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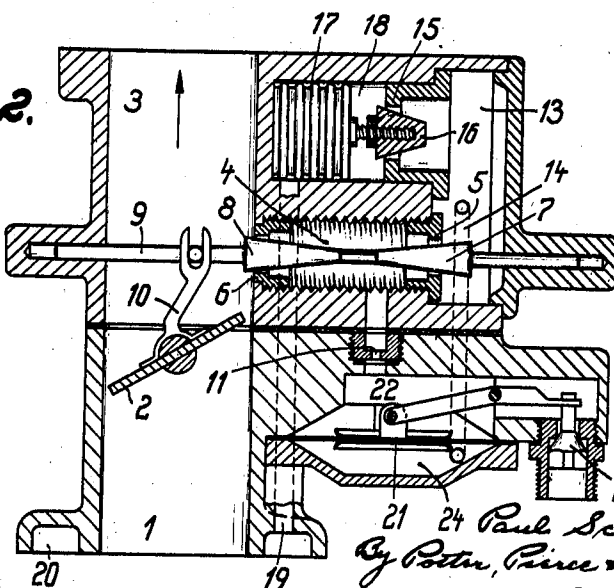
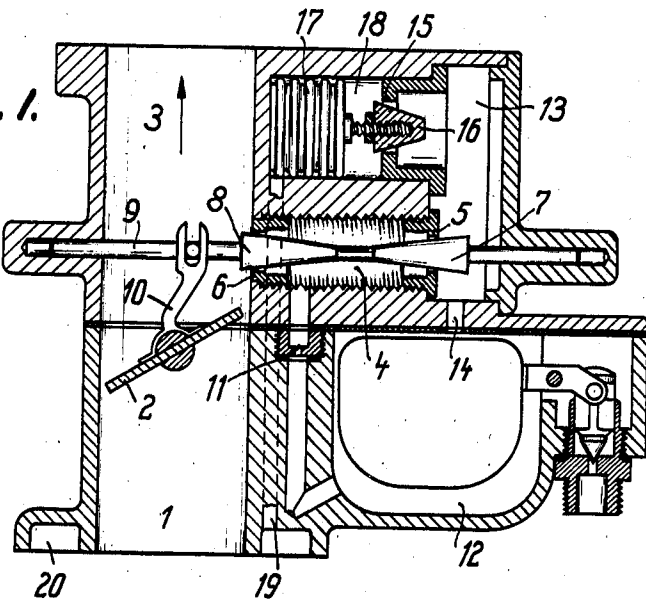
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CARBURETOR

Filed Jan. 30, 1939

2 Sheets-Sheet 1



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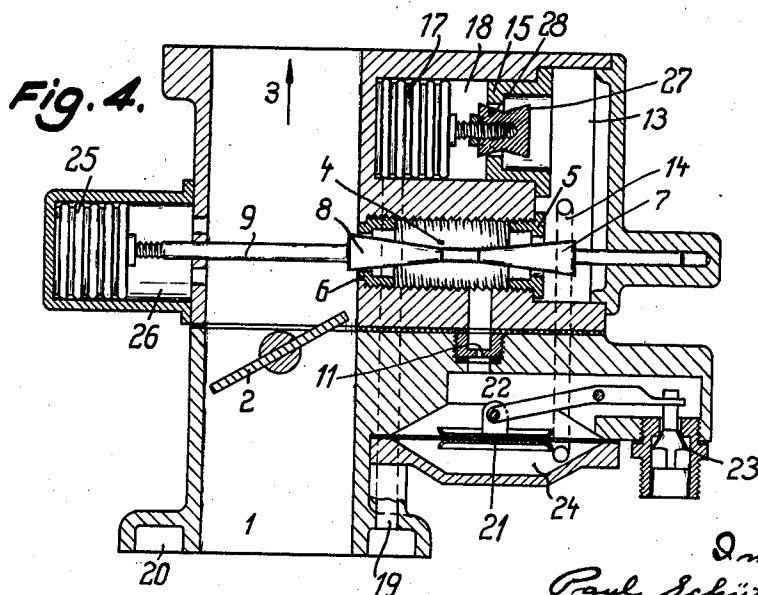
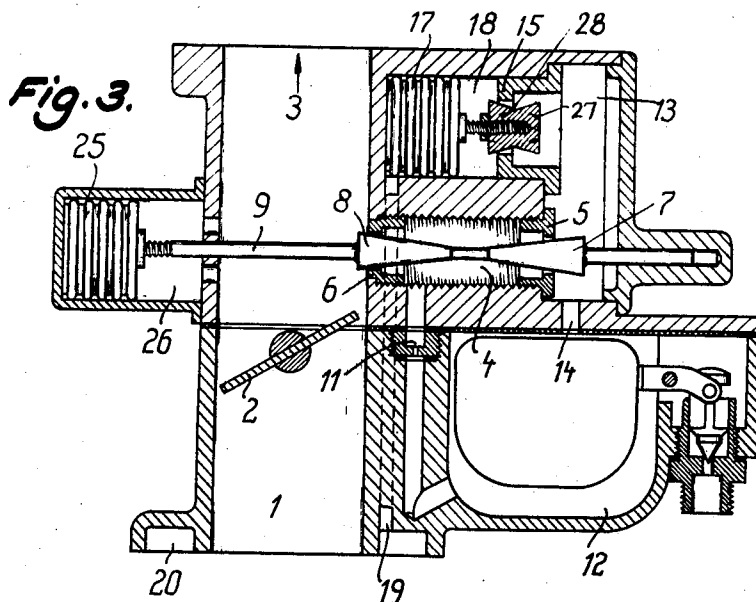
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UNITED STATES PATENT OFFICE

