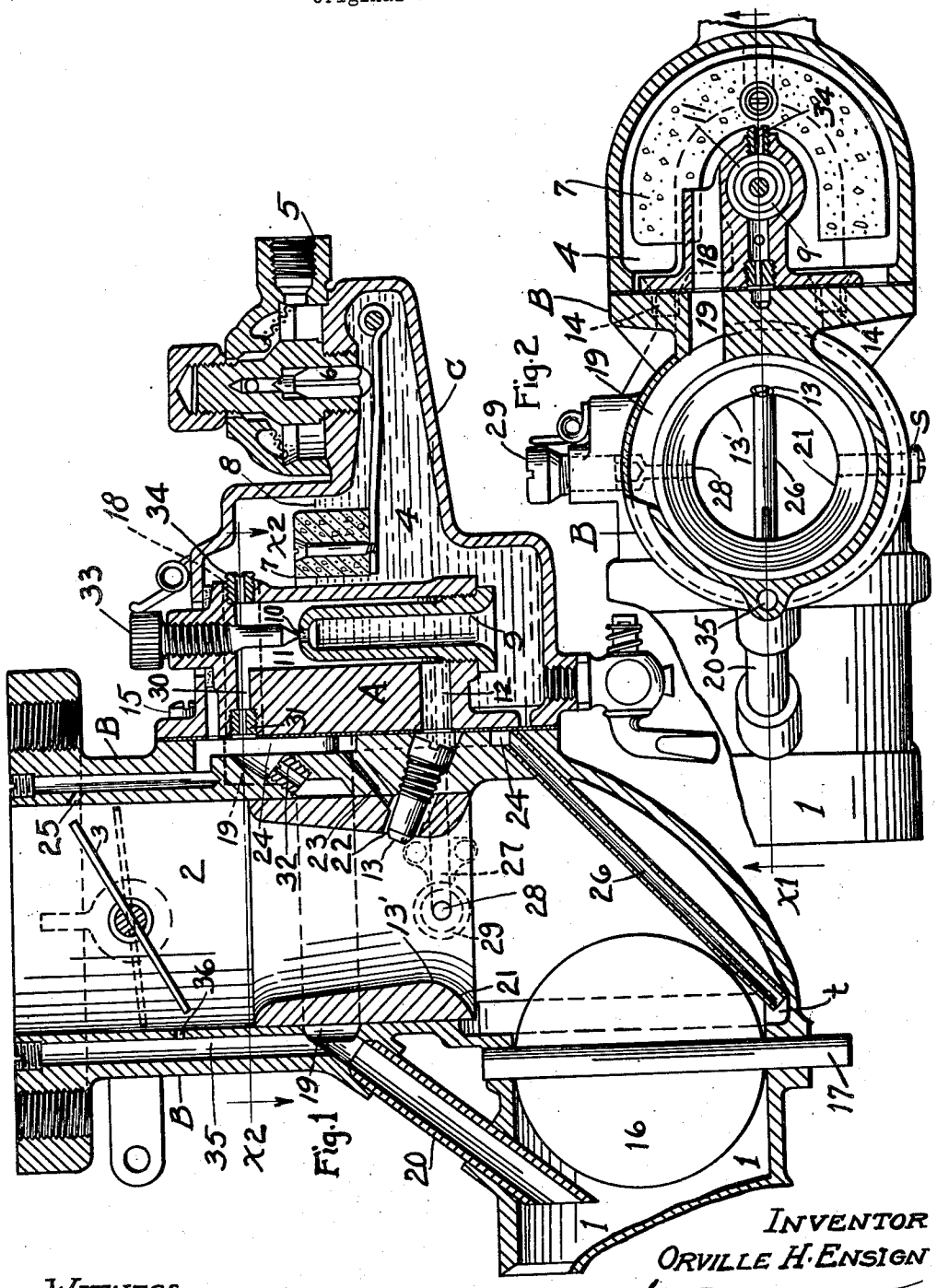
April 7, 1931. O. H. ENSIGN 1,799,585

CARBURETOR

Original Filed Oct. 6, 1925 2 Sheets-Sheet 1



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WITNESS
Robt. B. Woolsey

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CARBURETOR

Original Filed Oct. 6, 1925 2 Sheets-Sheet 2

Fig. 3

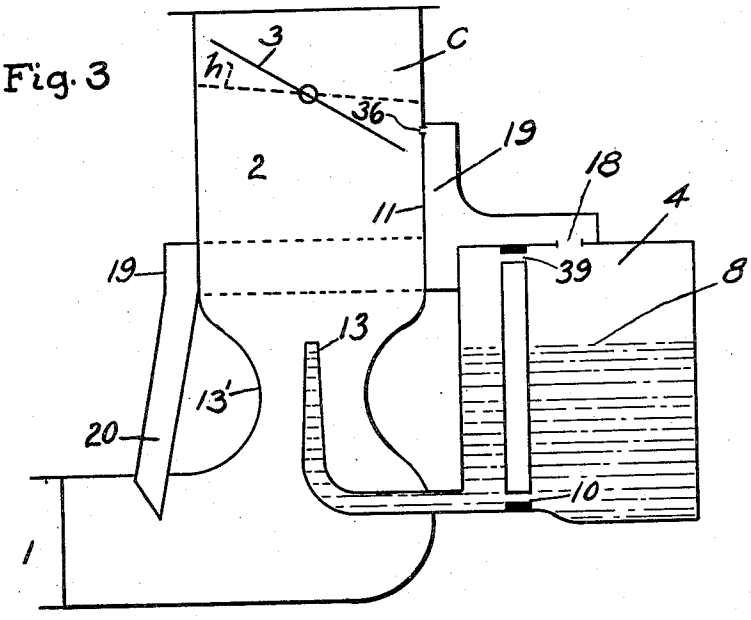
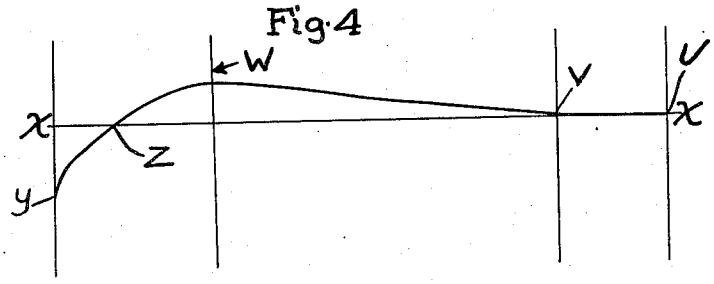


Fig. 4



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1,799,585

UNITED STATES PATENT OFFICE

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CARBURETOR

Application filed October 6, 1925, Serial No. 60,755. Renewed September 2, 1930.

This invention relates to carburetors for internal combustion engines and especially pertains to the development of maximum economy during par throttle operation.

In this invention I have made provision whereby I make use of the vacuum or depression above the throttle applied through the movement of the throttle only, to cause a depression upon the air in the float chamber to reduce the flow of the fuel through the nozzle during part throttle operation under governor control from about one fifth engine load to full engine load.

I have discovered with relation to the improvements in carburetors of the character above described, that it is possible to automatically cause the production of an appropriate lean mixture for the engine during its operation between something less than quarter load, and full load, and to automatically return to the production of mixture of necessary richness at full load; and this I have done by providing such carburetor with a port communicating between the suction chamber and the float chamber, specifically via the balancing system, and so located with respect to the throttle that as the throttle begins to open from light load toward full load, it will pass said port so that there will be applied thereto and to