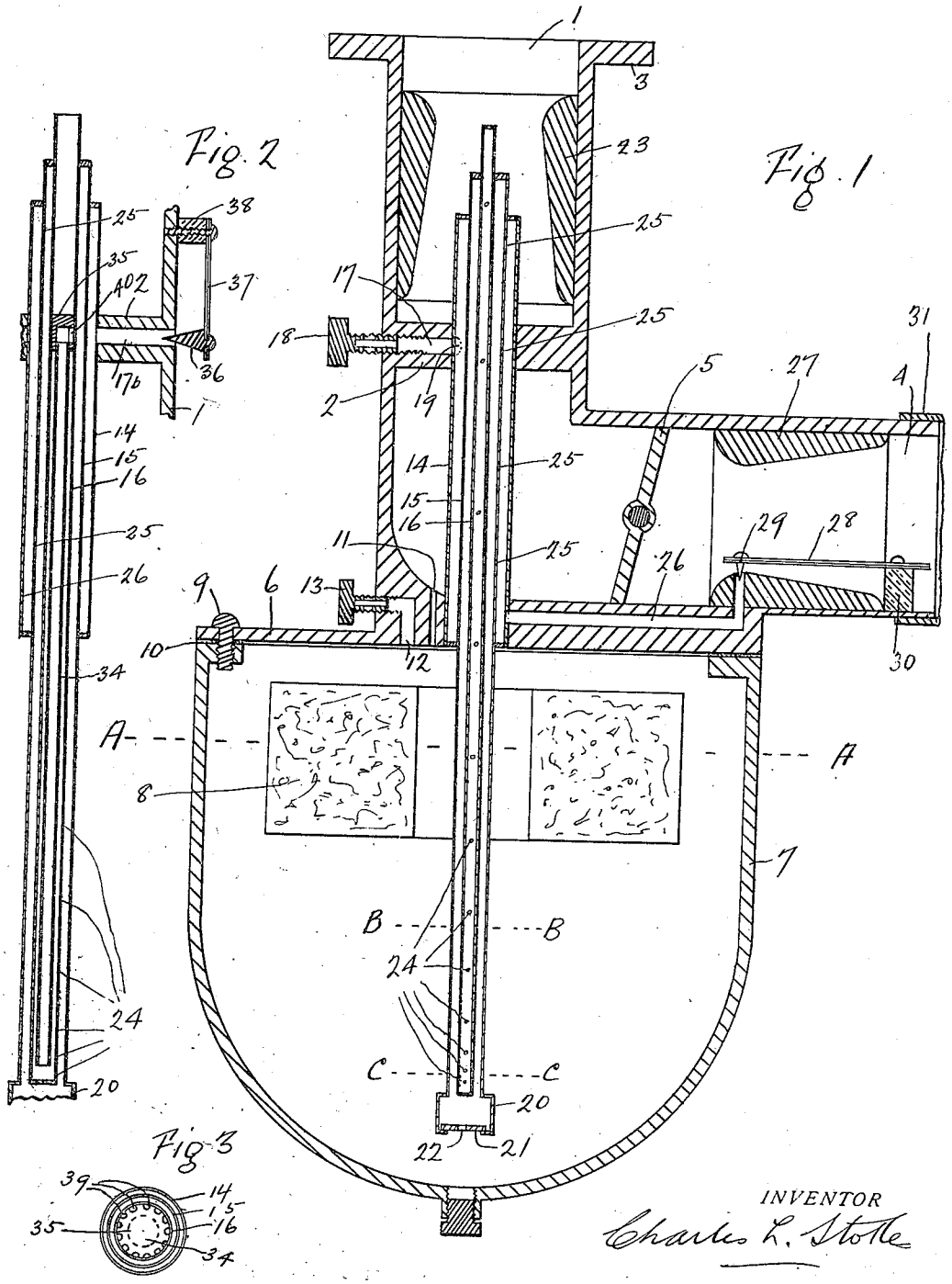
April 28, 1931. C. L. STOKES 1,803,150

CARBURETOR

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Fig 4

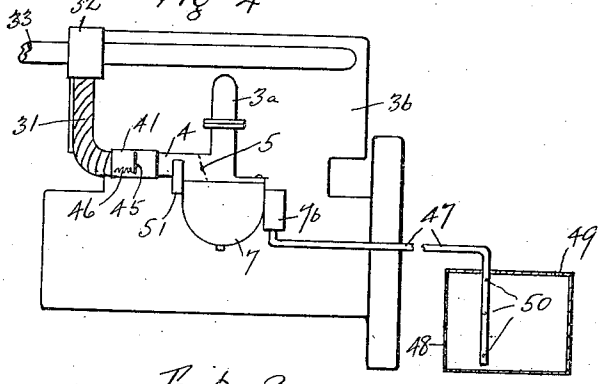


Fig. 6

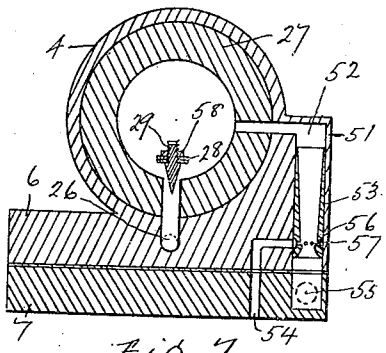


Fig 8

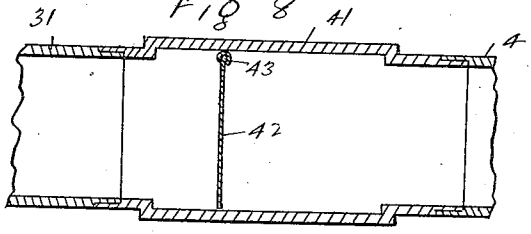


Fig 7

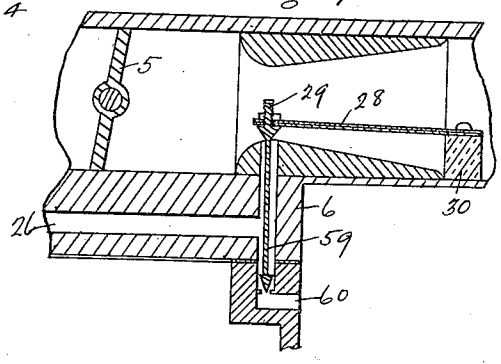
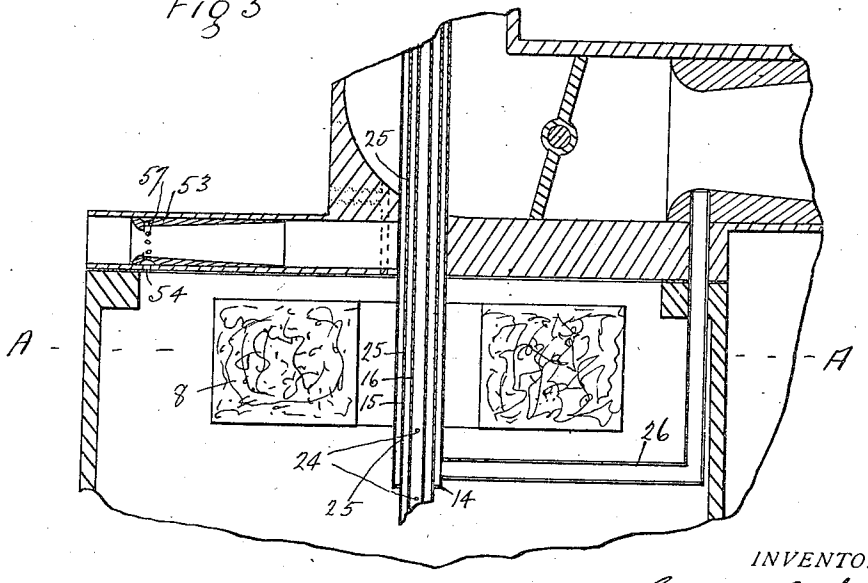


Fig 5



INVENTOR

Charles L. Stokes

Patented Apr. 28, 1931 1,803,150

UNITED STATES PATENT OFFICE

CHARLES LAWRENCE STOKES, OF LOS ANGELES, CALIFORNIA, ASSIGNOR TO CURTIS B. CAMP, TRUSTEE, OF GLENCOE, ILLINOIS

CARBURETOR

Application filed January 5, 1926. Serial No. 79,403.

My invention relates to improvements in automatic fuel regulators for supplying fuel in the proper amounts under all conditions to an internal combustion engine.