2,216,677

CARBURETOR

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1 Claim. (Cl. 261—39)

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March 2, 1927; 357 O. G. 5)

This invention relates to a carburetor for internal combustion engines in which the liquid fuel is atomised not directly within the combustion air which the motor has sucked in, but is led to an auxiliary mixing space in which a small amount of air is added to the fuel so that a super-rich mixture is formed to which the main amount of air is admixed only in the main mixing space. A thus designed carburetor presents, as is known, advantages as regards the regulation of the amount of fuel requisite at the time being, the regulation being effected in this way that the amount of air flowing through the auxiliary mixing space and, thus, also the height of the pressure existing in this space is varied, in dependency of a throttle valve, by means of a regulating body by which the width of the inlet aperture or of the outlet aperture or of both these apertures of the auxiliary mixing space is suitably adjusted.

The provision of the auxiliary mixing space presents first of all, the possibility to arrange the air regulating device (throttle flap) serving for regulating the motor performance not behind the main mixing space, but, counter to the usual arrangement, in front of this space whereby, under circumstance, service advantages can be attained. With this arrangement of the throttle flap the absolute pressure in the main mixing space increases with the increase of the width of the passage aperture which might entail a reduction of the supply of fuel at an increase of the performance of the motor if the fuel would be sucked directly into the main mixing space. The insertion of the auxiliary mixing space renders possible a reversal of the variation of the pressure at the fuel outlet place, in such a manner, that the absolute pressure in the auxiliary mixing space is reduced and the supply of the fuel is increased the more the throttle flap of the main mixing space is opened and the performance of the motor is correspondingly increased.

With such a carburetor, therefore, there is coordinated to every position of the throttle flap which position corresponds, in general, with a certain definite number of revolutions of the motor, a certain definite adjustment of the regulating body pertaining to the auxiliary mixing space, whereby is rendered possible that with the simplest constructional form of the carburetor a mechanical connection between the throttle flap and the regulating body can be provided. Instead thereof, the action of the throttle flap upon the regulating body takes place in an indirect manner with the aid of a member inserted between said parts and so designed as to permit to displace as a whole the

coordination of the positions of the regulating body. Such an alteration of the coordination is automatically obtained if the regulating body is readjusted by means of a pressure gauge, for instance a barometric box, subject to the atmospheric pressure and located behind the throttle flap. In this case the carburetor conveys an amount of fuel accommodated to the amount of air also if the number of revolutions of the motor and, thus, also the air-weight sucked in the unit of time varies by reason of a decrease of the load on the motor, the position of the throttle flap remaining unchanged. The yielding connection of the two regulating devices presents also the possibility to do away in a certain degree with the influence of variations of the atmospheric pressure upon the supply of the fuel, in that to every position of the throttle flap, for instance in the case of a reduction of the air pressure, automatically a position of the regulation device of the auxiliary mixing space is coordinated at which the amount of fuel sucked in is correspondingly reduced.

