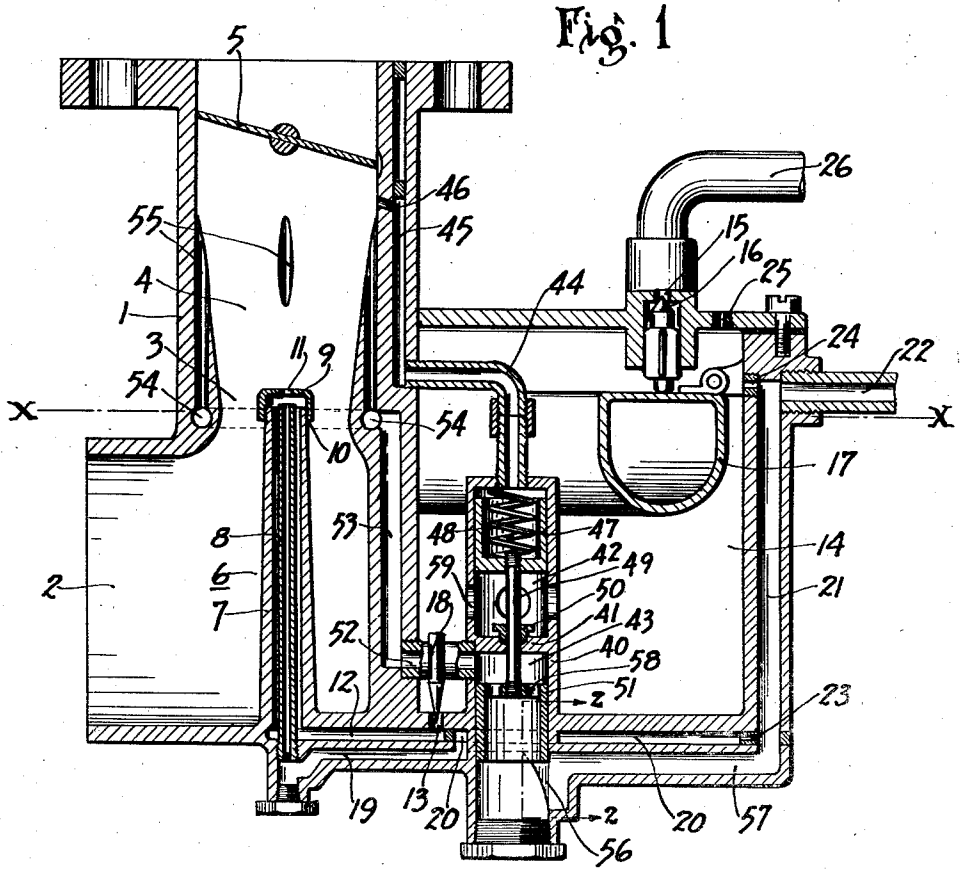
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CARBURETOR

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Fig. 1



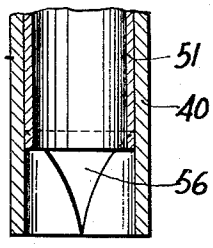


Fig. 2

INVENTOR.
Augustin M. Prentiss
BY A. P. McCrady
ATTORNEY.

