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CARBURETOR

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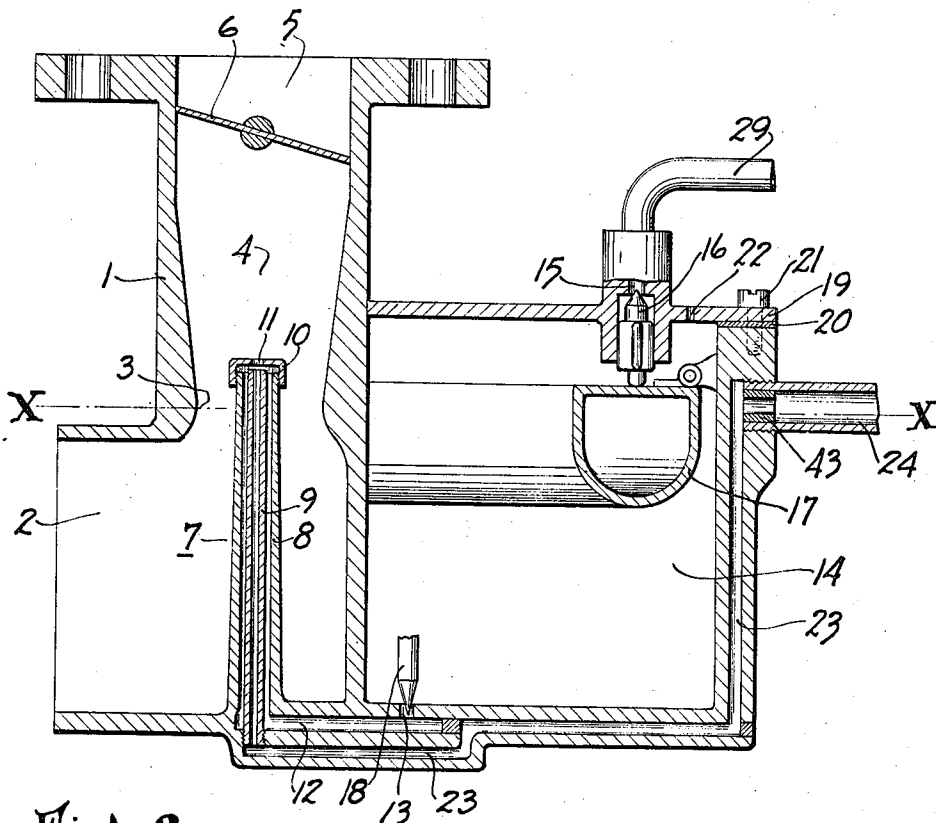
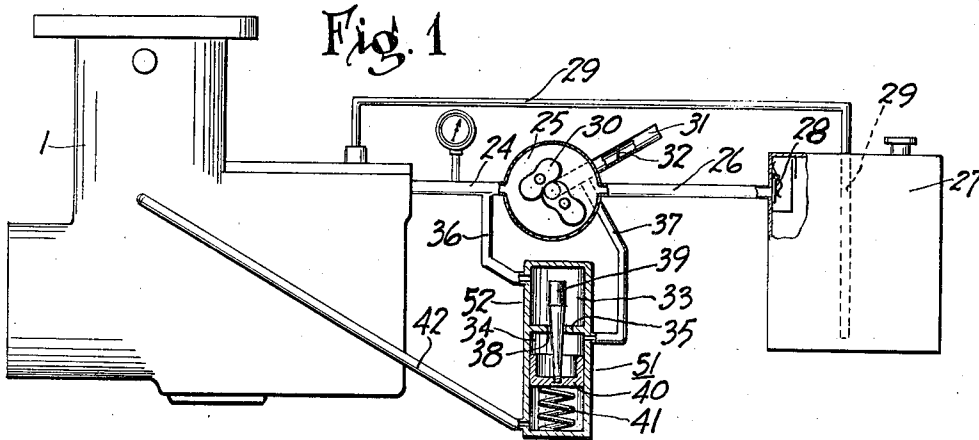


Fig. 2

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CARBURETOR

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27 Claims. (Cl. 261-76)

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

This invention is an improvement on the invention set forth in my United States Patent No. 1,329,309 issued January 27, 1920.

