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2,432,980

CARBURETOR

Original Filed Dec. 7, 1940

2 Sheets-Sheet 1

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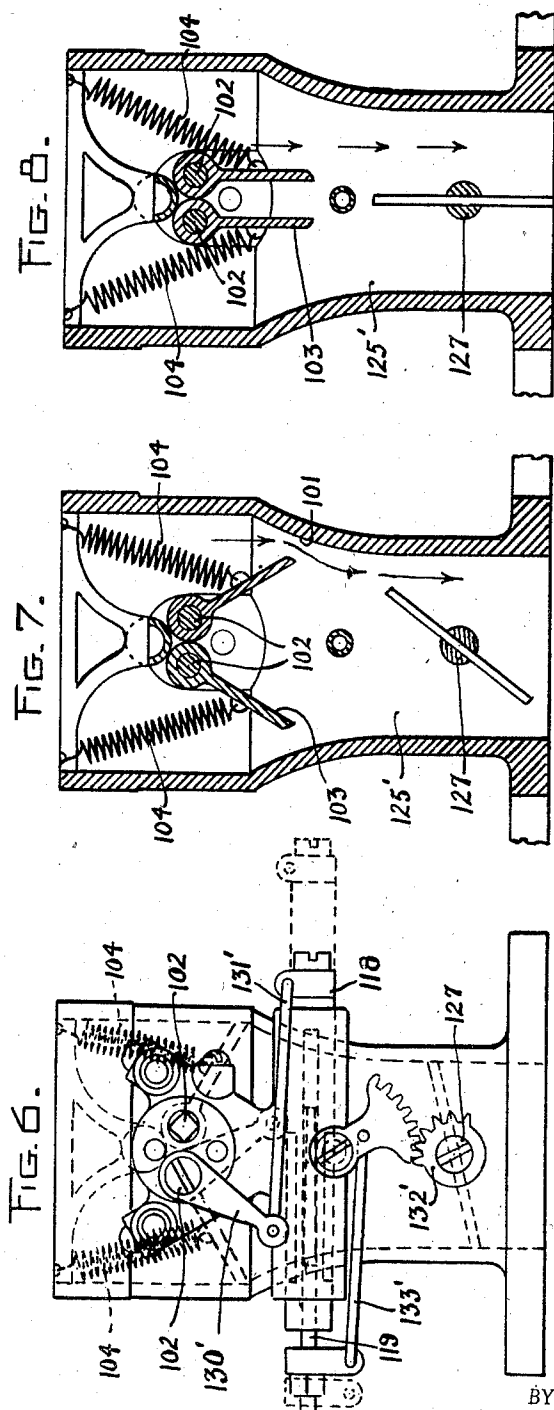
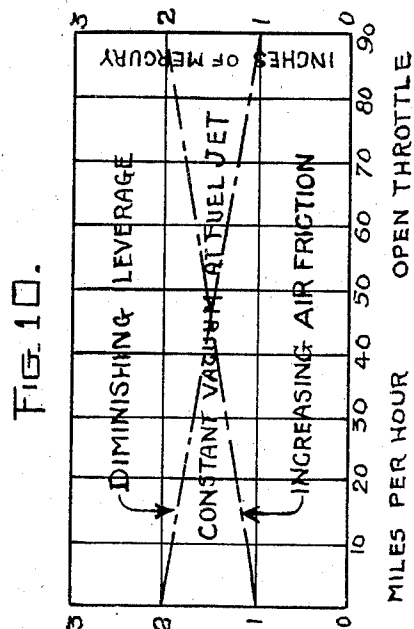
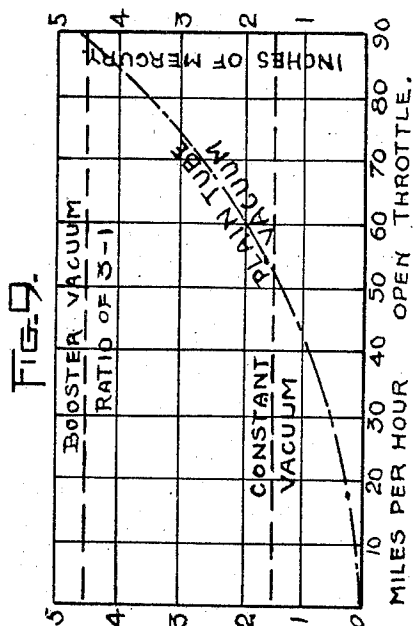
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,432,980

CARBURETOR

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16 Claims. (Cl. 261—39)

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This invention relates to improvements in carburetors.