Sept. 25, 1934. A. M. PRENTISS 1,974,585

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Fig. 3

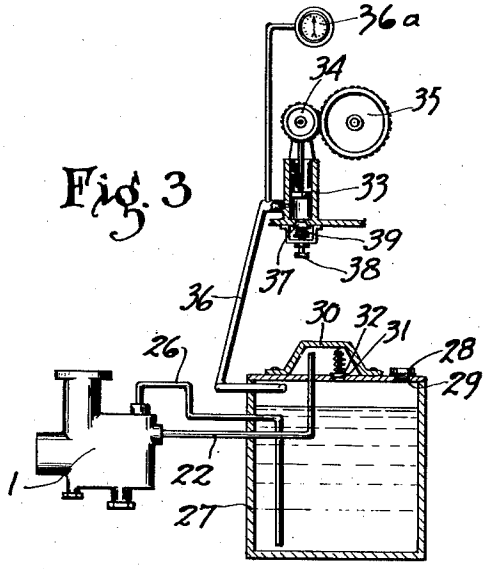


Fig. 5

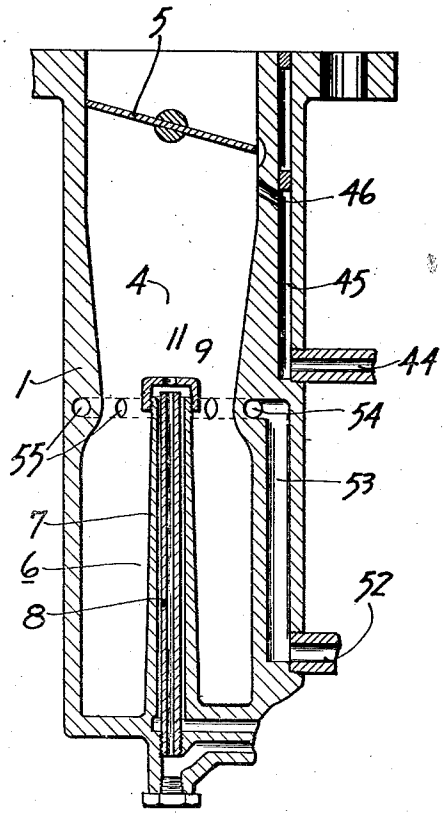
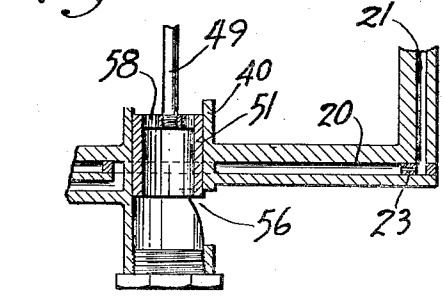


Fig. 4



INVENTOR.
Augustin M. Prentiss
BY A. Q. McCrady
ATTORNEY

Patented Sept. 25, 1934 1,974,585

UNITED STATES PATENT OFFICE

1,974,585

CARBURETOR

Augustin M. Prentiss, San Antonio, Tex., assignor to Bendix Aviation Corporation, South Bend, Ind., a corporation of Delaware

Application February 1, 1932, Serial No. 590,292

22 Claims. (Cl. 261—28)

This invention pertains to carburetors and more particularly has reference to compensating means for carburetors of the pressure feed type.

The invention herein disclosed is an improvement on the invention described in my United States Patent 1,329,309, issued January 27, 1920.

In my patent cited, I pointed out that since liquids do not obey the same laws of flow as gases, it is impossible to maintain a parity between a liquid flow and a gas flow when caused by the same variable effective head and the other factors influencing the flow are constant. On the contrary, a gas, such as air, being an elastic fluid, tends to expand and become less dense as the effective head increases, whereas a liquid, such as gasoline, being an inelastic fluid maintains its density and flows at an increasingly greater relative rate as the effective head increases.

In my patent cited, I further pointed out that due to the inherent difference between liquid and gas flows, any carburetor in which the gasoline and air feeds were caused by the same effective head, must necessarily fail to maintain a fixed ratio of flows as the effective head varies. This disparity is now generally recognized as overenrichment of the mixture at the higher operating speeds, that is, when the intake manifold vacuum is high. To overcome this overenrichment the practice of bleeding air into the main fuel jet has been widely employed. While this expedient, generally known as compensation, lessens the liquid fuel flow at the higher suctions, it fails to achieve a parity of flows under varying operating heads, because it involves the same fundamental defect it attempts to cure, that is, the difference between a liquid flow and a gas flow under the same varying heads. Thus, while an air bleed may be designed to come into action, when the suction in the carburetor reaches a certain value, dilute the mixture, and thus correct the overenrichment at that time, a further increase in effective head will again result in overenrichment as the flow of air through the bleed, following the law of gas flow, fails to keep up with the increasing liquid fuel flow.

Another disadvantage of the air bleed is that it materially weakens the effective head on the main fuel jet at low suctions, so much so, that various schemes are resorted to in order to supplement the main jet feed under low suctions. The most common of these schemes is the use of a separate fuel and air feed for idling operation and an auxiliary fuel jet usually called an economizer, arranged to come into action at low suctions when the throttle is wide open.

The primary object of this invention is to avoid the above difficulties by providing a carburetor in which the volume of air flow is varied in proportion as the fuel flow varies under varying effective heads, with a supplementary air flow which is regulated by the vacuum in the mixing chamber of the carburetor.

Another object of this invention is to maintain a desired ratio between the fuel supply and air supply, by the use of an air supply that, under all operating conditions, varies directly in proportion with the fuel supply, so that a mixture of desired proportions is maintained at all times.

Still another object of this invention is to provide a carburetor in which the liquid fuel is fed into the mixing chamber by a positive pressure, that is, a pressure higher than atmospheric.

Still another object of this invention is to provide a carburetor wherein a portion of the air supply is fed into the mixing chamber under a superatmospheric pressure.

A still further object of this invention is to provide a carburetor in which compensation for overenrichment of the mixture is secured by compressing a portion or all of the air supply.

A still further object of my invention is to provide a carburetor in which both the liquid fuel and air supplies are subjected to a substantially constant superatmospheric pressure and also to a vacuum which varies with the demands of the engine.

A still further object of my invention is to provide a carburetor wherein the proportion of liquid fuel to air is constantly maintained under all operating conditions at a predetermined value which may be varied as desired.

A still further object of my invention is to provide a carburetor having the above characteristics and an atomizing nozzle in which compressed air is applied to the liquid fuel column within the fuel nozzle to break up the liquid column before it issues from the fuel nozzle and thus secure an atomizing effect regardless of variations of specific gravity in the liquid fuel.