In the patent cited I pointed out the advantages of pressure feed of the liquid fuel over suction feed thereof and showed how, due to the difference between the laws of flow of liquids and gases, it was impossible to maintain parity between the air flow and liquid fuel flow through a carburetor where both are produced by a common vacuum. I then pointed out that a parity could be secured by properly varying either the pressure on the liquid fuel supply or the pressure on the air supply or both. In the patent cited I varied the pressure on the liquid fuel in order to secure compensation of the liquid fuel flow and thus obtain the desired parity. In this case, in order to maintain the desired parity between the air supply and liquid fuel supply to the carburetor, I vary the pressure on the supplementary air only. By supplementary air, in this specification, I mean that part of the carburetor air supply which is introduced into the mixing chamber under a superatmospheric pressure through the fuel nozzle and which is employed to break up and atomize the liquid fuel jet. By the term "predetermined ratio", used in this application, I mean such a controlled ratio between the fuel and air components of the mixture as will cause this ratio to vary with the speed and load of the engine in accordance with any desired curve of variation which curve has been previously determined as the best for optimum engine performance under all operating conditions. Thus, if a rich mixture is desired for idling and for high speed operation, and a leaner mixture for economy at intermediate speeds, these results are secured by applicant's invention with proper adjustment of the controls.

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:

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

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

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 and 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 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 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.

I obtain the foregoing results as follows. I first determine the fuel flow for each degree of pressure (vacuum) in the mixing chamber from formula (1) above. I then multiply these values by the proper multiple to give the desired mixture ratio. Thus, if a mixture ratio of 16 parts of air, by weight, to 1 part of liquid fuel, is desired, I multiply the fuel flows, for each value of mixing chamber pressure, by 16 and thus arrive at the required air flow. I then determine the actual air flow, for each corresponding degree of pressure in the mixing chamber, from formula (2) above. As air, being an elastic fluid, expands and becomes less dense as the effective head increases, while liquid fuel, being an inelastic fluid maintains its density, the air flow, determined as above, is found to increase at a relatively slower rate, compared to the liquid fuel, as the pressure (vacuum) in the mixing chamber increases. This deficiency in the air flow is determined, for each degree of pressure in the mixing chamber (P_m), by subtracting the value of G_2 , calculated from formula (2) above for the corresponding value of P_m , from $16 \times G_1$, calculated from formula (1) above, for the same value of P_m . Conversely, the required pressure to be applied to the air supply to bring it up to a parity with the liquid fuel supply, for any degree of pressure in the mixing chamber, is determined by substituting the value of $16 \times G_1$, (computed as above) for G_2 in formula (2) above, and solving for P_m . The resulting value of P_m , which we will denote as P'_m , is the pressure required to supply the proper flow of air to the mixing chamber for the given pressure (vacuum) P_m , therein. By way of illustration, let us suppose that when the pressure in the mixing chamber (P_m) is 10.7 pounds per square inch, (i. e. 4 pounds per square inch vacuum), the value of P'_m , computed as above, is 5 pounds per square inch. In order then to maintain the required parity of flow (16:1) between the air and liquid fuel, it will be necessary to increase the pressure of the air flow at that point by 1 pound per square inch. This might be accomplished by subjecting the air supply to the mixing chamber to a superatmospheric pressure, equal to 1 pound per square inch, gauge, when the vacuum in the mixing chamber of the carburetor is 4 pounds per square inch, and which varies directly as the vacuum in the mixing chamber by an amount, determined as above, for each degree of vacuum in the mixing chamber.