The invention provides apparatus by which the carburetor maintains a substantially constant vacuum in its mixing chamber. And it also provides for automatically changing the metering of fuel to maintain or to change richness of the mixture fed to the engine according to what is needed for the exigencies of driving; as for example, for starting, or for accelerating, or for merely maintaining speed, high or low, at light or heavy load.

The term "constant vacuum" as used herein relates to the strength of vacuum in the mixing chamber; i. e. the degree of depression there below surrounding air. It signifies a strength which is continuously sufficient, at least, to overcome whatever resistance may have to be overcome, in order to maintain continuity of fuel feed to the engine, in the particular car in which the apparatus is to be installed. Preferably it is also constant in the sense of being always below a predetermined upper limit. For illustration, I consider the vacuum constant when it stays always within the low range of one or two inches of mercury, or within some other predetermined narrow range. In the particular apparatus herein pictured, I found the vacuum to remain at 1.5 inches Hg throughout all reasonable speeds, grades and loads, this vacuum being observed at all speeds between 10 and 80 miles per hour, and being sufficient, to draw from a local bowl. The constancy permits of this vacuum being also applied to important uses outside of the carburetor, as, for steady wind shield wiping, and for lifting of fuel to the vicinity of the carburetor from a low rear reservoir, a boosting device of known type being used if requisite. When applied to fuel-lifting, the constancy of vacuum strength maintains continuity of fuel flow; and, conversely, the continuity of fuel flow, under all conditions of driving, maintains the constancy of vacuum.

When speed or load increases, more fuel must be sucked in by the unchanged low vacuum. The apparatus automatically takes account of these needs and regulates the meter, as changes of load are indicated by the operator's changing the position of the throttle pedal, and as changes of speed are indicated by movements of the air valve. I have discovered that optimum relations exist when a turning of the throttle-valve moves the straight taper meter about one quarter as far as is produced by an equal angular movement of the air valve; and that preferably this ratio of throttle effect to air valve effect is not more than 1:2.

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This valvular control of mixture ratio of fuel and air renders the service that has heretofore been performed by the customary choke; and no choke is requisite. Also it renders the service of the hitherto customary accelerator pump; and no such pump is desirable. This is especially so since the valve-control-of-meter tends to make acceleration be at a more nearly uniform rate, with economy of fuel. The currently felt need for "fast idling" is eliminated. By the application of a thermostatic positioning control to the needle or the fuel jet, the richness of mixture is made appropriate for cold starting, and no choke is requisite for this.

It is a feature that the whole apparatus improves over currently known types of carburetors, in that it occupies little space, has simple construction, few parts and low cost; and yet attains the constancy of vacuum and mixture control as described.

It is an important practical object of the invention to provide the apparatus in form available for quantity production; and also to embody these numerous advantages in apparatus of satisfactory reliability in action.

Other details of construction, and other advantages in construction and in operation, will appear from the description which follows and from the showing in the accompanying drawings.

The present application is a continuation in part of my application for patent, Serial 212,568, filed June 8, 1938; also is a continuation in part of my application for patent Serial 248,072, filed December 28, 1938, and it is a division of my application for patent Serial 369,068, filed December 7, 1940, entitled Apparatus for feeding and metering liquid fuel to an internal combustion engine.

In the accompanying drawings:

Figure 1 is a side elevation of apparatus embodying the invention including in vertical medial section a local float chamber and lifting apparatus operated by the carburetor vacuum for supplying fuel to the carburetor;

Figure 2 is an elevation looking from the right at the carburetor portion of Figure 1, the float chamber and the carburetor bowl being omitted, and a portion being broken away to show the metering pin;

Figure 3 is an elevation, in medial section of Figure 2;

Figure 4 is a plan, in section on 4—4 of Figure 2;

Figure 5 is a plan, in section on 5—5 of Figure 3; but showing the sliding jet and needle sleeve unsectioned.

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Figure 6 is a side elevation of another structural embodiment of the feature of the invention which provides a constant vacuum and controlled proportion of mixture;

Figure 7 is a medial vertical section through the carburetor of Figures 1, 2, 3 and 6, showing the air valves partly open;

Figure 8 is a similar view with the air valves fully open;

Figure 9 is a diagrammatic chart of the relation of the constant vacuum of the invention to the vacuum produced at various speeds in a plain tube carburetor of prior art; and

Figure 10 is a diagrammatic chart of changes in mechanical and air friction resistance to which the air valve is subject at various speeds, and their cooperation to maintain the vacuum constant, as speeds increase.

The drawings illustrate a carburetor with which I have attained the important results herein set forth, in operation of a Ford 8-cylinder car of 1938, with gasoline. Other volatile fuels can be used, appropriate adjustments of design being made.