the float chamber, a depression from the engine side of the throttle, beginning at a position of the throttle that will control the engine at something less than quarter load; and that as the throttle opens to full load, the depression on the float chamber via the balancing system diminishes.

An object of this invention is to provide a carburetor adapted to be operable by simple movements of the throttle alone to produce and utilize, during part throttle operation, the leanest practical mixture possible; and to do this without measurably affecting the mixture required during the low speed idling range of operation, and, by further simple movements of the throttle, alone, to produce and utilize the necessary rich mixtures for maximum power at wide open throttle.

In carrying out this invention I provide means for applying to the float chamber from above the throttle, a controlled variable depression, beginning at a small engine load position of the throttle, at a point beyond the slow speed idling position thereof, and continuing to wide open throttle.

I shall describe the invention as applied to a carburetor having a float bowl or constant level fuel chamber, a suction passage, a throttle therein, a fuel nozzle, an air intake, and a balancing means connecting the air intake with the float chamber and with the fuel nozzle, and forming the only air supply to said float chamber above the constant liquid level therein; said carburetor having an "economizer" port communicating with the balancing means and opening into the suction passage near and below that edge of the throttle which, in the operation of opening the throttle from low speed position, moves against the air stream; said port being adapted to receive and apply to the float bowl a controlled fraction of the manifold depression from the engine side of the throttle as such throttle moves from the light load position toward wide open position.