From what has just been said, it follows that instead of subjecting the entire air supply to the mixing chamber to a superatmospheric pressure, in order to make it maintain a parity with the liquid fuel flow, as indicated above, I may permit the main air supply to enter the mixing chamber under the influence of the vacuum therein alone, i. e., the main air supply may be drawn into the mixing chamber, at atmospheric pressure by the vacuum in the mixing chamber, and the de-

ciency in the air supply thus incurred, may be furnished under superatmospheric pressure. In this case, the amount of superatmospheric (compressed) air is determined for each degree of pressure (vacuum) in the mixing chamber by subtracting the corresponding value of G_2 (determined from formula (2) above) from the corresponding value of G_1 (determined from formula (1) above) multiplied by the mixture ratio (16). And the pressure under which this additional compressed air must be supplied is ascertained by substituting ($16 \times G_1 - G_2$) for G_2 in formula (2) above and solving for P_m . As before, let us denote this pressure as P'_m . Since, $16 \times G_1 - G_2$ has a definite value, for each value of P_m and since P'_m has a definite value for each value of $16 \times G_1 - G_2$, it follows that there is a direct relation between P'_m and P_m , and hence, if the value of P'_m can be controlled and made a function of P_m , then the correct amount of additional compressed air will automatically be fed into the mixing chamber for each corresponding value of the pressure (vacuum) (P_m) in said chamber. This is the essence of the invention in this case, and since the amount of compressed air furnished is exactly that required to bring the air flow up to a parity (16:1) with the liquid flow for any pressure (vacuum) in the mixing chamber, it is apparent that the total air supply to the mixing chamber, for any degree of pressure (vacuum) therein, is in accordance with the law of liquid flow, i. e., the "water formula" (1) shown above, and not in accordance with the "adiabatic formula" (2) above, which normally governs the flow of air.

An object of this invention is to provide a carburetor in which the liquid fuel is broken up within the fuel nozzle by compressed air so that it issues from said nozzle in a high state of atomization.

Another object of this invention is to provide a carburetor wherein a parity between the liquid fuel and air components of the fuel-air mixture is maintained by properly varying the pressure upon a part of the air supply so that the total air supply follows the law of liquid flow.

Still another object of this invention is to provide a carburetor in which only a small portion of the air supply is fed into the mixing chamber under pressure, but this portion is sufficient to completely atomize the entire liquid fuel component of the mixture and also compensate the mixture for the deficiency of air which results from the difference between the laws of flow of liquid and gases.

Still another object of this invention is to provide a carburetor in which parity between the liquid fuel and air supplies is secured by making the air supply follow the law of liquid flow.

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 drawing in which:

Figure 1 is a side elevation of my improved carburetor, showing in diagrammatic outline the main supply tank, air pump and connections therebetween, and in vertical section, the pressure regulator;

Figure 2 is a central longitudinal section, on an enlarged scale of my improved carburetor.

This invention broadly comprehends a liquid fuel supply under constant (atmospheric) pressure, a main air supply also under atmospheric pressure and a supplementary air supply under

superatmospheric pressure; the flows of the liquid fuel and main air being induced solely by the vacuum in the mixing chamber of the carburetor while the flow of supplementary air is caused by an effective head which consists of the vacuum in the mixing chamber and a variable superatmospheric pressure. This superatmospheric pressure varies between such limits and according to such a law, as will at all times cause the total air supply to bear a desired ratio to the liquid fuel supply. Thus, the supplementary air flow is such, at all times, as to equal the natural difference that always exists between a fluid flowing according to the law of liquid flow and according to the law of adiabatic gas flow. Since this supplementary air flow is under a superatmospheric pressure it is also utilized to atomize the liquid fuel by feeding it into the mixing chamber through an atomizing nozzle.

Referring to Figure 2 of the drawing, the reference numeral 1, denotes the body of a carburetor having a main air inlet 2, Venturi throat 3, mixing chamber 4, and mixture outlet 5 controlled by a butterfly throttle valve 6 in the usual manner. Integral with the bottom wall of air inlet 2 and extending to a point just above the center of the Venturi throat 3, is an atomizing nozzle 7 consisting of an outer liquid fuel tube 8 and an inner air tube 9, the former surmounted by a cap 10, having a perforation 11, through which the fuel from the nozzle is discharged into the mixing chamber 4.