In order to obtain a good accommodation to all circumstances arising in practical service it is, anyhow, recommendable, as regards carburetors intended especially for flying machines and being independent of the eventual existence of an arrangement and combination of members permitting variations of the motor load, to provide an additional arrangement and combination of parts by which the supply of the fuel can be correctly accommodated to the strongly varying height of the atmospheric pressure. The present invention relates to such an additional arrangement and combination of members constituting a device excellently suited for the purpose in view. The solution of the problem, in connection with a carburetor having an auxiliary mixing space for the production of a super-rich mixture, consists in subjecting the pressure in the auxiliary mixing space, or the two air pressures determining the amount of fuel at the time being, viz. the pressure in the auxiliary mixing space and the pressure in the float chamber, to the action of a regulable fore-atmosphere, that is to say, of a reduced atmospheric pressure in a fore-chamber through which air is passing, this pressure being so varied in dependency of the actually existing outer air pressure that the weight of fuel conveyed remains accommodated under all circumstances to the air-weight which the motor has sucked in. If the carburetor is equipped, instead of with a float chamber, with a pressure regulator, for instance a diaphragm regulator, as has become usual of late

with the carburetor of flying machines, there then is on the one side the auxiliary mixing space and on the other hand the air side of this regulator connected up to the fore-chamber provided according to this invention, this chamber serving for the production of a fore-atmosphere in dependency of the variations of the atmospheric pressure.

The construction becomes particularly simple if for the production of the suitable pressure in the fore-chamber the flow of the amount of air is used with which the auxiliary mixing space is fed. It is then only necessary to provide a connecting conduit between the fore-chamber and the float-chamber, or the pressure regulator provided as a substitute for this chamber respectively. The fore-atmosphere is then acted on preferably by varying the width of the air-entrance aperture of the said chamber, in which case the regulating body effecting said variation can be connected up to a barometric box. This regulating body is designed in known manner as a cone and generally so arranged that it throttles the entrance aperture of the fore-chamber more strongly if the atmospheric pressure decreases, in consequence whereof the box expands.

The device constituting the present invention is applicable also if the motor is equipped with a compressor which provides for the cylinder being supplied with a uniform amount of air per stroke also if the pressure of the atmospheric air decreases. In this case only the shape of the regulating body controlling the entrance of the air into the fore-chamber need be altered. There is then employed a conical regulating body which enlarges the entrance aperture in accordance with the decrease of the pressure of the atmospheric air. As now the compressor is active only to a certain definite minimum of the air pressure, in correspondence with its size, that is to say, is able to maintain the full charge-pressure only to a certain definite barometric height (so-called full-pressure height), variations in the supply of the fuel take place if that height is surpassed, these variations corresponding essentially to the variations taking place with ordinary motors, i. e. such operating without a compressor. It is suited to the purpose in view to provide the carburetors intended to cooperate with motors operating with a compressor with a double regulating body for the regulating of the fore-atmosphere, of which body the one part enlarges the width of the entrance aperture of said chamber in accordance with the decrease of the atmospheric pressure until the so-called full-pressure height has been attained, whereas, when this height is surpassed, the other part of said double regulating body comes into action and decreases the width of the entrance-aperture of the fore-chamber when the atmospheric pressure decreases.

The invention is based on the following consideration: If a lower atmospheric pressure acts upon a carburetor equipped with an auxiliary mixing space, three places of the carburetor are subject to that variation, viz. the pressure in the main mixing space, the pressure in the auxiliary mixing space, and the pressure in the float chamber or in the air-space of the diaphragm regulator. The reduction of the pressure in the auxiliary mixing space and in the float chamber or the equivalent therefor do not compensate one another, but produce a reduction of the head effecting the outflow of the fuel, this reduction being proportionally equal to the reduction of the

barometric pressure. The reduction of the pressure in the main mixing space, effects likewise, in cooperating with the reduction of the pressure in the outer space, a reduction of the head determining the amount of air sucked in, this reduction being in a certain definite ratio to the reduction of the barometric air pressure. Thus, in so far, if all dimensions are suitably chosen, an automatic compensation of all variations could be attained without any particular contrivance.