With these and other objects in view which may be incident to my improvements, my invention consists in the combination and arrangement of elements hereinafter described and illustrated in the accompanying drawings in which:

Figure 1 is a central vertical cross section of my improved carburetor;

Figure 2 is a fragmentary section on an enlarged scale, along the line 2—2 of Figure 1;

Figure 3 is a diagrammatic view, partly in section showing the air pump, main fuel supply tank and the connections between same and the carburetor;

Figure 4 is a fragmentary vertical section of the lower part of the float reservoir and air control cylinder, showing a modified form of the latter;

Figure 5 is a fragmentary vertical section of another modification in which all of the air sup-

ply is delivered to the mixing chamber under a superatmospheric pressure.

Unless specially controlled and regulated to the contrary, the flow of liquid fuel through a carburetor follows the general law of liquid flow and the flow of air follows the law of adiabatic gas flow. As to the air flow, it is logical to assume that the expansion of a gas approaching an orifice, being rapid, is adiabatic, and the authorities generally agree that the flow of air through a carburetor is, for all practical purposes, sensibly adiabatic. The observed data support this view.

The general formula for liquid flow and adiabatic gas flow, as applied to a carburetor, may be expressed as follows:

$$G_1=\mu_1 F_1 \gamma_1 \sqrt{2g\frac{(P_n-P_m)}{\gamma_1}} \quad (1)$$

$$G_2=\mu_2 F_2 \left(\frac{P_m}{P_n}\right)^{.71} \sqrt{6.88\ P_n \gamma_2 \left[1-\left(\frac{P_m}{P_n}\right)^{.29}\right]} \quad (2)$$

G_1 is the rate of liquid flow in pounds per second.

G_2 is the rate of air flow in pounds per second.

μ_1 is the coefficient of efflux for liquid flow.

μ_2 is the coefficient of efflux for adiabatic gas flow.

F_1 is the cross sectional area of the liquid fuel passageway of the carburetor—generally the area of the metering restriction in the fuel passageway.

F_2 is the cross-sectional area of the main air passageway of the carburetor in the zone of the fuel jet orifice—generally the area of the smallest section of the Venturi throat.

γ_1 is the unit weight of the liquid fuel, in pounds per cubic foot at 32° F. temperature.

γ_2 is the unit weight of the air in pounds per cubic foot at normal atmospheric pressure of 32° F.

g is the acceleration of gravity.

P_n is the superior pressure causing the fluid flow, which, in suction-operated carburetors, is the atmospheric pressure outside the carburetor.

P_m is the absolute pressure in the mixing chamber of the carburetor in the zone of the fuel jet orifice.

The foregoing nomenclature and formulas are, in accordance with Church's "Mechanics of Engineering", Part IV, Chapter VIII on "Kinetics of gaseous fluids".

For convenience of reference in this specification, I shall follow Church's terminology and refer to the formula for liquid flow (Formula (1) above), as the "water formula" and the formula for air flow, (Formula (2) above), as the "adiabatic formula". It will also be understood that where I refer, in this specification, to the air supply to the mixing chamber of the carburetor as being fed into said chamber "in accordance with the law of liquid flow", I mean in accordance with the "water formula" (Formula (1) above). That is to say, the total weight of air passing into the mixing chamber, per unit of time, for any given pressure (vacuum) in said chamber, is that found from the "water formula" ((1) above) for "P_m" equal to the pressure (vacuum) in said chamber, and not from the "adiabatic formula" ((2) above) which normally governs the flow of air through a carburetor.

It will be further understood that where I refer, in this specification, to the air supply to the mixing chamber being fed into the mixing chamber in accordance with the normal law of air or gas flow, I mean in accordance with the "adiabatic gas formula" (Formula (2) above) and where I use the term "normal operating conditions" I mean conditions of steady flow through the carburetor which excludes momentary fluctuations due to sudden changes in throttle opening.

This invention broadly comprehends means for feeding liquid fuel and air under a substantially constant superatmospheric pressure to a mixing chamber through one or more atomizing nozzles so that the liquid fuel is thoroughly atomized regardless of variation of specific gravity. The effective head causing the flows of liquid fuel and air is thus composed of the constant superatmospheric pressure mentioned plus the ordinary variable vacuum which exists in the mixing chamber of the carburetor under various operating conditions. While the supply of compressed air is fed into the mixing chamber under a substantially constant pressure, its rate of flow and volume is regulated in accordance with the vacuum in the mixing chamber. More particularly, the invention contemplates the use of a supplementary air supply to compensate for overenrichment of the mixture due to the natural disparity between the liquid fuel and air flows when caused by a common effective head. This supplementary air supply is controlled by a vacuum operated valve adapted to vary the amount of compressed air admitted to the mixing chamber in direct proportion to the liquid fuel admitted during the same period of time.