Fuel tube 8 communicates through a passageway 12 and port 13 with a liquid fuel reservoir 14 which is supplied by liquid fuel through an inlet 15 controlled by a valve 16 which is actuated by a float 17, so that the liquid fuel is always maintained in reservoir 14 at a constant level X-X. Float 17 has such a buoyancy as to always close valve 16 against the pressure of the liquid fuel in inlet 15 whenever the liquid level in reservoir 14 reaches the line X-X. Port 13 is controlled by a manually adjustable needle valve 18 so as to regulate the flow of liquid fuel to nozzle 7.

Reservoir 14 is closed by a cover 19 which seats on a gasket 20 and is held in place by screws 21. Cover 19 has a vent hole 22 which enables atmospheric pressure to be exerted at all times on the liquid fuel in reservoir 14.

Air tube 9 communicates through a passageway 23 whose width is greater than its depth, and pipe 24 with an air pump 25 which is geared to the engine (not shown). See Figure 1. Pump 25 is also connected by a pipe 26 to a main fuel supply tank 27 through a spring pressed check valve 28 and series of baffles so arranged as to prevent liquid fuel splashing into pipe 26, and running into pump 25 when the automobile is going down hill. A pipe 29 conveys liquid fuel to the carburetor reservoir 14 under the superatmospheric pressure maintained in tank 27 by pump 25.

Pump 25 is of the conventional rotary impeller type having a plurality of associated blades 30, and a common air intake 31 provided with a check valve 32.

In order to control the pressure in pipe 24, I have provided a novel form of pressure regulator 51 which consists of a cylindrical casing 52 divided into an upper chamber 33 and a lower chamber 34 by a partition 35, the upper chamber 33 being connected to pipe 24 by a pipe 35 and the lower chamber being connected to the pump 25 on its intake side by a pipe 37, as clearly shown in Figure 1.

Partition 35 has a central tapered aperture 38 which serves as a seat for a tapered valve 39 passing through aperture 38 and fixedly attached to a piston 40 which is adapted to reciprocate in chamber 34 with an air-tight fit. Interposed between the bottom of piston 40 and the bottom wall of casing 31 is a helical spring 41 which tends to push piston 40 upwardly in chamber 34 until the top of valve 39 contacts with the top wall of casing 31, in which position the opening through aperture 38 is a maximum.

Piston 40 is made responsive to the vacuum in mixing chamber 4 by a pipe 42 which connects the mixing chamber 4 with chamber 34 below piston 40. From the foregoing description, it is clear that the position of piston 39 and therefore the degree of opening of aperture 38 is dependent at all times upon the degree of vacuum in the mixing chamber 4, since when this vacuum is low, spring 41 pushes piston 40 up and when this vacuum is high it overcomes spring 41 and retracts piston 40.

Since the opening in aperture 38 governs the amount of air that is shunted around pump 25 and this determines the pressure in pipe 24, it follows that the pressure in pipe 24, and therefore in nozzle 7, is regulated by the valve 39 which in turn is subject to the vacuum in the mixing chamber 3. At the same time the vacuum in the mixing chamber governs the flow of air thereto and, subject to the influence of the superatmospheric pressure in nozzle 7, also the flow of liquid fuel. If the compressed air flow through pipe 24, passage 23 and tube 9 be disregarded, then the flows of air and liquid into the mixing chamber would be simply those due to the common vacuum existing in the mixing chamber at any time. But, as stated above, I have shown that where the air flow and liquid fuel flow are induced by a common vacuum, as this vacuum is increased, the liquid fuel flows faster than the air with a progressively increasing difference. If now a supplementary flow of air be supplied to the mixing chamber just sufficient to maintain the desired parity between the liquid fuel and air supplies under varying operating conditions, the tendency of the mixture to over-enrich at high speeds is compensated for and an optimum mixture is obtained. This result I accomplish by making the supplementary air flow through the nozzle 7 just sufficient at all times to compensate for the natural deficiency in the main air flow under all operating conditions. This is effected as follows. The minimum pressure on the air line 24 is made such as will effectively atomize the smallest flow of liquid fuel from the nozzle 7 when the engine is idling and the throttle is in the most restricted position (as shown in Figure 2) and no more. This pressure is very slight for such small liquid fuel flows.