The principal object of my invention is to automatically provide an internal combustion engine, in accordance with its suction, with the proper amount of fuel for starting, idling, accelerating and in general for all variable speed conditions.

Another object of my invention is to utilize at times the engine temperature for finer regulation.

Another object of my invention is to provide an automatically regulated carburetor for internal combustion engines.

This invention embodies in a novel form some of the principles shown and described in my co-pending applications Ser. Nos. 626,990, filed March 22, 1923; 644,925, filed June 12, 1923; 676,864, filed November 24, 1923; 715,912, filed May 26, 1924; 56,513, filed September 15, 1925; 67,864, filed November 9, 1925.

In the drawings Fig. 1 is a vertical cross-section of a carburetor embodying my invention.

Fig. 2 is a vertical section of a portion of a carburetor, with parts broken way;

Fig. 3 is a horizontal section of the outer, intermediate and inner tubes, showing the plug 35 in position therein;

Fig. 4 is a side elevation of an internal combustion engine shown more or less diagrammatically, and showing the invention in position thereon, with parts in section;

Fig. 5 shows a section similar to Fig. 1, and disclosing a modified form of construction, with parts broken away;

Fig. 6 is a transverse vertical section of the air passage, taken through the venturi and showing a modified form of construction;

Fig. 7 is a horizontal, vertical section of the air passage, showing a further modified form of construction; and

Fig. 8 is a longitudinal, vertical section of the air passage, anterior of the venturi.

Referring to the drawings, a carburetor is shown which includes a mixing chamber 1 of circular cross-section wherein is cast a cross piece 2. A flange 3 is adapted to connect the carburetor as a whole to the intake passage 3*a* of an internal combustion engine 3*b* and an air passage 4 opens the mixing chamber 1 to atmosphere, the passage of which is controlled by a butterfly throttle valve 5. The lower part of the mixing chamber and air passage forms a circular cover 6 adapted to enclose a bowl 7 containing liquid fuel supplied thereto in any well known manner through a passage 7*b* controlled by a valve (not shown) actuated by float 8 when a predetermined level of liquid fuel A—A has been attained therein. Inasmuch as the construction of the float and valve mechanism in a carburetor float chamber is well known, it is unnecessary to enlarge thereon as the same forms no specific part of my invention.

The cover 6 is held in air tight relation with bowl 7 by means of screws 9 and a gasket 10. Communication between the chamber 1 and bowl 7 is provided by a small passage 11 and atmosphere is admitted to bowl 7 through a passage 12 adjustably controlled by a valve 13. Alternatively passage 12 may communicate direct with passage 11 so that vapors may not be drawn off from the fuel in bowl 7.

Centrally of the chamber 1 and bowl 7 are placed a series of concentric tubes comprising an outer tube 14, an intermediate tube 15 and a central tube 16, the tubes being supported one between the other, by the cross piece 2 and the cover 6. A passage 17 for air is drilled through one arm of the cross piece 2, the passage of air therethrough being adjustably controlled by a valve 18 and passage 17 connects through an orifice 19 to the interior of pipe 14, the lower end of which is closed and does not extend into the bowl 7.

Pipes 15 and 16 extend through cover 6

close to the bottom of bowl 7, the lower end of pipe 15 containing an enlargement 20 wherein is placed an upwardly raising light check valve 21 having a small central orifice 22. The lower end of pipe 16 is closed, its upper end extending to the throat of a venturi 23 and a series of small orifices 24 of predetermined size and spaced apart predetermined distances are drilled in pipe 16 to communicate with the interior of pipe 15. A series of orifices 25 are drilled in pipe 15 to communicate with the interior of pipe 14 and said orifices are of predetermined sizes and spaced apart predetermined distances.

A passage 26 is drilled in cover 6 to communicate with the interior of pipe 14 and with the throat of a venturi 27 placed on the atmosphere side of throttle 5, and discharge from passage 26 is controlled by the action of a thermostat 28 which actuates a tapered valve 29, the same being mounted on an insulated block 30 interiorly of air passage 4.

A pipe 31 connects passage 4 to a stove 32 surrounding the exhaust pipe 33 of the engine 34 to which the carburetor as a whole is attached for the purpose of supplying heated air to aid in the vaporization of the liquid fuel drawn from bowl 7 in a well known manner.