Referring to the drawings, and particularly to Figure 1, the reference numeral 1 denotes the body of a carburetor having an air inlet 2, a Venturi throat 3, a mixing chamber 4, and a mixture outlet controlled by a throttle valve 5. Integral with the bottom wall of the air inlet 2 and extending to a point in the center of the throat 3, is an atomizing nozzle 6 which consists of an outer liquid fuel tube 7, a concentric inner air tube 8 and a perforated cap 9 surmounting the ends of said tubes and adjustably attached to outer tube 7 by suitable screw threads 10. By means of threads 10, the position of perforation 11 in cap 9, with respect to the end of inner tube 8, can be varied and thus regulate the fineness or coarseness of the spray issuing from nozzle 6.

Outer tube 7 communicates through a horizontal fuel passage 12 and port 13 with a liquid fuel reservoir 14, in which liquid fuel entering through inlet 15 is maintained at a constant level X—X by a valve 16 and float 17 in the usual way. Port 13 is controlled by a manually adjustable needle valve 18 which regulates the rate of fuel flow so that it may be fixed at any desired ratio with the air flow. Inner tube 8, of nozzle 6, communicates through connecting horizontal passages 19 and 20, and vertical passage 21, with air supply pipe 22, through which it receives a continuous supply of compressed air under a substantially constant pressure. The rate of flow of air through passages 20 and 19, to nozzle 6, is regulated by a metering restriction 23, which, with a low effective head passes just sufficient air to thoroughly break up and atomize the liquid fuel column which issues from tube 7 with the lowest vacuum existing in the mixing chamber under any operating condition. At the same time the rate of flow of liquid fuel through tube 8 is controlled by a superatmospheric pressure in the liquid fuel reservoir 14, which in turn, is regulated by two metering restrictions 24 and 25. Restriction 24 passes compressed air from passage 21 into reservoir 14, and restriction 25 permits a limited portion of this air to escape from chamber 14. The relative sizes of the two are so re-

lated, that with any desired superatmospheric pressure in passage 21, a somewhat lower superatmospheric pressure is maintained in chamber 14. The sizes of the passageways in restrictions 24 and 25 are very small and pass only the minimum amount of air to accomplish the foregoing result. By the means just described, the main jet delivers a sufficient mixture for the slowest operation of the motor, and there is no need to resort to the use of a separate idling system, as in suction operated carburetors where the suction on the main jet at slow speed is insufficient to overcome the surface tension and inertia of liquid fuel column in the main nozzle and withdraw liquid fuel therefrom.

Since liquid fuel and air are thus fed into the mixing chamber under a positive pressure which does not depend solely upon the vacuum in the mixing chamber, there is always a sufficient mixture available for the slowest operating speeds desired, regardless of whether the throttle is in its most restricted position, as when idling, or wide open, as when operating at slow speed under a heavy load. For this reason no supplementary fuel jets or economizers are necessary. Since liquid fuel and air are fed into the mixing chamber regardless of the vacuum therein, two other very important results are secured. First, whenever the throttle is moved to its most restricted position while the engine is operating, mixing chamber 4 (and even air intake chamber 2) are filled with the mixture which issues from nozzle 6 and accumulates therein, so that when the throttle is opened again, this additional accumulation of mixture is instantly available for acceleration and hence no special acceleration pump or other device is necessary to insure rapid and positive acceleration of the engine. Second, since the slow speed fuel feed does not depend upon the vacuum produced by the passage of air through the Venturi throat of the carburetor, this throat can be made relatively much larger than would otherwise be possible, and this in turn insures a larger volume of air passing through the carburetor at high speeds whereby the volumetric efficiency of the engine at such speeds is materially increased with resulting increase in power at high speed.

Referring to Figure 3, it will be noted that fuel supply pipe 26 communicates with a main fuel supply tank 27 which is provided with an air tight closure plug 28 for its filling aperture 29. Mounted upon tank 27 is a compressed air dome 30 which communicates with tank 27 through air port 31 controlled by a spring-pressed check valve 32, so arranged that it seats whenever the air pressure in dome 30 falls below a predetermined value (for example, two pounds per square inch) and cuts off communication with tank 27. In this way, during operation of the engine, a predetermined minimum air pressure is always maintained in the air supply pipe 22 which connects air dome 30 with air passage 21 of the carburetor. When the engine stops, the compressed air in passages 19 and 20, pipe 22, and dome 30, escapes through nozzle 6 and that in reservoir 14 escapes through orifice 25 until the air pressures therein sink to atmospheric. At the same time, since valve 32 requires a certain net pressure (of say, two pounds per square inch) to lift it, any compressed air up to this pressure will automatically be retained in tank 27 and this pressure is sufficient to lift the liquid fuel therein up to the carburetor bowl 14 even though the carburetor be placed on a level with or above the engine intake manifold