The pressure in line 24 is then progressively raised as the vacuum in the mixing chamber is increased, but at a slightly greater rate of increase, as is required for complete compensation. The rate of increase of pressure in line 24 is determined by the contour of valve stem 39. Thus, it will be noted that this stem is not truly conical, which would make the variation in pressure in line 24 in linear proportion to the variation in vacuum in the mixing chamber, but has a convex contour which closes aperture 38 with a progressively increasing speed as stem 39 is moved downwardly by the vacuum in the mixing chamber 4. This results in building up the pres-

sure in line 24 with an increasing speed as the vacuum in the mixing chamber 4 increases, and since the pressure in line 24 can thus be made to follow any desired law of variation with respect to the vacuum in mixing chamber, perfect compensation results.

In calibrating the Venturi throat 3 to pass the desired quantity of air for any degree of vacuum in the mixing chamber, the corresponding amount of compressed air discharged through nozzle 7 is of course taken into consideration, as is also the aspirating effect of the compressed air escaping from nozzle 7 which operates to somewhat increase the flow of liquid fuel from the nozzle. As these two effects tend to neutralize each other, their net influence is small.

From the foregoing description, it is apparent that the main air supply entering air intake 2 and passing through Venturi throat 3 is utilized to meter the flow of liquid fuel, with due calibration for the qualifying effects of the compressed air escaping from nozzle 7 and that compensation of the mixture is secured by making the compressed air supply just sufficient for this purpose under all operating conditions. This compressed air supply is also utilized to atomize the liquid fuel issuing from nozzle 7.

Many advantages flow from this novel arrangement. First, the extremely simple construction involved. The flow of supplementary (compressed) air is governed by a metering restriction 43 placed in pipe 24 at its junction with carburetor body 1, and the contour of valve stem 39 which regulates the pressure in line 24. These are factory adjustments. The only operating adjustments are the needle valve 18 which determines the strength of the mixture and the cap 10 which determines the fineness of the atomization of the liquid fuel.

Second, the complete atomization of the liquid fuel due to the action of the compressed air.

Third, complete and accurate compensation of the mixture under all operating conditions, so that any desired fuel-air ratio may be obtained. Thus, if a slightly rich mixture is desired for idling and for high speed operation, and a lean mixture for economy at intermediate speeds, these results can be readily secured by the proper calibration of metering restriction 43 and valve stem 39.

Fourth, no special acceleration device is required since the sudden increase in vacuum in the mixing chamber 4, resulting from a quick opening of the throttle, immediately closes aperture 38, which results in a maximum pressure in line 24 with corresponding increase in fuel flow due to the aspirating effect of the increased air flow from nozzle 7. Thus, a supplementary emulsion of compressed air and liquid fuel is injected into the mixing chamber under a superatmospheric pressure and this is immediately available to supply the increase of fuel required for quick acceleration. As soon as the vacuum in mixing chamber 4 stabilizes after the throttle is kicked open, the law of liquid fuel and air immediately stabilizes also, and uniform operating conditions are resumed.

The operation of my device is as follows: When the engine is started, pump 25 which is geared thereto with a high gear ratio, at once delivers a jet of air to the mixing chamber through nozzle 7. This jet of air carries with it a relatively large amount of fuel which is ejected from the nozzle by the aspirating effect of the escaping air. This rich mixture facilitates starting and makes un-

necessary any special starting device, though, of course, a conventional choke may be used in the air intake, if desired, to increase the suction on the nozzle 7.

As the pump 25 is geared to the engine, it automatically varies in speed with the engine and thus automatically varies the volume of compressed air supplied with the speed of the engine subject of course to the regulating effect of the pressure regulator.