With a decrease of the atmospheric pressure the heads in the carburetor which determine the supply of the air and the fuel become smaller so that the proportion of the spatial quantities of air and fuel conveyed per second remains unchanged. But the proportion of the weights of said two substances conveyed per second does not remain unchanged, as the density of the air (its specific weight) is reduced in correspondence with the reduction of the outer air, whereas the density of the fuel (its specific weight) is not reduced. The air-fuel-mixture supplied into the auxiliary mixing space becomes then poorer in air or, in other words, the motor received a comparatively too large amount of fuel. This can be obviated by reducing the head determining the supply of the fuel more strongly than head determining the supply of the air.

Now, this is attained, according to this invention, first of all, by the provision of a fore-atmosphere in which the pressure is varied not in correspondence with the pressure of the atmospheric pressure but in a higher degree, as suited to the object in view, this increase of the pressure being proportionally equal to the increase of the barometric variation at the time being. From this fore-atmosphere the pressures are drawn which determine the supply of the fuel. If, however, the motor is equipped with a compressor which renders the weight of the air with which the motor is fed independent of the variations of the pressure of the atmospheric air up to a certain definite barometric height, there then is obtained, as it were, a reversal of said conditions as long as that height is not surpassed.

It has already been mentioned that the pressure-difference determining the outflow of the fuel varies in simple dependency of the outer pressure, whereas now the air-weight conveyed to the motor remains unchanged if the charging pressure in front of the inlet valve remains unchanged. The supply of fuel to the auxiliary mixing space is, therefore, in this case too small, but this can be corrected by compensating the variation of the atmospheric pressure by means of an oppositely acting fore-atmosphere. The carburetor intended for cooperation with a compressor operates, thus, with a certain strongest relief of the atmosphere if it is situated in the proximity of the ground, and the relief decreases in the same measure in which the flying machine rises. The decrease of the relief, or of the throttling at the entrance to the fore-chamber lasts, however, only until the above-mentioned full-pressure height has been reached. If the machine rises still higher, the throttling must again be increased progressively as now the air-weight with which the motor is supplied per stroke decreases gradually, this taking place in a higher degree than with the weight of the fuel, as has already been mentioned.

The invention is illustrated diagrammatically and by way of example in the accompanying drawings in which are shown four constructional forms of the invention, the figures showing, how-

ever, only the members indispensably requisite to understand the invention, whereas all other members have been omitted for the sake of clearness.

5 In the drawings,

Fig. 1 is a vertical sectional view through a carburetor embodying the invention,

Fig. 2 is a similar view illustrating a modified form of the invention,

10 Fig. 3 is a similar view illustrating another modified form of the invention, and

Fig. 4 is a similar view illustrating another modification of the invention.

15 In the example illustrated in Fig. 1 is supposed that the carburetor is fed in the usual manner from a float chamber and that the regulating device for the auxiliary mixing space is mechanically coupled with the regulating device of the main mixing space. The air enters through the inlet aperture 1 into the main tube of the carburetor and flows first past the throttle flap 2 whereupon it streams into the main mixing space 3 located behind said flap. Laterally connected up to this main mixing space is the auxiliary mixing space 4 which has an air inlet aperture 5 and a mixture outlet aperture 6. The sectional areas of said two apertures are controlled by means of either accurately or approximately conically shaped regulating bodies 7 and 8 secured to a rod 9 coupled with the throttle flap by means of a forked lever 10 and a pin in connecting the forked end of this lever with said rod. The fuel enters into the auxiliary mixing space 4 through the delivery nozzle 11 which receives the fuel from the float chamber 12.

Now, there is provided, according to this invention, a forechamber 13 in which is produced a fore-atmosphere in a certain definite dependency of the atmospheric pressure existing at the time being. It is suited to the object in view to arrange said fore-chamber 13 in such a manner that the auxiliary mixing space 4 can draw the small amount of air which it requires directly from said fore-chamber. The controlled inlet of the auxiliary mixing space forms, thus, at the same time the outlet of the fore-chamber which is connected with the air space of the float chamber 12 through the conduit 14. The air sucked from the fore-chamber 13 into the auxiliary mixing space flows into said chamber 13 through an aperture 15 likewise subjected to the action of a regulating body 16. At the highest barometric air pressure to be reckoned with this regulating body 16 assumes a certain definite position by which a certain fall of pressure in the fore-chamber relatively to the pressure of the atmospheric air is produced. If this latter pressure falls, the regulating body 16 will be so shifted that the sectional area of the inlet aperture 15 is reduced and, thus, the fall of pressure in the fore-chamber 13, that is to say, the absolute pressure of the fore-atmosphere, is varied in a correspondingly higher degree. The readjustment of the regulating body can be effected automatically by means of a barometric box 17 which contains in known manner a certain definite quantity of gas and the outer surface is accessible to the action of the atmospheric air. If the carburetor is intended for flying machines it is suited to the purpose in view to mount the box in a closed space 18 which is connected by a pipe 19 with a damming-up space 20 located at a side of the air-inlet aperture 1 of the carburetor, so that in the case of the wind due to the flight being

utilized for the compression of the air equal conditions exist at all air supply places.