During the operation of the engine, tank 27 is continuously supplied with compressed air at a pressure slightly above the pressure necessary to lift valve 32, by an air pump 33, which is geared to the engine by spur gears 34 and 35, and is provided with a check valve to prevent air delivered to outlet pipe 36 from returning to the pump, and with an overflow relief valve 37 to permit the escape into the atmosphere of compressed air whenever the pressure in pump 33 rises above a certain predetermined value. Valve 37 is adjusted by a screw 38 which regulates the tension in a spring 39 which actuates the valve. Screw 38 is so set as to cause valve 37 to maintain a pressure in pump 33 equal to that required to lift valve 32 when the pressure in dome 30 is a maximum, plus the drop in pressure which occurs in passing through pipe 36. Pipe 36 is larger in cross-section than pipe 22 so that a greater flow of air enters tank 27 through pipe 36 than can escape through pipe 22, hence a constant superatmospheric pressure is maintained in tank 27. A dash gauge 36*a* shows the pressure in pipe 36. Since it requires a certain net pressure to lift valve 32, pump 33 must maintain a higher pressure in tank 27 at all times during the operation of the engine, and valve 37 is set to open at this higher pressure. Of course, it is to be understood that the pressures mentioned herein by way of illustration are not to be taken as fixed values, nor even strictly relative, as obviously they may be varied within certain limits and operate the carburetor in accordance with my invention. In this connection, it is also pertinent to point out that while valve 37 makes pump 33 substantially a constant pressure pump, it by no means follows that this pump delivers a constant volume of air under all operating conditions. On the contrary, as the vacuum in the mixing chamber increases, the effective head on the air line from nozzle 6 to pump 33 likewise increases in proportion, since, in addition to the positive pressure in the air line, there is also a negative pressure effective upon the delivery end of the line which serves to augment the effective head, causing the flow of air through the line. With the increase in effective head (pressure and vacuum), there is a corresponding increase in the flow of compressed air in accordance with the law of adiabatic gas flow expressed by the second formula on page one ante. Since valve 37 is set so as to open only when the pressure reaches a certain predetermined value above atmospheric, the range of pumping pressure and the volume of air delivered by the pump increases with vacuum acting on the air line. Also since the vacuum in the mixing chamber can only increase with corresponding increase in speed of the engine, except momentarily when the throttle is suddenly opened, and the pump 33 is geared to the engine, the increase in volume of compressed air induced by the increased vacuum is automatically supplied by the corresponding increase in the speed of the pump.

It is to be particularly noted that the liquid fuel is also subject to the same range of effective heads as the air flow just described, except that the constant air pressure in reservoir 14 is somewhat below that of the compressed air in the air line feeding nozzle 6, but this difference is offset by the aspirating effect on the liquid column in the fuel tube 7 by the discharge of compressed air past the end of the tube 7 and out through orifice 11, so that the net effective pressure on both the liquid fuel and compressed air is the same, not considering the vacuum in the mixing

chamber. And since this vacuum adds equally to the effective heads of both liquid fuel and compressed air it affects both in the same way, but not to the same extent, due to the difference in laws of liquid and gas flow hereinbefore pointed out.

To take care of this disparity and prevent the consequent overenrichment of the mixture as the speed of the engine increases, I have provided means for admitting to the mixing chamber, a supplementary air supply which is so regulated as to compensate for overenrichment and maintain the mixture at any predetermined fuel air ratio desired under all operating conditions.

In the embodiment of my invention shown in Figure 1 of the drawings, this means consists of the following mechanism. A cylinder 40, integral with the bottom wall of the float reservoir 14 is divided by a wall 41 into an upper chamber 42 and a lower chamber 43. Upper chamber 42 is in communication through pipe 44, and passages 45 and 46 with the mixing chamber 4, so that there is always substantially the same vacuum in chambers 4 and 42. Adapted to reciprocate with an air-tight fit in chamber 42 is a piston 47 which is in the form of a cup and partially encloses a helical spring 48 interposed between the piston and the top wall of chamber 42 and so arranged as to force the piston down to its lowest position when the vacuum in the mixing chamber 4 is a minimum. As the vacuum in the mixing chamber increases, it gradually raises piston 47, against the action of spring 48, until the piston reaches its highest position with its upper edge abutting the top wall of chamber 42, when the vacuum in the mixing chamber is a maximum.

Adjustably attached to piston 47 by suitable screw-threads is a piston rod 49 which passes through a liquid-tight packing gland 50 in the wall 41 and is similarly attached to a cylindrical sleeve valve 51 which is adapted to reciprocate with an air-tight fit in lower chamber 43. At its upper end chamber 43 communicates through pipe 52, passages 53 and 54 and tuyères 55 with mixing chamber 4, while at its lower end chamber 43 also communicates through port 56 and passage 57 with passage 21 which in turn connects with air pump 33 as above described. Sleeve valve 51 has in its upper wall a plurality of ports 58 whose combined area equals the cross sectional area of each of the passages 57, 52, 53, and 54, which are all equal, so that when valve 51 is raised so as to fully uncover port 56, compressed air from passage 21 has an unrestricted path to the mixing chamber 4 through the passages mentioned and tuyères 55.