The tension on check valve 28 is such that this valve is held closed until the speed of the pump is sufficient to build up the normal pressure in line 26 and open it. This insures that all of the compressed air produced by the pump upon starting of the engine is delivered to the carburetor to insure quick and easy starting. Pressure is not necessary in the tank instantly upon starting as the fuel in the carburetor reservoir 14 is sufficient to run the engine until the pump 25 builds up its normal pressure. For this reason, the loss of pressure due to refilling tank 27 is of no consequence, as the reduced air space left when the tank is filled is quickly brought up to pressure by the pump before the fuel in reservoir 14 is exhausted.

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 changed in combination and arrangement 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, and means for supplying air thereto at a rate which varies in accordance with the law of liquid flow, by supplying a portion of said air supply subject to a variable pressure.

2. In a carburetor, a mixing chamber, a main air supply thereto under atmospheric pressure, a supplementary air supply thereto under a superatmospheric pressure, and means to vary the pressure on the supplementary air supply so that the total air supply will be fed into said chamber according to the law of liquid flow.

3. In a carburetor, a mixing chamber, means for supplying liquid fuel thereto under atmospheric pressure, and means for supplying air thereto at a rate which varies in accordance with the law of liquid flow, a portion of said air supply being subject to a variable pressure.

4. In a carburetor, a mixing chamber, means for supplying liquid fuel thereto under atmospheric pressure, a main air supply and a supplementary air supply thereto, said supplementary air supply being subject to such a variable superatmospheric pressure as will cause the total air supply to be fed into said chamber in accordance with the law of liquid flow.

5. In a carburetor, a mixing chamber, means for supplying liquid fuel thereto under atmospheric pressure, a main air supply fed into said chamber in accordance with the law of adiabatic gas flow, a supplementary air supply fed into said chamber at such a variable rate as equals the difference between the rate of flow of said main air supply under the law of adiabatic gas flow and under the law of liquid flow.

6. In a carburetor, a mixing chamber, means for supplying liquid fuel thereto under atmospheric pressure, and means for supplying air thereto, including means for subjecting a portion of said air supply to such a variable superatmos-

pheric pressure as will cause the total air supply to be fed into said chamber at a rate which bears a desired predetermined ratio to the rate of said liquid fuel supply.

7. In a carburetor, a mixing chamber, a liquid fuel supply thereto, a main air supply and a supplementary air supply thereto, said supplementary air supply being subject to such a variable superatmospheric pressure as will cause the total air supply to be fed into said chamber at a rate which bears a desired predetermined ratio to the rate of said liquid fuel supply.

8. In a carburetor, a mixing chamber, an atomizing nozzle therein, and means for supplying air to said chamber at a rate which varies in accordance with the law of liquid flow, a portion of said air supply being fed into said chamber through said nozzle under a variable superatmospheric pressure.

9. In a carburetor, a mixing chamber, an atomizing nozzle therein, a main air supply to said chamber, and a supplementary air supply through said nozzle to said chamber, said supplementary supply being subject to a superatmospheric pressure varying inversely with the pressure in the mixing chamber, so that the total air supply is fed into said chamber in accordance with the law of liquid flow.

10. In a carburetor, a mixing chamber, and means for supplying air thereto including vacuum-controlled means for subjecting a portion of said air supply to such a variable superatmospheric pressure as will cause the total of said air supply to be fed into said mixing chamber in accordance with the law of liquid flow.

11. In a carburetor, a mixing chamber, a main air supply thereto under atmospheric pressure, a supplementary air supply thereto under a superatmospheric pressure, and vacuum-controlled means to vary the pressure on the supplementary air supply so that the total air supply will be fed into said chamber according to the law of liquid flow.

12. In a carburetor, a mixing chamber, means for supplying liquid fuel thereto under atmospheric pressure, and means for supplying air thereto, including vacuum-controlled means for subjecting a portion of said air supply to such a variable superatmospheric pressure as will cause the total air supply to be fed into said chamber at a rate which bears a desired predetermined ratio to the rate of said liquid fuel supply.

13. In a carburetor, a mixing chamber, an atomizing nozzle therein, and means for supplying air to said chamber, including vacuum-controlled means for feeding a portion of said air supply through said nozzle to said chamber under such a variable superatmospheric pressure as will cause the total of said air supply to be fed into said chamber in accordance with the law of liquid flow.