The carburetor represented is of a preferred simple construction for maintaining a constancy of vacuum which feeds and mixes fuel with air in a degree of richness which is automatically varied, for dealing with the exigencies of car driving, to accord with the fuel ratio needed for optimum results, either for economy of fuel or for power of drive. The construction shown can be produced economically in quantity methods, one important feature being that it permits the use of a straight taper jet meter (119, Figure 2) connected to the valves (102, 103; 126, Figure 3) so that it can make a relatively lean mixture for operating at part throttle, without excluding the ability to produce full power at wide throttle. Thus it economizes fuel during ordinary driving; and yet makes maximum acceleration available, without fuel waste.

As seen in Figures 3, 7, 8, the carburetor is a round tubular body 101, which is set vertically for down draft of air, and has its mixing chamber 125' between the inlet air valve vanes 103 and the outlet throttle valve disk 126. The air valve consists of two segmental vanes, whose hubs 105 cross the middle of the casing diametrically on parallel pivot shafts 102; and whose perimeter arcs each seat against the tube wall obliquely at about 60° from the axis. Above these hubs a frame 106, inserted at the air entrance of the tube, has a depending diametrical cross bar 107 with curved under surface to rest on top surfaces of the vane-hubs, against which it is pressed continuously by tensile springs 104 that are anchored to this frame 106, and are attached to the vanes 103, tending to draw the vanes up against their respective seats, initially having stress that is about half of what they have when the air valve is wide open. Thus they provide initial vacuum; and at all times their downward pressing of bar 107 against the hubs of the vanes provides friction which prevents flutter of the vanes, being a brake shoe and air seal between them.

The spring 104 of each air vane is dimensioned and mounted so that, as it elongates and increases in tension, with the opening of the air valve, its end on the vane swings with the vane, about the axis of the vane, so as to make the axis of the spring approach the axis about which the vane is turning; and thus the arm of that moment which is tending to close the valve, becomes shortened as the magnitude of the force

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of that moment grows with the extension of the spring.

But for making the vacuum be constant, the factors concerned can be combined variously. The preferred construction is illustrated in Figures 3-8, which indicate a combination with practically no change of air friction and practically no change of the moment of mechanical resistance.

The air valve in the illustrative embodiment which is being described has to do work when it moves; and it should be responsive to minute changes. This is important, for if the valve were to stick at low speed the engine would stop. When idling, the air opening may be not over .005 inch. I have found that by making each air vane completely unbalanced, i. e., with the air which can impinge on it passing wholly on one side of its pivot, the valve provides sufficient torque to overcome the friction of its shaft 102, as well as the drag of the brake surface 107 that prevents valve flutter, and to propel the fuel meter. The gearing of the two vanes together at 102', Figure 4, makes all of the torque from both vanes be available and sufficient for these services. By making the air valve in two vanes, instead of one large one, simplicity of structure is achieved, with diametric pivots, and a good structure for mixing.

The springs 104 used in the installation that is being described each have free length of one-half inch of coil, with 25 convolutions of .020 wire. When set, the coils are stretched to one inch for the closed-valve initial position; and, when suction of the engine begins, this produces the vacuum of 1½ inches Hg. When the valve has moved 60° to wide open position the spring coil is stretched to one and one half inches, and has twice its initial tension; the 60° swing has reduced the effective leverage through the arm about the shaft 102 from one-half inch to one-fourth inch, and the moment mechanically opposing the opening of the valve is the same as it was at the start. Thus the torque set up on the air valve shaft is the same at both extremes of valve travel.

The constant vacuum thus provided in the mixing chamber 125' draws in fuel which reaches the spray tube 125 (Figures 3, 5) from any suitable supply duct 124, 125 (Figure 2) through a metering passage between a tube 118 and a straight-tapered metering needle 119 whose longitudinal position in the tube 118 is fundamentally set by an atmospheric temperature thermostat 138, and is operatively under control of the air valve and throttle valve 103, 126 through their shafts 102, 127 and connections, which, in Figure 2, comprise crank arms 130, 132; links 131, 133; and a lever 134' whose mid-portion is pivoted on one end of that tube 118 and can move the tube longitudinally in its housing on the outside of the carburetor body.

Figure 2 illustrates an arrangement in which the fuel metering pin 119 has a slide bearing in an end part of the tube 118, and a tapering portion within the tube. The end of this pin outside of the tube is attached to the thermostat 138 which is a sheaf of five bi-metallic leaves clamped together, the second and fourth leaves being cut short at 138' to make the end portion of the sheaf have flexibility, so that it can bend without making the pin bind in its close fit in its tube 118. The middle of the body of the tube has passages and ports for fuel to pass transversely at a rate

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which depends upon what part of the straight taper of the pin is opposite the metering port.