I have reduced this invention to practice by applying a certain port and passage arrangement to the balancing system set forth in my patent for carburetor, No. 1,506,229, issued August 26, 1924; and to the general type of carburetor design set out in my application, Serial No. 40,532, filed June 30, 1925 for carburetor. Said application describes, among other things, the application of the patented balancing system to the general type of carburetor shown in the present application; and also sets out the system of fuel feed and idling by-pass that is here shown. In-so-far as there is common novel subject matter in this and said copending application, said application carries the claims thereto, including the idling by-pass system. There are, however, certain aspects in which the idling by-pass and "economizer" (of this application) act in conjunction to produce the whole economical and efficient action desired; and those aspects of combination are treated of here.

The location and size of the "economizer" port determines the amount of the depression

in the constant level chamber at the different throttle positions for different loads, and thereby determines the character of the mixture at each point on the load curve.

Other objects, advantages and features of invention may appear from the accompanying drawings, the subjoined detailed description and the appended claims.

The invention may be understood by reference to the accompanying drawings.

Figure 1 is a vertical section illustrating the application of this invention to a carburetor of the form shown in my application, Serial No. 40,532, filed June 30, 1925.

Fig. 2 is a broken fragmental section on line $x2$, Fig. 1.

Fig. 3 is a diagram of the invention applied to a carburetor of a simple type, the fuel supply and adjusting and idling means not being shown.

Fig. 4 is a diagram showing a mixture curve indicating the air to fuel ratio at different points on the load under throttle control.

The carburetor shown in Figs. 1 and 2 is provided with an air intake 1, a suction passage 2 controlled by a throttle 3, and a float bowl or constant level fuel chamber 4 supplied with fuel through the usual fuel connections 5 controlled by the valve 6. A float 7 in the fuel chamber 4 cooperates with the valve 6 to maintain the fuel in said chamber at a constant level 8.

Fuel is delivered from the constant level fuel chamber to the suction passage through a fuel passage, which comprises a fuel riser 9 opening into a suction chamber 11 through a fuel orifice 10, which may be located at any suitable height in said riser but is preferably located near the upper end thereof above the normal fuel level. The riser 9 is spaced from the walls of the suction chamber 11 to provide ample clearance for fuel and air flow from the fuel orifice to the fuel nozzle. The lower end of the suction chamber is extended in the form of a U-tube comprising a horizontal passage 12, which opens through an inclined nozzle 13 to the main air stream slightly above the smallest diameter of the Venturi throat 13'. The bottom of this U tube will collect and hold fuel in transit when the carburetor is shut down.

The major portion of the fuel passage from the float bowl is formed in a bracket member A, which is secured by screws 14 to the flanged face of the main body member B, which contains the air intake and suction passage. A member C that forms the constant level fuel chamber 4 is secured by screws 15 to the member B and encloses the bracket member A when in position.

The air intake may be provided with the usual choke 16 which may be operated by any usual means connected to the shaft 17.

The fuel chamber 4 is supplied with air through a balancing means that comprises a duct 18 formed in the member A and connected to a cored passage 19 formed in the member B and a balance tube 20 that leads from the air intake into the cored passage 19, thus supplying air to the float chamber at a pressure coordinating with the air pressure in the air intake.

The suction passage is provided at its lower end with a Venturi tube 21 of the usual form, having an opening to accommodate the fuel nozzle and affording a clearance 22 around the nozzle, and secured in the suction passage by a screw S extending through the wall of the member B and through the venturi 21.

The clearance 22 around the nozzle 13 communicates with passage 23 forming a part of the idling by-pass 24 which leads to the idling orifice 25, above the throttle.

The idling by-pass 24 is shown as being connected to the by-pass tube 26 which is extended to the sump t. The idling by-pass 24 is also extended laterally by a drill hole 27 to an idling adjustment vent 28, which is located slightly below the smallest diameter 13' of the venturi, and is controlled by a valve 29.

The passage through which the idling depression is applied to lift fuel through riser 9, comprises a passage 30 directly open to the suction chamber 11 through a calibrated plug 31.

The calibrated plug 32 connects between the balancing system and the idling by-pass 24 to make it possible to bring the range of the idling control within adjustment of valve 29 when shifting the carburetor from one motor to another.