14. In a carburetor, a mixing chamber, an air supply and a liquid fuel supply thereto, and means for regulating the pressure on a portion of said air supply so that the total air supply enters said chamber at rate which bears a predetermined ratio to said liquid fuel supply under all normal operating conditions.

15. In a carburetor, a mixing chamber, an air supply and a liquid fuel supply thereto, means for compressing a portion of said air supply, and means for regulating the pressure on said portion of the air supply so that the total air supply enters said chamber at a rate which bears a pre-

determined ratio to said liquid fuel supply under all normal operating conditions.

16. In a carburetor, a mixing chamber, an air supply and a liquid fuel supply thereto, and vacuum-controlled means for regulating the pressure on a portion of said air supply so that the total air supply enters said chamber at rate which bears a predetermined ratio to said liquid fuel supply under all normal operating conditions.

17. In a carburetor, a mixing chamber, an air supply and a liquid fuel supply thereto, and means, responsive to the pressure in said chamber, for regulating the pressure on a portion of said air supply so that the total air supply enters said chamber at rate which bears a predetermined ratio to said liquid fuel supply under all normal operating conditions.

18. In a carburetor, a mixing chamber, a main air supply, a supplementary air supply, and a liquid fuel supply thereto, and means for regulating the pressure on said supplementary air supply so as to make the total air supplied to said chamber bear a predetermined ratio to said liquid fuel supply under all normal operating conditions.

19. In a carburetor, a mixing chamber, a main air supply, a supplementary air supply, and a liquid fuel supply thereto, and vacuum controlled means for regulating the pressure on said supplementary air supply so as to make the total air supplied to said chamber bear a predetermined ratio to said liquid fuel supply under all normal operating conditions.

20. In a carburetor, a mixing chamber, a main air supply fed into said chamber in accordance with the normal law of air flow, a supplementary air supply, and vacuum-controlled means to regulate the pressure on said supplementary air supply so that the total air supplied to said chamber varies with respect to the pressure therein in accordance with the law of liquid flow.

21. In a carburetor, a mixing chamber, means for supplying liquid fuel thereto under atmospheric pressure, and means for supplying air thereto including means for subjecting a portion of said air supply to such a variable superatmospheric pressure as will cause the total of said air supply to be fed into said mixing chamber in accordance with the law of liquid flow.

22. In a carburetor, a mixing chamber, an atomizing nozzle therein, a main air supply to said chamber, and a supplementary air supply through said nozzle to said chamber, said supplementary supply being subject to such a variable superatmospheric pressure as will cause the total air supply to be fed into said chamber in accordance with the law of liquid flow.

23. In a carburetor, a mixing chamber, an air supply and a liquid fuel supply thereto, and means for regulating the pressure on a portion of said air supply so that the total air supply enters said chamber at rate which bears a constant ratio to said liquid fuel supply under all normal operating conditions.

24. In a carburetor, a mixing chamber, a main air supply, a supplementary air supply, and a liquid fuel supply thereto, and means controlled by the pressure in said chamber, for regulating the pressure on said supplementary air supply so as to make the total air supplied to said chamber bear a predetermined ratio to said liquid fuel supply under all normal operating conditions.

25. In a carburetor, a mixing chamber, a main air supply fed into said chamber in accordance

with the normal law of air flow, a supplementary air supply, and means to regulate the pressure on said supplementary air supply so that the total air supplied to said chamber varies with respect to the pressure therein in accordance with the law of liquid flow.

26. In a carburetor, a mixing chamber, a main air supply fed into said chamber in accordance with the normal law of air flow, a supplementary compressed air supply, and means to regulate the pressure on said supplementary air supply so that the total air supplied to said chamber varies

with respect to the pressure therein in accordance with the law of liquid flow.

27. In a carburetor, a mixing chamber, a main air supply fed into said chamber in accordance with the normal law of air flow, a supplementary air supply, and means controlled by the pressure in said chamber, to regulate the pressure on said supplementary air supply so that the total air supplied to said chamber varies with respect to the pressure therein in accordance with the law of liquid flow.

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