Suction in the mixing chamber 125' draws fuel from an adjacent supply chamber 113, which in Figure 1 is behind the fuel lifting chamber 112, through a duct 02 (dotted in Figure 1) that leads it to the valve intake 124 (Figure 2), where its rate of entering the duct 125 is controlled by the measure of space currently existing between the fuel-metering valve-element, comprising the needle or pin 119 and its seat in the jet tube 118. This regulatory valve is not located within the mixing chamber as is usual; but its outlet duct 125 leads thither by any convenient course and has there a discharge orifice construction that extends completely across the mixing chamber 125'. This end portion of the duct 125 is a tube which has its end closed, is set horizontal, and has discharge orifices 108 distributed on all sides of the tube at intervals across the whole width of the chamber, between air and throttle valves.

The metering pin 119 represented in Figures 2 and 6 is made with a taper that is long and straight. This favors low cost, and high precision, in production of valve-elements by mass manufacture methods, and permits precision in setting the rate of fuel flow, under regulatory control by movements of air and throttle valves. The illustrative pins use about five-eighths inch length of straight taper, in a taper-ratio of about 1 in 30.

The local chamber for supply of fuel to the inlet duct 02 may be situated in any convenient place; and its contents may be replenished to constant level by any suitable means. In the structure here being described, fuel contents are maintained at constant level by power of the constant vacuum in the carburetor mixing chamber 125' which has a small suction air duct 110, Figure 1, through a Venturi vacuum booster 114, and valve 49 actuated by the float 45. This part of the apparatus here shown is not claimed herein, but is described and separately claimed in my said Letters Patent 2,304,066 of December 8, 1942. Pulsations of vacuum in chamber 112, alternating with pulsations of atmosphere, with the falling and rising of the float 45 at an average frequency of 60 or so per minute, cause rapid repetition of surges of liquid fuel in the chamber 112 to a hydrostatic head sufficient to replenish the bowl, lifting this fuel from a distant low reservoir 00 through inlet 01 into the local chamber 112, whence it flows into the atmospheric bowl as needed. The described means for producing constancy in the strength of vacuum can be designed so that the vacuum will always be sufficient to lift the fuel to a level which is constant, relative to the carburetor, under all conditions of throttle opening in normal operation of a car.

The invention provides for differential regulatory control of the metering of fuel by the air valve shaft 102 and the throttle valve shaft 127. The swing of the air valve crank 130 on shaft 102, and the travel of its link 131 connected to one end of the lever 134', approximate parallelism with the swing of the throttle valve crank 132 on shaft 127 and the travel of its link 133 which is connected to the other end of that lever 134'. The movements of these said parts are in approximate parallelism with the straight endwise travel of the elements 118, 119 of the fuel meter, one of which elements is pivoted on the lever 134' between the said two ends of that lever. The degree of opening between these

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meter elements 118, 119, at any instant is a resultant of the positions occupied at the same instant by the two valve cranks 130, 132. Whenever either the air valve or the throttle valve moves, it moves its own end of the lever, and thus moves the meter element 118 proportionately, but does not move the valve which is connected at the other end of the lever. Since that other valve may occupy any of various positions, and may itself be in motion at the very same instant, there may be a great complexity of lever positions and angles. Assuming that the valves and meter have a certain zero position, as when the engine is idling, and neither the air valve nor the throttle valve is perceptibly open, one may observe that when acceleration is desired the driver's moving of the throttle and its crank arm 132 to a moderately open position shifts the lever 134' and the meter element 118 to a slightly open position before the air valve is moved. This enriches the mixture, say to a ratio of 13 or 14 of air to one of fuel vapor, and produces maximum acceleration. The increase of suction which attends rising engine speed opens the air valve 103 and so shifts the meter, accumulatively, to a larger opening which maintains and even increases the richness ratio while drawing in more of both fuel and air. But when the desired speed has been reached, the driver's relaxing of the throttle, to cease acceleration, lets the richness ratio fall back somewhat, to the economical ratio 16 to 1, leaving the air and throttle valves both standing at whatever positions occur while maintaining the higher speed. If the throttle be afterward merely to call for more power, without increase of speed, as on reaching a more difficult grade, the operator's continuation of throttle opening pressure continues the needed richness of mixture. He can set the throttle valve open wide, advancing the metering pin accordingly for accelerating by enrichment. But, with any ensuing increase of engine speed, the resulting wider opening of air valve restores the predetermined economical ratio of mixture, at the same time advancing the metering pin still further, which provides the greater feeding of fuel that is needed for top speed.