Maximum power adjustment is made by adjusting valve 33 which controls the fuel orifice 10. The calibrated plug 34 admits or furnishes air vent to further atomize the fuel flowing through the nozzle 13, and to assist in developing the proper mixture curve.

The structure thus far described is that of the carburetor set out in my copending application referred to. In the following will be described the characteristically novel elements of the present invention and their modes of operation and their cooperation with certain features of the structure thus far described.

The duct 35 is a portion of this particular invention, and in the arrangement shown in Fig. 1, communicates with the balancing system at the junction of the balance tube 20 with the cored passage 19. The port 36 is located below and near the level of the throttle at the closed throttle position, so that when the throttle is opened to a small fractional load position, depression is applied from above the throttle to the balancing system, thereby affecting all the connections thereto, including the pressure within the float chamber.

In the particular type of carburetor to which this invention is shown applied in Fig. 1, the balancing system is so connected to the float chamber that air pressure corresponding to the pressure in the air intake is applied to the float chamber and, modified, to the fuel nozzle, and such balancing system is also connected through 32 to the idling by-pass and thence to the venturi through the nozzle clearance and to the sump. The connection of the balance system from the air intake is comparatively large relative to the economizer port 36 so that there is practically free flow of air from the air intake to the float chamber and to the fuel nozzle.

In operation under load, the flow of air through the venturi causes at the end of the nozzle 13 a depression which is applied through the U-shaped passage, to the fuel orifice 10 and the calibrated vent 34, and causes fuel to flow through said passage along with air from the calibrated vent 34 and such fuel and air issues from nozzle 13 into the venturi to mingle with the main air stream. When idling, the velocity of air through the venturi is not sufficient to cause the correct amount of fuel to flow through the orifice 10, nor is it sufficient to lift such fuel from the nozzle up to the nearly closed throttle. The lifting of such fuel is provided for in the idle by-pass system extending from the clearance space 22 through passages 23, 24 terminating in the idling orifice 25 above the throttle when idling. The idling fuel delivered through nozzle 13 is drawn into the clearance 22 and delivered through the idling orifice 25.

The idling by-pass consisting of the clearance space 22 around the nozzle 13, the passage 23 and the extension of this passage 24 up to the idling orifice 25 must be so proportioned that, with the air bleed through the calibrated plugs 32, 34 and through the tube 26 and the further air bleed through the adjusted vent 28 there will be caused the correct amount of suction to be applied through calibrated plug 31 to lift fuel through orifice 10, and also the correct amount of suction to be applied to the end of clearance sapce 22 to deliver fuel from the nozzle and draw it through the idling by-pass and deliver it through idling port 25. This occurs when the engine is idling and when, as stated above, the Venturi depression applied to nozzle 13 is not sufficient to lift fuel through orifice 10. Immediately the throttle is opened beyond idling position, the Venturi suction becomes sufficient to raise the fuel through orifice 10 and, the applied suction at port 25 becoming less by reason of throttle opening, the suction then applied by the idling by-pass to orifice 10 becomes less and particularly so because that suction is relieved by air entry at 32 and 26 as well as at 34. Thus, although the idling by-pass may continue, even at open throttle, to pull some fuel up from clearance 22 and nozzle 13, its effect in initially lifting and feeding that fuel through orifice 10 begins to fall off at a throttle opening very little more than idling position.

Furthermore, in operation of this particular invention as applied in Fig. 1, when the throttle valve 3 is closed, to the idling position shown by the dotted lines, there is practically no effect upon the balancing system or upon the depression in the float chamber from the depression on port 36 through the duct 35; but as the edge of the throttle valve 3 approaches and passes the comparatively small port 36 in picking up load, the high depression above the throttle is applied to the balancing system causing an increased flow of air through the tube 20 to supply the draft of clean air through port 36 to thin the mixture and also to cause a drop of pressure in the cored way 19, and thence to all of its connected ports or vents, and increases the depression in the float chamber, and so modifies the depression in the float chamber as to diminish the flow through the nozzle 13, thus producing a highly economical mixture under fractional loads; when the throttle is wide open, port 36 being so small in proportion to the balancing system, the effect is so slight on the mixture that it can be ignored or corrected by change of plug 34, to obtain the desired mixture proportion throughout the range of the carburetor operation.