The distance between piston 47 and valve 51 is adjusted by screw-threaded rod 49 so that when piston 47 is in its lowest position, valve 51 just closes port 56 and when piston 47 is in its highest position, valve 51 just completely opens port 56. In order that piston 47 may move freely but without sudden fluctuations in cylinder 40, chamber 42 has been placed in free communication with reservoir 14 through a plurality of large ports 59 so that liquid fuel from reservoir 14 freely enters and leaves chamber 42 when piston 47 reciprocates therein. The liquid fuel in chamber 42 thus steadies the movement of piston 47 and prevents fluctuations therein due to the sudden opening of the throttle. It is to be particularly noted that port 56 is of peculiar shape and arrangement and herein lies the method of regulating the amount of supplementary compressed air so that it is just that required for compensation at all times.

From Figure 2, it will be seen that port 56 is generally of the shape of an inverted isosceles triangle whose sides are not straight lines, but convex curves. The total area of port 56 is approximately equal but slightly less than the cross-sectional area of passage 57 so that port 56 controls the flow through passage 57 at all times. The shape of port 56 is such that the area uncovered by valve 51 in any position equals the area necessary to pass the volume of compressed air necessary for compensation with the vacuum existing in the mixing chamber at the time. In other words, the uncovered area is such that with an effective head, equal to the constant superatmospheric pressure in passage 21 and the vacuum in chamber 4, the flow of air through port 56 at any instant will be such as to just equal the difference between the quantity of air entering chamber 4 through air inlet 2 and air tube 8, and the quantity required to form the desired mixture with the liquid fuel supplied to chamber 4 at that time. As the flow of air required for compensation does not vary as a simple linear function of the vacuum in the mixing chamber but at a progressively increasing rate as the vacuum increases, it is necessary that port 56 be so shaped that the area uncovered by valve 51 will increase at the same higher rate as that required for compensation, and the sides of port 56 are thus concave curves defining the necessary port area for each position of the valve 51 whose movement is controlled by the vacuum in the mixing chamber.

Referring to Figure 4, I have shown a modification of my carburetor wherein the additional air required for compensation is taken direct from the atmosphere instead of from the compressed air line, as in Figure 1. The only structural changes necessary are the omission of air passage 57 and that part of cylinder 40 which covers port 56 so that this port opens directly into the atmosphere. Passage 21 is now reduced to the size of passage 20, as it now only supplies compressed air to nozzle 6, and pump 33 can be made correspondingly smaller. Of course, port 56 must be recalibrated and made somewhat larger as the effective head of air passing through it is reduced by the amount of the positive pressure in passage 57 of Figure 1. The functioning and operation of this modification are otherwise the same as that shown in Figure 1.

In Figure 5, I have illustrated still another modification of my invention in which the main air intake of the carburetor is completely closed and all of the air entering the mixing chamber is supplied under positive pressure by the air pump. The only structural changes required are the following. Instead of an air intake passage 2, the body of the carburetor extends downwardly and completely encloses the space around the nozzle 6, the tuyères 55 instead of entering the mixing chamber in a vertical direction near the top of the chamber, are now made almost horizontal so as to direct the issuing currents of compressed air against the end of the nozzle 6, so as to baffle each other and more intimately mix with the spray issuing from nozzle 6. In this modification the entire air supply, except the small fraction furnished atomizing nozzle 6, passes through the compensating valve which is structurally the same as in Figure 1 except that port 56 is recalibrated so as to pass the right amount of air for a proper mixture under all operating conditions,

due allowance, of course, being made for the fraction of air supplied through nozzle 6. Since the total air supply is here furnished by the air pump, it must be made of correspondingly greater capacity and, of course, the amount of pressure used in the air line must be increased, and to a limited extent, may be fixed as desired for compressing effects. Also metering restrictions 23 and 24 must be made correspondingly smaller.

In operation, compressed air is supplied through pipe 22, a portion of which passes through restriction 24 to maintain the fuel in the chamber 14 under superatmospheric pressure, as above explained, while another portion passes through restriction 23 and passages 20 and 19, to tube 8, whence it issues at 11, mingled with fuel. Another portion of the air supplied to the carburetor passes through port 56 and passage 53 to the mixing chamber through tuyères 55, the rate of flow being varied with the suction at 46, so that when added to the quantity entering through air inlet 2 it forms a mixture of the desired richness under all operating conditions.