In the next example illustrated in Fig. 2 the carburetor per se is designed in the same manner as in Fig. 1, but for the float chamber 12 a diaphragm regulator 21 is substituted. The chamber 22 of this regulator is filled with fuel and communicates with the nozzle 11 that extends into the auxiliary mixing space through a conduit, as shown. The supply of the fuel into the chamber 22 is regulated by means of the valve 23 which is actuated by the diaphragm of the regulator 21. The oppositely located chamber 24 is acted on by the variable air-pressure, that is to say, it is acted on, according to the present invention, by the pressure of the fore-atmosphere in the fore-chamber 13, with which the chamber 24, is connected by the pipe 14.

The further examples illustrated in the Figs. 3 and 4 correspond in general with those shown in the Figs. 1 and 2, but there is in these cases the regulating device 7, 8 of the auxiliary mixing space coupled with the throttle flap not directly, but the readjustment is effected by means of a barometric box 25 enclosed in a chamber 26 connected up to the main mixing space 3. Instead of the box 25 it is, of course, possible to make use of a spring-actuated piston located in a cylinder. If, on opening the throttle valve, the pressure in the main mixing space rises, this increased pressure acts upon the box 26 whereby the regulating device 7, 8 will be readjusted in a manner similar to said device being directly coupled with the throttle flap 2. But an additional feature of this constructional form is that the range of the readjustability of the regulating device 7, 8 differs from that of the throttle flap, in that to every position of the throttle flap another position of the regulating device in dependency of the number of revolutions of the motor, or of the pressure existing in the main mixing space and depending on the number of revolutions respectively, can be coordinated. The modification of the carburetor operating with an auxiliary mixing spaced does not pertain to the present invention, but has been added merely for the sake of completeness, especially for the purpose of elucidating the constructive details if a compressor is inserted between the carburetor and the motor.

Concerning the manner of operation of the device constituting the present invention it will, for the first, be sufficient to consider the example illustrated in Fig. 1. If the flying machine flies in a uniform height the outer air-pressure can be assumed as being unvariable. In the inlet branch 1 and in the damming-up space 20 exists always the same air-pressure, independent of the number of revolutions, or the performance, of the motor, in the main mixing space, however, the absolute pressure rises uniformly, when the performance of the motor increases, from its smallest value to its greatest value at full load, but also this value remains always below the air-pressure at the inlet 1, or in the damming-up space 20 respectively, on account of the considerable speed of the air streaming to the motor. In the auxiliary mixing space 4 exists a pressure which is always higher than the pressure in the main mixing space 3. While the pressure existing in this space rises with an increase of the performance of the motor, it falls at the same time, and, in fact, stronger, in the auxiliary mixing space, in that the inlet aperture 5 is reduced and the outlet aperture 6 is enlarged when the throttle flap is opened. This fall of pressure in

the auxiliary mixing space is, it is true, diminished a little in that simultaneously therewith the pressure in the fore-chamber rises a little which is due to the cause that the position of the regulating body 16 is not varied, whereas the suction through the aperture 5 is reduced. But as, at the same time, also the pressure in the float chamber 12 rises, the supply of the fuel does not depend solely on the change of the state in the auxiliary mixing space 4, but on the difference between the pressure in the spaces 12 and 4, this difference increasing with the increase of the pressure in the forechamber, so that the desired increase of the fuel supply is obtained.

The determination of the quantity of fuel to be supplied to the respective motor is attained by a suitable configuration of the regulating bodies 7 and 8.

If, however, at any given performance, that is to say, at a given position of the throttle flap, as well as of the regulating bodies 7 and 8, the outer air pressure changes, for instance by reason of a change of the position of height of the flying machine, then the position of the three regulating bodies 2, 7 and 8 remains unchanged, whereas the regulating body 16 gets gradually readjusted in correspondence with the change of the outer air pressure, for instance in such a manner that it exerts a stronger throttling action when the outer air-pressure decreases.