The operation of the carburetor with automatic fuel regulation is as follows:

If throttle 5 be closed and it is desired to start the engine at very low temperatures, the discharge end of passage 26 will be wide open due to the action of thermostat 28. Upon cranking the engine, the suction of the same will be applied through chamber 1 to the discharge end of tube 16 and through orifice 11 to the bowl 7. The cranking suction thus engendered will cause liquid fuel to be drawn in comparatively large volume through orifices 24 below the normal liquid level A—A. At the same time let it be assumed that the suction applied through orifice 11 is sufficient only to draw the liquid fuel in tube 15 down to the level B—B, this being made possible by the air adjusting screw 13. The cranking of the engine will continue whereby liquid fuel will be drawn through orifices 24 in sufficient quantity to ensure a quick start, the same carbureting the air passing through any of the orifices 24 above the liquid level B—B in pipe 15 and also the small portion of air passing through throttle 5 and orifice 11.

As soon as the engine starts the vacuum applied through chamber 1 and the said orifices will suddenly increase whereby the liquid level in tube 15 will recede to the line C—C permitting only sufficient liquid fuel to pass through the lowermost orifice 24 for idling the engine. Should this amount of fuel be insufficient to keep the engine idling, the speed of the engine will drop off whereby the vacuum will drop off and therefore the fuel in tube 15 will rise and cover one or more of the orifices 24 whereby additional liquid fuel will be supplied the engine to keep it running.

During this time of starting the engine, substantially atmospheric pressure will prevail anteriorly of throttle 5 and therefore atmospheric pressure will substantially prevail interiorly of pipe 14 and also of pipe 15 because the air may pass readily through orifices 25 from passages 17 and 26, the uppermost orifice 25 being relatively large for passing air only.

If a higher engine speed is desired, the throttle 5 will be opened a predetermined distance whereupon the pressure in chamber 1 and bowl 7 will increase to the end that liquid fuel will rise in pipe 15 a predetermined amount and supply additional fuel through a predetermined additional number of the orifices 24. When throttle 5 is further opened to wide open, the suction in 26 will be increased to a maximum whereby the liquid fuel in pipe 15 will be raised to cover the orifices 24, with the possible exception of one, and will be discharged into passage 26 and thus into chamber 1 through a predetermined number of orifices 25. In this manner a proper proportion of fuel to air is maintained for operating the engine to which the carburetor is attached. It will be noted that the liquid fuel being drawn through orifices 25 will be mixed with air passing through 17 and thus the delivery and carburetion thereof is accelerated. As the engine warms up, the height to which the liquid fuel will rise in tube 15 is automatically reduced by the action of thermostat 28 and valve 29 which is so regulated that the flow of heated air passed will decrease the mixture strength with increasing engine temperature until an optimum mixture is being supplied.

If throttle 5 be closed and it is desired to suddenly accelerate the engine, throttle 5 will be thrown wide open whereupon the vacuum in bowl 7 will be reduced to a minimum and a vacuum in passage 26 will be increased very largely whereby the liquid column in tube 15 will rise rapidly to the uppermost orifice 25 and thus provide a large volume of liquid fuel for quick acceleration and immediately thereafter, the inertia of the column being spent, the liquid fuel in pipe 15 will recede to discharge the correct quantity of liquid fuel through other orifices 25 and 24.

From the operation described, it will be seen that I have provided what for convenience of description will be termed a manometer member which includes a constant level arm in the bowl 7 and a variable level arm in tube 15 and I take advantage of the differentials shown in engine vacuums for operating the manometer member to give correct fuel proportions under all conditions of engine suction, according to the throttle

opening. Normally the vacuum in bowl 7 may vary from atmosphere at quick acceleration to four inches of gasoline when idling, but of course these proportions will change with different designs for different engines and I can maintain any desired differential pressure between the manometer arms up to several inches of mercury.

The sizes of the orifices and distances therebetween are purely a matter of trial for each type of engine, but in general said distances are preferably sufficient to prevent excess feed through the orifices under very small fluctuations of liquid in the manometer member arm 15. This can be arranged to any degree by extending the tubes 15 and 16 even through the bottom of bowl 7 in a suitable extension thereof.

It will be noted that bowl 7 is substantially always under a slight vacuum and also that the rise of liquid fuel in tube 15 at acceleration and otherwise for discharge through orifices 25 is due to an increase in suction in 26 and not essentially to a decrease in suction in bowl 7, this decrease being sufficient only to permit the liquid fuel to rise in tube 15 not more than the normal level A—A, but the inertia of the reciprocating liquid fuel column will cause it to rise higher.