In the above described connections of throttle and air valves to fuel valve, and in all alternative arrangements, opening movements of the throttle valve and air valve operate accumulatively to open, and conversely their closings have cumulative effect toward closing, the fuel valve. My differential control of the richness of the mixture permits of having the necessary rich ratio, 12 or 13 of air to 1 of fuel, during acceleration; and yet operating at the economical ratio 15 or 16 to 1 for ordinary constant speed. The parts can be organized so as to operate at whatever mixture is desired as the economical normal running mixture.

The relative lengths of the crank arms 130 and 132 and of the lever arms may be selected so as to produce whatever leverage ratio may be desired, between the valves and the meter. This ratio may differ for different fuels, and for different elevations. Also the ratio between the air valve and the throttle valve, as to the distance each will move the meter during an equal angular travel of valve, is subject to variation at choice. I have discovered and have demonstrated by analyses of exhaust gases that in a carburetor of the type herein described the optimum ratio, for gasoline fuel used at sea level, has the throttle

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move the fuel valve only about one-fourth as much as the air valve moves the fuel valve element in an equal angular movement of air valve. The dotted lines in Figure 6 express this ratio approximately, the leverage shown in full lines being ignored when this dotted feature is considered.

I have found the important fact that by providing a ratio of one to four the various influences can be integrated, with high efficiency and economy, for maintaining performance as above described, yet with there being always available an automatic change to a richer ratio when more power is demanded, by a mere pressure of the driver on the throttle. However, results that are good can be had up to a critical ratio in which the air valve moves a fuel valve element twice as far as the throttle valve moves the fuel valve element to which it is connected in an opening movement of equal angular distance.

The meter element and mid-portion of the lever 134' are responsive to movement of each valve, as thus described, because the meter is easily mobile while each valve is so firmly held between its spring and the opposing pressure of air or of the operator, as the case may be, that it stands firm in whatever position they fix it, and so acts as a fulcrum whenever the other valve moves.

The joint and differential control of metering jet may be had by gearing which does not include a lever. One such means is by connecting one of the valves to the jet, and the other to the pin, as seen in Figure 6, through crank arms whose lengths are in desired ratio. In this case the metering pin 149 is moved by link 133' and a reduction gearing 132' connection of the throttle valve 127, while the arm 130' of the air valve is directly connected to the jet 118 through a link 131'. The opening travels of the two valves move the needle and the jet in opposite directions.

The delivery of fuel into the mixing chamber 125' in Figures 2-8 is through a spray tube 125' which is set across the air passage and has the two characteristics which cooperate to produce a homogeneous mixture, first that the discharge occurs from holes at numerous locations on the way across the air stream (Figure 5), and second that the spray streams originate in and proceed in numerous directions from a sheltered region (Figures 7, 8), in the midst of the air stream for dispersion with a minimum of coalescing. When using gasoline as fuel I have found that surface tension of the liquid affords such resistance to its passing through these holes that it flows to the end of the tube, and escapes in finely divided state with uniformity of volume in all parts of the length, even though the holes are as large as $\frac{1}{16}$ " in diameter.

The setting of the air vanes 103 on parallel pivots 102 that cross the middle of a vertical, down-draft, round air passage 101 (Figures 3, 4) makes each valve be segmental, with its pivot at its chord and be exposed to air pressure on only one side of its pivot. Since the moving edge of the vane is round, and opens away from a round wall, the whole extent of the half round edge stands at least slightly away from the wall whenever the vane is at all open. Therefore, whenever the engine is running there is always a current of air between the wall and all parts of that edge of the vane which is adjacent to the wall. This avoids trouble from frost and ice-lock.

By making the closed position be at an angle

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below horizontal, the rather abrupt path of departure of the vane from the vertical wall makes the air valve be wide open, with the vane vertical at the middle, within a swing of only 60° or so. This occurs at high speeds and helps to keep the vacuum down, within the required range. For control of vacuum at low speeds, the taper of the passage wall from air valve to throttle valve begins in near perpendicularity to the plane of the seated air valve. Therefore whenever the air valve is barely open the air passage is very narrow, with consequent retardation of air inflow, which helps to raise the vacuum to the desired range of constancy. From the said perpendicularity the taper proceeds into a curve that is convex toward the path which the edge of the swinging vane follows in its more open positions (Figures 7, 8). Factors that combine at low speed to produce the desired $1\frac{1}{2}$ Hg inches of vacuum include the initial tension of the spring 104 and the air retardation above described. At great speeds factors that combine to prevent the vacuum rising above the desired range of constancy include the shortening of the effective length of the arm of the spring, the widening of the air passage, and its straightening from initial crookedness. The factors concerned can be varied in a mutually compensatory manner to produce a vacuum that is constantly within the range of one to two inches of mercury, or other desired range, at all stages of air valve opening, corresponding to all speeds and loads.