Regardless of which of the above described embodiments of my invention are employed, the principle of operation is the same, i. e., the total air supply to the mixing chamber varies with the pressure (vacuum) in said chamber in accordance with the "water formula" (Formula 1) and not in accordance with the adiabatic formula (Formula 2). This result is secured as follows: The carburetor in the form shown in Figure 1, is operated first as a simple suction-feed carburetor, with all supplementary air through port 56 shut off, under various loads and speeds from minimum to maximum. The pressures (vacuums) in mixing chamber 4 are ascertained by a manometer connected thereto and the corresponding flows (by weight) of liquid fuel and air are measured by flow meters. Under these conditions the flow of air for each degree of pressure (vacuum) in the mixing chamber is determined and is found to correspond very closely with the adiabatic formula cited ante. Similarly, the flow of liquid fuel is determined for each degree of pressure (vacuum) in the mixing chamber and is found to correspond with the "water formula" cited ante. The deficiency in the air flow for each degree of mixing chamber pressure (vacuum) is then found by subtracting the air flow, determined as just described, from the corresponding fuel flow multiplied by the desired mixture ratio (as 16:1). The valve 51 and port 56 are then designed to pass an amount of supplementary air equal to the deficiency in the main air supply, as thus determined, for each degree of pressure (vacuum) in the mixing chamber. Since the valve 51 is responsive to the vacuum in the mixing chamber, and moves in direct proportion to the intensity of said vacuum, the correct amount of supplementary air to be passed into the mixing chamber is a function of the area of port 56 for each position of valve, and port 56 is shaped accordingly. After the foregoing data is determined, if the embodiment of my invention shown in Figure 1 is to be used, the port 56 is designed to pass the supplementary air supply, determined as above, under a head, consisting of the constant superatmospheric air pressure supplied by pump 33, plus the variable vacuum in mixing chamber 4. If the form shown in Figure 4 is to be used, port 56 is designed to pass the same supplementary air supply under a head consisting of the variable vacuum in mixing chamber 4 above, while if the form shown in Figure 5 is used, port 56 is designed to pass a total air supply equal to the entire required air supply, determined as above, under a head consisting of the constant superatmospheric pressure of pump 33 plus the variable vacuum in chamber 4.

From what has been said above, it is seen that, irrespective of the particular embodiment of my invention employed, the total air supply flowing into the mixing chamber for any particular degree of vacuum therein corresponds to that shown by the "water formula" and not that shown by the adiabatic formula. Since the liquid fuel also flows according to the "water formula" it follows that the ratio between the air supply and liquid fuel supply can be held constant under all operating conditions, or can be varied as desired by suitably changing the shape of port 56.

While the air entering the carburetor through air inlet 2 and that entering through passageway 23 and nozzle 6, separately considered, flow according to the natural law of air flow (i. e. "adiabatic formula") the amount of supplementary air entering through nozzle 6 is so controlled with reference to the vacuum in the mixing chamber, that the total amount of air entering the mixing chamber per unit of time, (i. e., the rate of total air flow) is equal to that shown by the "water formula" for each corresponding degree of vacuum in the mixing chamber. Hence, in this specification where I speak of so regulating the air supply as to make it flow in accordance with the law of liquid flow, it will be understood that I mean the total amount of air entering the mixing chamber, per unit of time, is that corresponding to the "water formula", and not the adiabatic formula, for each corresponding degree of vacuum in the mixing chamber.

While I have shown and described the preferred embodiment of my invention, I desire it to be understood that I do not limit myself to the constructional details shown by way of illustration as these may be modifed in combination and arrangement by those skilled in the art without departing from the spirit of my invention or exceeding the scope of the appended claims.

I claim:

1. In a carburetor, a mixing chamber, an atomizing nozzle, an air supply and a liquid fuel supply to said nozzle, both under a superatmospheric pressure, and a vacuum-controlled compressed air supply to said mixing chamber.

2. In a carburetor, a mixing chamber, an atomizing nozzle in said chamber, an air supply and a liquid fuel supply to said nozzle, both under a superatmospheric pressure, an additional air supply to said mixing chamber, means for compressing said additional air supply, and means for admitting said compressed air to said mixing chamber so as to make the total air supplied to said chamber always bear a predetermined ratio to said liquid fuel supply.

3. In a carburetor, a venturi, a fuel nozzle, a mixing chamber, air inlets anterior and posterior to the fuel nozzle, and means for supplying air to the posterior inlet at a superatmospheric pressure varying with the pressure in the mixing chamber.

4. In a carburetor, a venturi, a fuel nozzle, a mixing chamber, air inlets anterior and posterior to the fuel nozzle, and means for supplying air to the posterior inlet comprising a source of superatmospheric pressure air, a conduit leading from said source to said mixing chamber, and a valve in said conduit responsive to pressures in said mixing chamber.

5. In a carburetor, a venturi, a fuel nozzle, a mixing chamber, an air inlet posterior to the fuel nozzle, and means for supplying air to said air inlet comprising a source of superatmospheric pressure air, a conduit leading from said source to said mixing chamber, a valve controlling said conduit, and control means for said valve responsive to pressures existing in said mixing chamber.

6. In a carburetor, a mixing chamber, an air supply at atmospheric pressure, a compressed air supply, and a liquid fuel supply thereto, and automatic pressure-responsive means for regulating the compressed air supply so as to make the total air supplied vary in accordance with the law of liquid flow, and thereby always bear a predetermined ratio to said liquid fuel supply.