It should also be noted that liquid fuel is always in both arms of the manometer member, i. e. in the tube 15 and bowl 7 and at no time is the fuel totally withdrawn from tube 15. At the same time the level in bowl 7 is maintained substantially constant, this being arranged by making the cubic contents of tube 15 relatively negligible as compared with the cubic contents of bowl 7 less the volume of float 8.

It is understood of course that for a particular engine, the passages 12 and 17 may be a particular size calibrated for that engine, in which case the adjusting screws 13 and 18 may be dispensed with although the same are especially useful when testing.

Referring to Fig. 2, a rearrangement of the tubes 14, 15, and 16 is shown wherein the liquid fuel tube 16 is enlarged to receive a small central air tube 34 which communicates with atmosphere at its upper end through a plug 35 adapted to communicate with a passage 17*b* forming an extension of passage 17 in the cross piece 2. The passage 17*b* is adapted to be adjustably opened and closed by a valve 36 actuated by a thermostat 37 mounted on an insulated block 38 fastened to the outside of chamber 1.

The plug 35 is adapted to hold 34 centrally and to substantially close the tube 16 with the exception of a series of notches or grooves 39 around its perimeter and the interior of tube 34 communicates through a passage 40 with the interior of tube 15 and thus through orifice 25 with the passage 17*b*. The operation of this modification is substantially as already described with the exception that a constant current of air is now being drawn through passage 17*b*, tube 14, tube 15 and passage 40, down through the tube 34 substantially to the bottom of the interior of tube 16 thence upwardly past the grooves 39 to the engine. The liquid fuel level in tube 15 will be caused to rise and fall as already described whereby varying amounts of liquid fuel will be drawn interiorly of pipe 16 where the same will be mixed with the ascending column of air and drawn to the engine. In this manner a more rapid and steady feed of fuel and air mixture will be carried to the engine.

Referring to Fig. 4 wherein my device is shown attached to the engine 3*b*, a casing 41 is shown inserted between pipe 31 and passage 4 containing a flap valve 42 preferably set in an enlarged portion of square cross section. The valve 42 is mounted on a spindle 43 which extends through casing 41 and joined to arm 45, said arm and valve 42 being restricted in their movement by spring 46 attached to casing 41 and arm 45. This valve 42 may be used when it is desired to use large size venturis 23 or 27 in which case the suction at their throats would be diminished for a given flow of air and is useful in accelerating from idling speed because it throws an increased suction on the discharge of tube 16 and passage 26 temporarily whereby increased accelerating charges of liquid fuel are drawn through orifices 24 and 25. An equivalent is a loose weighted valve mounted off center as shown in an application executed of even date herewith.

While it is understood of course that bowl 7 may be, and generally is, supplied with liquid fuel from a tank by gravity, or through the well known vacuum tank, at the same time the system herein described readily adapts itself to the automatic supply of liquid fuel from a low level to the bowl 7 at a high level and this is accomplished by establishing higher degrees of vacuum inside the bowl 7 and tube 14 while maintaining substantially the same pressure differentials therebetween.

Referring particularly to Figs. 4 and 6, this may be accomplished by passing the feed pipe 47 direct from the passage 7*b* to the bottom of a liquid fuel tank 48 at a low level, the tank 48 being open to atmosphere through a port 49. The pipe 47, inside the tank 48, may contain a series of very small orifices 50 for lightening the rising column of fuel as is well shown and described in my reissued Patent No. 14,701. In this case I provide that the uppermost orifice 50 will always be above the normal liquid level in the tank 48.

Au extension 51 is provided on the side of cover 6 and extension 51 is drilled with a passage 52 adapted to communicate with the throat of venturi 27 and is adapted to receive

a small venturi 53 the throat of which communicates through a passage 54 with the interior of bowl 7. The other end of passage 52 communicates through a passage 55 with atmosphere. The venturi 53 may have what is known as a "stepped" portion 56 at its throat and may communicate through a series of holes 57 with a passage 54.