Figure 10 is a chart indicating how the simultaneous increasing of air friction and diminishing of forces tending to hold the valve closed are mutually balanced so that neither the increase of the one nor the diminution of the other takes the vacuum out of the said range. Figure 9 contrasts the constant vacuum thus obtained with the vacuum which carburetors of the plain tube type experience, in which the vacuum increases with the square of the speed of the inrush of air. The latter vacuum rises along the curved line up to nearly five inches Hg during a rise of speed of car from zero to 90 miles per hour. But in the carburetor of the invention, the curve marked "constant vacuum" is constantly within the range of 1 to 2 inches, illustrated as being constant at 1.5 inches Hg.

As the vacuum of a mixing chamber can be used exteriorly, and can be boosted by known methods, the constancy of the carburetor vacuum is a feature of importance for steady and sure operation of the outside utility to which it may be applied, which, for example, may be the operating of a windshield wiper. The chart Figure 9 therefore illustratively shows a boosted constant vacuum of 4 to 6 inches; and Figure 1 illustrates the use of such a boosted constant vacuum for raising fuel unflinching from a low level reservoir 00 through duct 01 to pump chamber 112. Vacuum reaches the valve 49 through a Venturi booster 114 from an external orifice 110 of a duct (not shown) from a mixing chamber 125'.

The combined effect of the constant vacuum and the illustrated ratio of valves, meter, and leverage connection produces an economical firing mixture having about 1 part of fuel vapor to 16 of air, when the ratio is such that the air valve moves the meter four times as far as the throttle valve moves the same in an equal angular travel of valve. In operation the valves enrich this mixture automatically and temporarily from time to time, up to about 1 to 12 for full power.

While the ratio between valves and meter is a matter of choice, my discovery that a 4:1 movement of meter is best for all speeds and loads has been confirmed by exhaust gas analyses. If the gearing ratio is made less than 2:1 the mixture becomes too rich in acceleration and in climbing hills at moderate speed, so that a ratio lower than that is not advisable.

The connecting of air valve and throttle valve to the metering means may be in any of several ways. Figure 2 shows valves both connected to an element that moves the tube of the meter with respect to a stationary pin. Obviously the element might be arranged to move the pin, relative to a stationary tube. In Figure 6 one valve moves the tube and the other valve moves the pin. There may be two metering tapers on a single pin. In another good arrangement (not shown) the two tapers may be on separate metering pins, one pin worked by the air valve and the other pin worked independently by the throttle valve, but both jets feeding the same vacuum chamber. The leverage ratios of the respective valve connections to the meter will differ from each other according to the principle above set forth, the parts being arranged so that the fuel metered by the throttle valve is about one fourth as much so that metered by the air valve, thus maintaining the principles of differential metering.

I claim as my invention:

1. A carburetor comprising a body having a mixture passage extending therethrough; a manually controlled throttle valve in the outlet, comprising a disk on a pivot shaft; at least one air valve in the inlet, comprising a vane on one side of a second pivot shaft, openable by air pressure thereon; a spring attached to the vane and body, tending to close the vane; a fuel supply chamber and a duct therefrom having a discharge orifice in the mixture passage intermediate the vane and throttle; and a fuel valve in said duct comprising relatively reciprocable tapered pin and seat elements; combined with a crank arm on the said throttle shaft; a crank arm on the said vane shaft; a lever pivoted on one of said valve elements and having oppositely extending arms; a link connecting the throttle crank arm to one of said lever arms; and a link connecting the air vane crank arm to the other lever arm; the lengths of said lever arms and crank arms being so proportioned that a given angular movement of the vane arm by air pressure on the vane shifts the fuel valve element accumulatively with, and at least twice as far as, an equal angular movement of the throttle arm.

2. A carburetor comprising a body having a mixture passage extending therethrough; a manually controlled throttle valve in the outlet, comprising a disk on a pivot shaft; at least one air valve in the inlet, comprising a vane on one side of a second pivot shaft, openable by air pressure thereon; a spring attached to the vane and body, tending to close the vane; a fuel supply chamber and a duct therefrom having a discharge orifice in the mixture passage intermediate the vane and throttle; and a fuel valve in said duct comprising relatively reciprocable tapered pin and seat elements; combined with a crank arm on the said throttle shaft; a crank arm on the said vane shaft; linkage connecting the throttle crank to one of said valve elements for shifting that element in opening direction as the throttle is manually opened; linkage connecting the air vane crank to the other said valve element for shifting that other element in the opposite

direction for further opening as air pressure opens the vane; the lengths of crank arms and of the said linkage connections being so proportioned that a given angular movement of the vane by air pressure thereon shifts its fuel valve element at least twice as far as an equal angular movement of the throttle crank shifts the valve element to which the throttle is connected.