Referring more particularly to the diagram Fig. 3 illustrating the sectional view of a carburetor provided with an air intake 1, and a suction passage 2 controlled by a trottle 3; and having a constant level fuel chamber 4 supplied with fuel at a constant level 8, by means of the usual devices, not shown; fuel is delivered to the contracted portion 13′ of the suction passage 2 from the constant level fuel chamber by way of the restricted fuel orifice 10 and the fuel nozzle 13.

The balance tube 20 picks up pressure and velocity head in the air intake, and conveys it by the passage 19 around the suction passage 2 to the connecting port 18 which applies air to the surface of the fuel in the fuel chamber, and this air is furnished to the fuel jet nozzle by means of the restricted vent 39.

The point w represents a point on the curve sage 19 and the suction passage 2 at a point slightly below the throttle when it is closed in the idling position shown in dotted line h.

The location of port 36 in a carburetor applied to an automobile engine, should be such that the throttle upon being opened will pass said port 36 at a predetermined automobile speed, as about 15 miles an hour on the level. In fact, for maximum economy in any given case, the port 36 should be and is so placed that the throttle passes it, and the resultant economizing action of mixture thinning be-

gins, as low as possible in the load range of the engine, consistent with not interfering with proper idling operation and smooth pick-up and operation. In an automobile engine, this point may be put typically at about 15 miles per hour on the level. Defining this point with relation to throttle position (although that varies for different carburetors, different engines, conditions of operation, etc.) it may be said that port 36 is so positioned that the throttle edge passes it when the throttle is only fractionally open. The drawing shows that in this particular design the throttle passes port 36 at a position about 22° opening (angle from the horizontal). This varies in different carburetors, several different actual devices on several different engines showing opening angles from 18° to 33°; but the largest such angle is distinctively what may be termed a minor-fractional position of opening.

And the point of opening at which the throttle passes port 36 and economizing action begins may also be defined with relation to operation of the idling by-pass; the economizing action beginning late enough in the opening movement that the idling action is not interfered with. The throttle does not pass port 36 until the idling by-pass suction of feeding fuel has fallen off, as explained before and the main nozzle has begun to feed fuel. Consequently the idling arrangement and the economizing arrangement cooperate to give the engine at all times just the desired mixture.

As the car increases its speed to 15 miles per hour and is held at that speed by the throttle, the manifold depression will still be relatively high, being from 5 to 7 pounds below that of the atmosphere; and on account of this high depression much better vaporizing takes place in the manifold than would take place with a wide open throttle; therefore, a much thinner mixture can be used and will be supplied to the engine; and the mixture will continue to thin out, up to a predetermined speed, as 25 miles per hour, for instance.

In this invention at this point where a thinner mixture can be utilized, the edge of the throttle disk 3 passes the port 36 and applies manifold depression at that particular speed to modify the depression in the balancing system, and thus reduces the pressure on the surface of the fuel in the constant level fuel chamber 4, thereby diminishing the flow of the fuel therefrom through the nozzle 13. Such effect will continue until the throttle reaches the position that will hold the car at a predetermined speed on the level, of 35 miles an hour more or less. From there on the further opening of the throttle will cause this modified depression in the balancing system to rapidly fall.

The balancing system openings 20 and 19, and the port 18 should be relatively large, and the port 36 relatively small so that the effect on the balancing system of the depression remaining above the contracted portion 13′ of the suction passage will be slight at wide open throttle position, which is the desired position of throttle for all speeds of the car at maximum power mixture.

This device is particularly novel in that it makes possible by changing the size and location of port 36, within the limits stated, to so modify the mixture throughout that portion of the power curve under throttle control, that the very thinnest mixture that can be successfully burned in an engine cylinder may be delivered and used at the points where the speed is under definite control by the throttle; and this is effected without interfering with the operation from very low speeds up to where the thinning can safely begin and still give full power mixture under wide open throttle.

The above described operation is illustrated by the diagram shown in Figure 4. The line x—x may be taken to represent a constant mixture throughout the full speed range on a motor under throttle control, the line z, w, v represents the modification of such a mixture by this invention as the engine is speeded up by opening the throttle.

The line x—x may be assumed to represent a mixture having a ratio of air and fuel of 14 to 1, which is a little richer than the best chemical mixture.

Any point assumed on the curves indicates that particular mixture at a sustained speed under throttle control on a level road.

The point y may represent a mixture of about 10 to 1 for idling.

The point z indicates the point where the edge of the throttle is at the port 36.