7. In a carburetor, a mixing chamber, an air supply and a liquid fuel supply thereto, means for compressing a portion of the air supply and means for admitting said portion to said mixing chamber so as to make the total air supply vary in accordance with the law of liquid flow, whereby the total air supply always bears a predetermined ratio to said liquid fuel supply.

8. In a carburetor, a mixing chamber, means for supplying thereto liquid fuel and air, both under superatmospheric pressures, and means for regulating the air supply so as to make it vary in accordance with the law of liquid flow and thereby always bear a predetermined ratio to said liquid fuel supply.

9. In a carburetor, a mixing chamber, an air supply at atmospheric pressure and a liquid fuel supply thereto, and automatic pressure, responsive means for feeding compressed air thereto at such a rate that the total air supply varies in accordance with the law of liquid flow, whereby the total air supply always bears a predetermined ratio to the liquid fuel supply.

10. In a carburetor, a mixing chamber, means for feeding liquid fuel thereto and means comprising a variable vacuum and a constant superatmospheric pressure for feeding to said chamber air at a rate which varies in accordance with the law of liquid flow.

11. In a carburetor, a mixing chamber, means for feeding liquid fuel thereto, means for feeding air thereto comprising the vacuum within said chamber and a superatmospheric pressure such that the total air supply varies in accordance with the law of liquid flow, whereby a constant ratio is maintained between the liquid fuel and air in said chamber.

12. In a carburetor, a mixing chamber, an atomizing nozzle in said chamber, an air supply and a liquid fuel supply to said nozzle, both under superatmospheric pressures, a supplementary air supply to said chamber, and means for admitting said additional air supply to said chamber at such a variable rate that the total air supplied to said chamber always bears a predetermined ratio to said liquid fuel supply.

13. In a carburetor, a mixing chamber, means for supplying thereto liquid fuel and air each under an effective head which comprises a constant superatmospheric pressure and a variable vacuum, and means for admitting said air to said chamber at a rate which varies in accordance with the law of liquid flow, whereby a constant ratio is maintained between the liquid fuel and air in said chamber.

14. In a carburetor, a mixing chamber, an atmospheric air supply to said chamber, an atomizing nozzle in said chamber and comprising an air tube and a liquid fuel tube, means for supplying air and liquid fuel to said tubes respectively, each under an effective head consisting of a constant superatmospheric pressure plus a variable vacuum, such that the total air supply varies in accordance with the law of liquid flow.

15. In a carburetor, a mixing chamber, means for supplying thereto liquid fuel and air, each under a superatmospheric pressure, and vacuum-actuated means for regulating the air supply so as to make it always bear a predetermined ratio to said liquid fuel supply.

16. In a carburetor, a mixing chamber, means for supplying thereto liquid fuel and air, each under a constant superatmospheric pressure, and means for regulating the air supply so as to make it vary in accordance with the law of liquid flow, and thereby always bear a predetermined ratio to said liquid fuel supply.

17. In a carburetor, a mixing chamber, an air supply at atmospheric pressure, a compressed air supply, and a liquid fuel supply thereto, and means for admitting said compressed air supply to said chamber at a rate equal to the difference between the rate of said atmospheric air supply flowing in accordance with the law of gas flow, and a predetermined multiple of said liquid fuel supply flowing in accordance with the law of liquid flow, whereby the total air supply always bears a predetermined ratio to said liquid fuel supply.

18. In a carburetor, a mixing chamber, an air supply at atmospheric pressure, a compressed air supply under constant pressure, and a liquid fuel supply thereto, and means for varying the flow of compressed air so that the total air supply varies in accordance with the law of liquid flow, whereby a predetermined ratio is always maintained between the total air supply and the liquid fuel supply.

19. In a carburetor, a mixing chamber, an air supply thereto at atmospheric pressure, a compressed supply and a liquid fuel supply thereto under constant superatmospheric pressures, and means for varying the flows of both air supplies so that the total air supply varies in accordance with the law of liquid flow, whereby a predetermined ratio is always maintained between the total air supply and the liquid fuel supply.

20. In a carburetor, a mixing chamber, an air supply under atmospheric pressure and a liquid fuel supply thereto, means including a passageway for supplying compressed air to said chamber, and means for regulating said compressed air supply by varying the size of said passageway, whereby the total air supply to said chamber varies in accordance with the law of liquid flow.

21. In a carburetor, a mixing chamber, means for supplying thereto liquid fuel and air each under a superatmospheric pressure, and means including a vacuum-actuated valve, for regulating said air supply so as to make it always bear a predetermined ratio to said liquid fuel supply.

22. In a carburetor, a mixing chamber, means for supplying thereto liquid fuel and air each under a superatmospheric pressure, and means including a valve, actuated by the pressure in said chamber, for regulating said air supply so as to make it always bear a predetermined ratio to said liquid fuel supply.

AUGUSTIN M. PRENTISS.