It has already been mentioned that the pressure in the main mixing space decreases in the same proportion as the pressure in the inlet branch 1, the damming-up space 20, and in the box space 18, in consequence whereof also the fall of pressure from which the supply of the air in relation to the space concerned depends is reduced in the same measure. But the reduction of the air supply, related to the weight of the air, is stronger, in that at the same time also the density of the air streaming into the motor decreases. It is, therefore, not sufficient to reduce the fuel supply in proportion to the reduction of the outer air pressure, but the fuel supply must be reduced in a higher measure. This is effected by the readjustment of the regulating body 16 in the fore-chamber 13 in such a manner that a stronger fall of pressure takes place by which fall in the float chamber 12, as well as in the auxiliary mixing space 4, a correspondingly stronger reduction of the pressure and, thus, also a stronger reduction of the active head is caused.

It is, by the way, possible to design the box 17 in such a manner that it exerts a controlling action not only in dependency of variations of the air pressure, but also, quite generally, in correspondence with changes of the weight of the air so that it is subject also to influences due to the temperature.

If the carburetor is to be used in connection with a compressor inserted between the same and the motor, it is advisable to employ instead of the single regulating body 16 a double regulating body 27, 28 as shown in Figs. 3 and 4 of the drawings. There is, in such a case, no corresponding connection between the throttle flap 2 and the regulating device 7, 8; each of these members can be manually adjusted, if necessary, but it is preferable to expose the regulator to the action of a pressure-sensitive member, whereas the throttle-flap is adjusted by a pressure-regulator (not shown) which maintains the pressure behind the compressor on a uniform height, at least as long as the size of the compressor renders such an action possible.

If the flying machine is on the ground and the air pressure is the highest possible the part 27 of the regulating body is in its extreme throttling position and the forechamber is, if the motor is running, under a correspondingly strongly reduced pressure. The fuel supply is so determined that it corresponds to the full performance at the corresponding position of all movable members. An intended variation of the motor performance is attained by simultaneous readjustment of the pressure to be maintained by the regulating device for the pressure which the charge is to have, and of the regulating device 7, 8 of the auxiliary mixing space. If the flying machine gets, however, into a greater height without the performance of the motor having been readjusted there would fall, on the one hand, the pressure in the fore-chamber 13 and in the same proportion also in the spaces 20 and 18, as would likewise do the active feed head between the spaces 23 and 4, whereas, on the other hand, the weight of the air supplied into the motor remains unchanged by reason of the pressure of the charge remaining uniform. Owing, however, to the action of the regulating body 27 the mixture is prevented from becoming poor, in that the sectional area of the aperture 15 is enlarged in proportion to the reduced outer air-pressure, whereby the pressure in the fore-chamber is increased so that this pressure can uphold its original value and, therefore, the pressure existing in the spaces 22 and 4 and playing a part in the supply of the fuel remain unaffected. The dimensions of the regulating bodies 27, 28 are such that the second part becomes active when the flying machine has risen to full-pressure height. Above this height a motor provided with a compressor is subject to the same conditions as a motor having no compressor, in that at a greater position of height of the flying machine the weight of the air flowing into the motor commences to become lower, in fact in a higher degree than corresponds to the decrease of the outer air pressure. The regulating body 28 now entering into the aperture 15 causes a deeper fall of the pressure existing in the fore-chamber 13 whereby the compensation of the fuel supply is obtained in the same manner as has already been described with respect to Fig. 1.

I claim:

In a carburetor for internal combustion engines having a main mixing chamber and an auxiliary mixing chamber communicating with said main mixing chamber, a fuel chamber, means for regulating the supply of fuel to said fuel chamber, a fuel supply conduit leading from said fuel chamber to said auxiliary mixing chamber, an air supply chamber communicating with said auxiliary mixing chamber, means for regulating the cross sectional area of the passages leading from said air supply chamber to said auxiliary mixing chamber and from the latter to said main mixing chamber, an air supply conduit leading to said air supply chamber, means responsive to the pressure in said air supply conduit in advance of said air supply chamber for regulating the cross sectional area of the passage from said air supply conduit to said air supply chamber, and means for connecting the air supply chamber with said fuel supply regulating means whereby the action of said fuel regulating means is modulated by variations in pressure in said air supply chamber.

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