The point w represents a point on the curve at about 25 miles an hour for a motor car, while the point v represents a point between 35 and 40 miles per hour, and u represents maximum speed.

The point w may represent a fuel ratio as thin as 17 to 1 depending upon the heating arrangements used on the motor, while at the point v, and continuing on to u, the mixture has returned to the normal of about 14 to 1 for full load work or any wide open throttle work, thus illustrating that for part loads under part throttle control, the thinnest possible mixture that can be economically burned can be produced and supplied to the engine by this device.

In the foregoing description I have used the terms one quarter load or one fifth load to mean that where for instance, a tractor engine is being operated under a governor at constant speed, and the load is reduced to one quarter or one fifth of the maximum that the engine can pull, the governor will have caused the throttle to assume a position

which will hold the engine at the loads one quarter or one fifth maximum at the normal speed. The position of the port 36 must be located carefully to get the best results on each different engine.

I claim:

1. A carburetor having a constant level fuel chamber, a suction passage, a throttle in the suction passage, a fuel nozzle, an air intake, and balancing means connecting the air intake with the fuel chamber, said balancing means forming the only air supply to the fuel chamber above the liquid level; said carburetor having a port communicating with the balancing means and located in the wall of the suction passage near but wholly spaced from the closed throttle and exclusively at the intake side of that edge of the throttle which moves toward the intake upon opening, and said port being so placed with relation to the throttle that said throttle edge passes said port and puts said port in communication with the depression at the suction side of the throttle when the throttle is opened to a minor fraction of its full opening; and said carburetor having an idling passage which by-passes the fuel nozzle and communicates with the suction passage, the communication of the idling by-pass with the suction passage and the communication of said port with the balancing means being independent of each other.

2. A carburetor having a constant level fuel chamber, a suction passage, a throttle in the suction passage, a fuel nozzle, an air intake, and balancing means connecting the air intake with the fuel chamber, said balancing means forming the only air supply to the fuel chamber above the liquid level, said throttle being of the rotating butterfly type which stands across the suction passage in closed position and is rotated to approximate parallelism with the suction passage axis to reach fully open position; the said carburetor having a port communicating with the balancing means and located in the wall of the suction passage near but wholly spaced from the closed throttle and exclusively at the intake side of that edge of the throttle which moves toward the intake upon opening, so that when the throttle is in or near closed position it cuts off the application of suction to said port, and said port being so located with reference to the throttle that said throttle edge on its opening movement passes said port at a minor-fractional angle of opening and thus applies suction to said port at and beyond said angle of opening; and said carburetor having an idling passage which by-passes the fuel nozzle and communicates with the suction passage, the communication of the idling by-pass with the suction passage and the communication of said port with the balancing means being independent of each other.

3. A carburetor having a constant level fuel chamber, a suction passage, a throttle therein, a fuel nozzle and an air intake; said carburetor having a port communicating with the fuel chamber above the fuel level and located in the wall of the suction passage near but wholly spaced from the closed throttle and exclusively at the intake side of that edge of the throttle which moves toward the intake upon opening, and said port being so placed with relation to the throttle that said throttle edge passes said port and puts said port in communication with the depression at the suction side of the throttle when the throttle is opened to a minor fraction of its full opening, and said carburetor having an idling passage which by-passes the fuel nozzle and communicates with the suction passage, the communication of the idling by-pass with the suction passage being independent of the communication of said port with the fuel chamber.

4. A carburetor having a constant level fuel chamber, a suction passage, a throttle in the suction passage, a fuel nozzle and an air intake, the throttle being of the rotating butterfly type which stands across the suction passage in closed position and is rotated substantially to a position parallel with the suction passage axis to reach its full open position; said carburetor having a port communicating with the fuel chamber above the fuel level therein and located in the wall of the suction passage near but wholly spaced from the closed throttle and exclusively at the intake side of that edge of the throttle which moves toward the intake upon opening, so that when the throttle is in or near closed position it cuts off the application of suction to said port, and said port being so located with reference to the throttle that said throttle edge on its opening movement passes said port at a minor-fractional angle of opening and thus applies suction to said port at and beyond such angle of opening, and said carburetor having an idling passage which by-passes the fuel nozzle and communicates with the suction passage, the communication of the idling by-pass with the suction passage being independent of the communication of said port with the fuel chamber.