The object of providing a small venturi 53 in communication with the throat of a larger venturi 27 is to compound the vacuum in response to the flow of a volume of air through venturi 27 at slow speeds so that normally the vacuum engendered thereby at the throat of venturi 27 may be multiplied many times at the throat of venturi 53. In this manner I am enabled to maintain a vacuum in the bowl 7 of from two to three inches of mercury which is sufficient to maintain the normal liquid level A—A and at the same time permit the proper functioning of the fuel regulator itself. This vacuum of two to three inches of mercury is normally sufficient to supply an automobile engine with liquid fuel on a steep grade where wide open throttle conditions and the aforesaid vacuum need not be maintained constant but may vary within limits provided not less than a minimum is developed. In Fig. 6 it will be noted also that the valve 29 may be made adjustable in the thermostat 28 by having a screw-threaded stem and a lock nut 58.

Referring to Fig. 5, a modification is shown wherein the tube 14 is extended below the normal liquid level A—A and the passage 26 is also brought below the liquid level to communicate with the interior of 14. Thus on acceleration advantage is taken of the normal hydrostatic head to accelerate the discharge of liquid fuel through orifices 25 to the passage 26, which also may be controlled if desired by thermostat 28 and valve 29. The passage of air through pipe 26 in this case is brought through the wall of pipe 14 and through a venturi 53 as already described, the throat of said venturi communicating with the interior of bowl 7 through a passage 54. Referring particularly to Fig. 7, an alternative construction is shown wherein the thermostat 28 will operate in a reverse direction, that is, it will operate to open the valve 29 with increasing temperature. In this case the valve 29 has an extension valve 59 attached thereto adapted to open and close an air passage 60 in the flange of bowl 7 synchronously with the opening and closing of the valve 29 whereby increasing or decreasing amounts of air will be admitted to passage 26 to increasingly or decreasingly affect the height to which the liquid fuel will reciprocate in tube 15, thereby giving an automatic fuel regulation according to temperature.

The action of the liquid in the manometer comprising bowl 7 and tube 15 may, of course, be used on any carburetor for the functions of priming and idling, provided the float chamber of the same is maintained under partial vacuum as described herein by suitable connections to the mixing chamber on the engine side of the throttle.

When idling the engine at optimum temperature, the lowermost orifice 24 will preferably be of correct size to supply the engine with just sufficient fuel at that temperature. Such orifice will, of course, provide insufficient fuel for idling at low temperatures so that the manometric action will then supply additional fuel through one or more of the next succeeding lower orifices 24. In general the lowermost three or four orifices 24 may be spaced to cut in or out at a change of 20 R. P. M. in engine speed. When the engine is throttled from wide open to closed throttle, it will be noted that the liquid fuel will be drawn away from passage 26 thus preventing backfiring in the muffler due to a rich mixture.

While the new functions of my fuel regulation as applied to carburetors has been described, it must be borne in mind that a great simplicity of construction, with corresponding cheapness of cost, as well as economy in operation is attained.

It will thus be seen that the invention comprises the use of a rising and falling column of liquid fuel from which varying amounts are supplied to the engine depending on the engine requirements through its suction and that the heads under which such varying amounts are supplied will vary depending on the position of said column from which the same are drawn. The inertia of the reciprocating column is valuable for giving increased supplies upon acceleration and this inertia may be increased as will be described in another application.

In general increasing amounts of liquid fuel are drawn from a column increasing in length, the volume of the column being maintained substantially constant and vice versa, while the liquid column remains unmixed with air.

The thermostats 37 and 28 are mounted on insulating blocks 38 and 30 respectively in order that they should not be affected by the heat abstracted from the carburetor casting by the latent heat of evaporation of the liquid fuel, but only affected by increasing or decreasing engine temperatures. Thus, it will be obvious that the thermostat 37 may also be enclosed in a casing and joined by a pipe to exhaust 33 as shown for thermostat 28 and also illustrated in said copending applications, Ser. Nos. 56,513 and 67,864.

It is of course obvious that many combinations and changes can be made in the structure as shown to get like results but all such changes are within the scope of the appended claims.

I claim:

1. A carburetor for an internal combustion engine comprising a mixing chamber for liquid fuel and air, a liquid fuel reservoir connected therewith, means to raise and lower a column of liquid fuel from the reservoir through the mixing chamber, means including a throttle valve anterior of said mixing chamber, to apply the engine suction to both ends of the column and means to maintain a partial vacuum in the reservoir by said suction for maintaining the liquid fuel therein substantially constant from a low level supply.