3. A carburetor comprising a body having a mixture passage extending therethrough, a manually controlled throttle valve in the outlet, comprising a disk on a pivot shaft; at least one air valve in the inlet, comprising a vane on one side of a second pivot shaft, openable by air pressure thereon; a spring attached to the vane and body, tending to close the vane; a fuel supply chamber and a duct therefrom having a discharge orifice in the mixture passage intermediate the vane and throttle; and a fuel valve in said duct comprising relatively reciprocable tapered pin and seat elements; combined with a crank arm on the said throttle shaft; a crank arm on the said vane shaft; linkage connecting the throttle crank to one of said valve elements; and linkage connecting the vane crank to one of said valve elements; said crank arms and their said connections being so arranged that a movement of the air vane opens or closes the fuel valve cumulatively with an opening or closing, respectively, of the throttle valve, and proportioned so that a given angular movement of the air vane makes at least twice as great a shift of the fuel valve as an equal movement of the throttle valve.

4. A carburetor as in claim 3, wherein the said crank arms and their linkage connections are so proportioned that a given opening movement of the air vane opens the fuel valve approximately four times as far as an equal angular movement of the throttle valve opens the fuel valve.

5. A carburetor as in claim 3, further characterized in that a thermostat, based on the said body, has its moving end secured to one of the said fuel valve elements, thereby to modify, according to atmospheric temperature, the starting position of the fuel valve, and its areas of opening produced by the throttle and vane.

6. A carburetor as in claim 3, further characterized in that the said spring is a tension spring attached to the vane for its direction of pull on the vane to shift toward the vane's pivot shaft as the vane swings open, thereby to maintain its effective vane-closing moment approximately constant and tending to maintain a constant strength of suction in the chamber between vane and throttle.

7. A carburetor comprising, in combination, a body having a mixture passage extending therethrough; a manually controlled throttle valve in the outlet; at least one air valve in the inlet, comprising a vane pivoted on an axis at one edge of the vane, openable by air pressure, and having a spring attached to the vane and to the body in tension tending to close the vane; that part of said passage which is between these valves being a vacuum and mixing chamber, the said spring being mounted on said vane and body for the line of its pull on the vane to shift toward the axis of the vane as the vane swings open, to reduce the length of its arm effective for closing the vane in a ratio that maintains the vane-closing moment approximately constant and so tends to maintain a constancy of strength of vacuum in the said vacuum chamber; combined with a liquid fuel supply chamber outside of the said passage and adjacent to the vacuum and mixing cham-

ber, a duct for liquid fuel leading from said fuel supply chamber into said vacuum and mixing chamber; a fuel regulatory valve comprising two relatively movable elements for said duct, and transmission mechanism connecting said vane shaft to one of said elements, and transmission mechanism connecting said throttle shaft to one of said elements, each mechanism shifting the element connected therewith to regulate the area of valve opening, said mechanisms being effective separately and cumulatively and proportioned for a given angular movement of the vane to change the fuel valve opening at least twice as much as an equal angular movement of the throttle.

8. A carburetor comprising, in combination, a body having a mixture passage extending there-through; a manually controlled throttle valve in the outlet; at least one air valve in the inlet, comprising a vane pivoted on an axis at one edge of the vane, openable by air pressure, and having a spring attached to the vane and to the body in tension tending to close the vane; that part of said passage which is between these valves being a vacuum and mixing chamber, the portion of said passage which is closed by said inlet vane having a segmental cross-section, and the said vane therein being segmental, the vane's said pivotal axis being at its chordal edge, from which the vane extends across the passage and has its curved edge seating against the arcuate wall of the said segmental cross-section; said spring being mounted on said vane and body for its line of pull on the vane to shift toward the pivotal axis of the vane as the vane swings open, to reduce the length of its arm effective for closing the vane in a ratio that maintains the vane-closing moment approximately constant and so tends to maintain a constancy of strength of vacuum in the said vacuum chamber; combined with a liquid fuel supply chamber outside of the said passage and adjacent to the vacuum and mixing chamber, a duct for liquid fuel leading from said fuel supply chamber into said vacuum and mixing chamber; a fuel regulatory valve comprising two relatively movable elements for said duct, and transmission mechanism connecting said vane shaft to one of said elements, and transmission mechanism connecting said throttle shaft to one of said elements, each mechanism shifting the element connected therewith to regulate the area of valve opening, said mechanisms being effective separately and cumulatively and proportioned for a given angular movement of the vane to change the fuel valve opening at least twice as much as an equal angular movement of the throttle.