5. A carburetor having a constant level fuel chamber, a suction passage, a throttle in the suction passage, a fuel nozzle, an air intake, and balancing means connecting the air intake with the fuel chamber, said balancing means forming the only air supply to the fuel chamber above the liquid level; said carburetor having an economizer port communicating with the balancing means and located in the wall of the suction passage near but wholly spaced from the closed throttle and exclusively at the intake side of that edge of the throttle which moves toward the intake upon opening, and said port being so placed

with relation to the throttle that said throttle edge passes said port and puts said port in communication with the depression at the suction side of the throttle when the throttle is opened to a minor fraction of its full opening; said carburetor also having an idling system comprising an idling by-pass leading from the fuel nozzle to a delivery point in the suction passage located at the suction side of the throttle, and means in connection with the by-pass adapted to feed fuel from the fuel chamber to the fuel nozzle by virtue of the depression applied to the idling system from the suction side of the throttle when the throttle is substantially closed, the arrangement being such that, upon opening movement of the throttle, the feed of fuel to the nozzle by the idling system substantially lessens by the time the throttle reaches its position at which suction is applied to said port communicating with the balancing means.

6. A carburetor having a constant level fuel chamber, a suction passage, a throttle in the suction passage, a fuel nozzle and an air intake, the throttle being of the rotating butterfly type which stands across the suction passage in closed position and is rotated substantially to a position parallel with the suction passage axis to reach its full open position; said carburetor having a port communicating with the fuel chamber above the fuel level therein and located in the wall of the suction passage near but wholly spaced from the closed throttle and exclusively at the intake side of that edge of the throttle which moves toward the intake upon opening, so that when the throttle is in or near closed position it cuts off the application of suction to said port, and said port being so located with reference to the throttle that said throttle edge on its opening movement passes said port at a minor-fractional angle of opening and thus applies suction to said port at and beyond such angle of opening; said carburetor also having an idling system comprising an idling-by-pass leading from the fuel nozzle to a delivery point in the suction passage located at the suction side of the throttle, and means in connection with the by-pass adapted to feed fuel from the fuel chamber to the fuel nozzle by virtue of the depression applied to the idling system from the suction side of the throttle when the throttle is substantially closed, the arrangement being such that, upon opening movement of the throttle, the feed of fuel to the nozzle by the idling system substantially lessens by the time the throttle reaches its position at which suction is applied to said port communicating with the fuel chamber.

7. A carburetor comprising a constant level fuel chamber, a suction passage having an air inlet and a fuel and air mixture outlet, a throttle in the suction passage, and a fuel nozzle communicating with said fuel chamber; means for supplying to said suction passage outlet a comparatively rich fuel and air mixture during idling operations when the throttle is closed or nearly closed; said carburetor having a port, independent of said idling mixture supply means, communicating with the space above the fuel level in said float chamber and located in the wall of the suction passage near but wholly spaced from the closed throttle and exclusively at the intake side of that edge of the throttle which moves toward the intake upon opening, and said port being so located with relation to the throttle that said throttle edge passes said port and puts said port in communication with the depression at the suction side of the throttle when the throttle is opened to a minor fraction of its full opening but beyond its position of idling operation; an abnormal depression, transiently in the opening movement of the throttle, being thereby applied to the fuel chamber by way of said port to cause a transient abnormal decrease in the proportion of fuel delivered from the nozzle after the throttle moves beyond its position of idling operation.

8. A carburetor having a constant level fuel chamber, a suction passage having an air inlet and a fuel and air mixture outlet, a throttle in the suction passage, a fuel nozzle communicating with said fuel chamber, and balancing means connecting the air inlet and the fuel chamber, said balancing means forming the only air supply to the fuel chamber above the liquid level; means for supplying to said suction passage outlet a comparatively rich fuel and air mixture during idling speed operation when the throttle is closed or nearly closed; said carburetor having a port, independent of said idling mixture supply means, communicating with the balancing means and located in the wall of the suction passage near but wholly spaced from the closed throttle and exclusively at the intake side of that edge of the throttle which moves toward the intake upon opening, said port being so located with relation to the throttle that said throttle edge passes said port and puts said port in communication with the depression at the suction side of the throttle when the throttle is opened to a minor fraction of its full opening but beyond its position of idling operation; an abnormal depression, transiently in the opening movement of the throttle, being thereby applied to the fuel chamber by way of said port to cause a transient abnormal decrease in the proportion of fuel delivered from the nozzle after the throttle moves beyond its position of idling operation.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 29th day of September, 1925.

ORVILLE H. ENSIGN.