2. In a carbureting system for an internal combustion engine, a liquid fuel reservoir for the carburetor, means to raise and lower a column of liquid fuel from the reservoir through the carburetor, means including a thermostatically controlled valve to draw off sufficient fuel from the column for varying operating conditions on the engine, means to apply engine suction to both ends of the column and means to maintain sufficient vacuum in the reservoir for maintaining the liquid fuel therein substantially constant from the low level supply.

3. In a carbureting system for an internal combustion engine, a liquid fuel reservoir for the carburetor, a liquid fuel supply at a lower level than the carburetor, means to raise and lower a column of liquid fuel from the reservoir through the carburetor, means to draw off sufficient fuel from the column for varying operating conditions on the engine, a conduit joining said reservoir and said low level supply, means to maintain sufficient vacuum in the reservoir for maintaining the liquid fuel supply therein substantially constant through said conduit from the low level supply and means to introduce air into said conduit.

4. In a carbureting system for an internal combustion engine, a liquid fuel reservoir for the carburetor, a liquid fuel supply at a lower level than the carburetor, means to raise and lower a column of liquid fuel from the reservoir through the carburetor, means to draw off sufficient fuel from the column for varying operating conditions on the engine, a conduit joining said reservoir and said low level supply, means to maintain sufficient vacuum in the reservoir for maintaining the liquid fuel supply therein substantially constant through said conduit from the low level supply and means to introduce air into said conduit at a point above the normal liquid level in said now level supply.

5. A carburetor for internal combustion engines, comprising a fuel chamber, an air passage, a plurality of venturi in said passage, means for supplying fuel from said fuel chamber to said venturi, and thermally operated means for controlling the supply of fuel to one of said venturi.

6. In a fuel feeding system for internal combustion engines, an intake passage for said engine, a venturi in said passage, a fuel chamber, a nozzle pipe extending from said venturi into said chamber, said pipe being closed at its upper end and open at its lower end and having a plurality of openings in the side wall of its upper end portion, a nozzle tube extending into said pipe, said nozzle tube being closed at its lower end and having a nozzle opening at its upper end and provided with a plurality of openings in its side wall, means for supplying air to said pipe, and means for maintaining said chamber at sub-atmospheric pressure.

7. A carburetor comprising a fuel chamber, an intake passage, a throttle in said passage, a pair of nozzles for supplying fuel to said passage, and a thermally controlled valve for controlling the supply of fuel to one of said nozzles.

8. In a fuel feeding system for internal combustion engines, an intake passage, a float chamber connected to said passage, an outer tube closed at its lower end and extending upwardly in said intake, an inner and an intermediate tube extending downwardly into said chamber below the normal liquid level therein and extending upwardly in said outer tube, said inner tube being closed at its lower end, having openings in its lower portion and provided with a nozzle opening at its upper end, said intermediate tube being open at its lower end and closed at its upper end and having air openings in its upper portion, said outer tube being in connection with the atmosphere, and a throttle for controlling the passage of air through said intake passage.

9. A carburetor for an internal combustion engine comprising a mixing chamber, a venturi in said chamber, a fuel supply reservoir, a nozzle tube extending from the venturi into said reservoir, said tube being open at its upper end and closed at its lower end and having a vertical series of openings in its side wall, a second tube substantially coextensive therewith being closed at its upper end and open at its lower end, the upper end having openings in the side wall thereof, a third tube surrounding the upper end of the second tube and communicating therewith through said openings in the wall thereof and means for applying a variable suction to said third tube to vary the fuel level in the second tube.

10. A carburetor for an internal combustion engine comprising a mixing chamber, a throttle valve at the intake of said chamber, a venturi in said chamber, a fuel supply reservoir, a nozzle tube extending from the venturi into said reservoir, said tube being open at the end adjacent the venturi and closed at the end in said reservoir and having a vertical series of openings in its side

wall, a second tube surrounding said nozzle tube closed at its upper end and open at its lower end, the upper end having openings in the side wall thereof, a third tube enclosing the upper end of the second tube and communicating with the second tube through the openings in the wall thereof and means responsive to the position of the throttle valve for varying the suction in said third tube, thereby varying the fuel level in the second tube.

Signed at Wilmington, in the county of Los Angeles and State of California, this 14th day of October, A. D. 1925.

CHARLES LAWRENCE STOKES.