9. A carburetor as in claim 7, in which there are two said chambers for holding fuel supply, outside of the said passage and adjacent to the vacuum and mixing chamber, that one of these two supply chambers which is first in the line of supply having an inlet for liquid fuel from below and an outlet for liquid to flow by gravity to the supply chamber which is second in line of supply, said first chamber also having, for air, a port with valve for inlet from atmosphere, and an outlet port with duct and valve for air to go from it to said vacuum chamber, with a float for opening the said ports alternately; the said fuel duct leading from said second fuel supply chamber; whereby at all speeds and loads the said constant strength of vacuum can feed fuel to the mixing chamber from a reservoir at lower level.

10. A carburetor as in claim 7 in which there is also a duct leading to said vacuum chamber,

having an inlet orifice located at the exterior of the body and adapted for connection to an air operated mechanism outside of the mixing chamber, whereby the approximately constant vacuum of said vacuum and mixing chamber can exert approximately constant power to operate apparatus having moving elements.

11. A carburetor as in claim 7, further characterized in that the said regulatory valve in the fuel duct is outside of the vacuum and mixing chamber; and that the fuel duct has a terminal portion comprising a tube set horizontally across the said passage between the inlet valve and the throttle valve; with discharge orifices on all sides of said tube at intervals all of the way across the said constant vacuum space.

12. A carburetor as in claim 8, further characterized in that the said inlet portion of the passage has a round cross-section, and that there are two of the said segmental vanes therein, having their chordal edges pivoted across the middle of the passage, said vanes extending obliquely thence and their curved edges seating against opposite walls of the passage; the structure and mounting of the said tension springs of each vane being such that when the vane is fully open each spring has tension of about double and has a moment arm of about half what the tension and moment arm respectively are when the vane is seated.

13. A carburetor as in claim 8, further characterized in that the said inlet portion of the passage has a round cross-section, and there are two of the said segmental vanes therein, their chordal edges being pivoted across the middle of the passage and geared together; and their curved edges seating obliquely against opposite walls thereof; hubs at the pivotal axes, and a friction anti-flutter brake pressing on the hubs.

14. A carburetor as in claim 8, further characterized in that the said inlet portion of the passage has a round cross-section, and there are two of the said segmental vanes therein, their chordal edges being pivoted across the middle of the passage, and geared together; their curved edges seating obliquely against opposite walls thereof; hubs at the pivotal axes; a frame loose in the inlet, having a shoe resting on the hubs, covering the space between the hubs against air leakage; the said tension springs of the vanes being attached to the body through this frame, whereby their spring pressure on the hubs provides anti-flutter braking.

15. A carburetor as in claim 8, further characterized in that the said inlet portion of the passage has a round cross-section, and there are two of the said segmental vanes therein, having their chordal edges pivoted across the middle of the passage; these vanes extending obliquely across the passage and seating their curved edges against opposite walls; further characterized in that the longitudinal contour of that part of the passage wall that is beside the paths of the edges of the vanes is convex toward the middle of the passage; whereby, during air valve opening travel, the course opened for air travel is initially tortuous and narrower than the instant measure of valve travel, thus augmenting air friction at this stage of opening, with diminution of tortuosity as opening travel proceeds.

16. A carburetor as in claim 8, further characterized in that the said inlet portion of the passage has a round cross-section, and there are two of the said segmental vanes therein, pivoted across the middle of the passage at their chordal

edges, and extending thence to opposite walls; further characterized in that the delivery end of said fuel duct is a tube extending fully across the vacuum and mixing chamber, set horizontal, adjacent to and parallel to said chordal edges in the middle space sheltered thereby; there being discharge orifices on all sides of this tube, distributed along it all of the way across, for induction of fuel to all parts of the space which is between the inlet vanes and the throttle valve.

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REFERENCES CITED

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

	Number
	1,977,721
5	1,254,355
	1,381,208
	1,586,683
	1,982,291
	1,611,347
10	1,288,426

	Number
	11,368
15	431,793

UNITED STATES PATENTS

Name	Date
Funderburk	Oct. 23, 1934
Reichenbach	Jan. 22, 1918
McCarthy	June 14, 1921
Mock	June 1, 1926
Gould	Nov. 27, 1934
Hartwell	Dec. 21, 1926
Kerns	Dec. 17, 1918

FOREIGN PATENTS

Country	Date
Great Britain	May 13, 1912
Great Britain	July 16, 1935