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1,536,042

E. A. BESSOM

CARBURETOR

Filed April 30, 1917

Fig. 1.

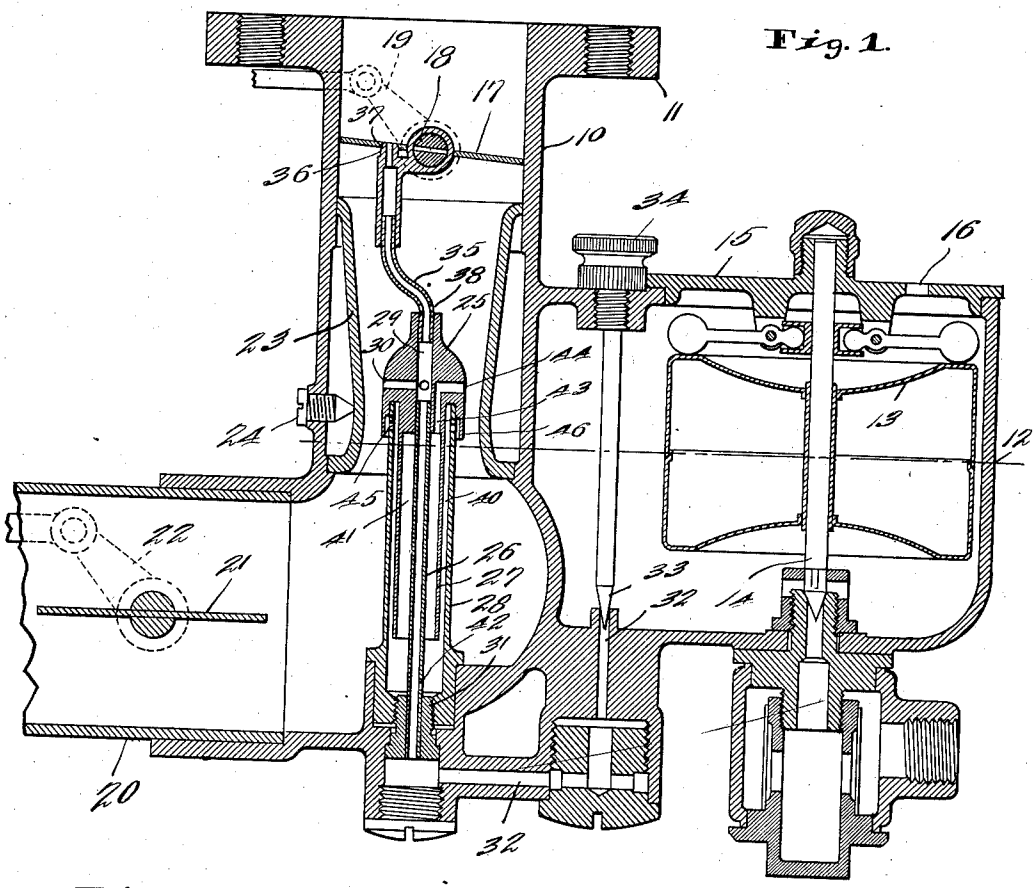


Fig. 2.

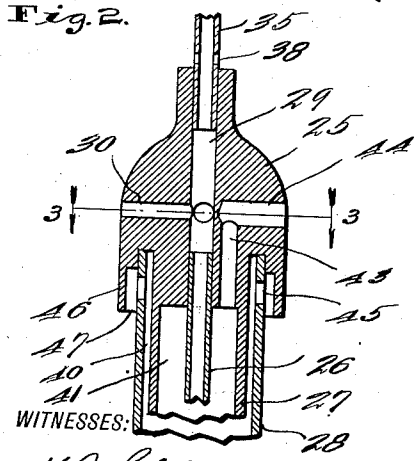
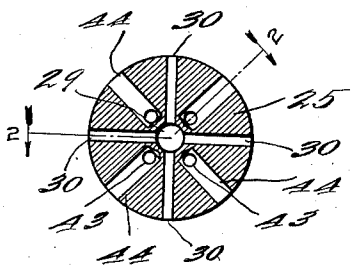


Fig. 3.



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UNITED STATES PATENT OFFICE.

EARL A. BESSOM, OF INDIANAPOLIS, INDIANA, ASSIGNOR TO THE WHEELER-SCHEBLER CARBURETOR CO., OF INDIANAPOLIS, INDIANA, A CORPORATION OF INDIANA.

CARBURETOR.

Application filed April 30, 1917. Serial No. 165,322.

To all whom it may concern:

Be it known that I, EARL A. BESSOM, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented a new and useful Carburetor, of which the following is a specification.

In carburetor design the great object has always been to obtain a proper proportioning and mixing of the fuel and air under the varying conditions which are encountered. However, great difficulty has been experienced because, although the flow of the fuel and the flow of the air are fundamentally according to the same law, yet as I understand it there are certain disturbing influences, as on account of the viscosity, surface tension, and relatively greater inertia of the liquid fuel. In consequence, a certain head, or suction, is necessary in order to initiate the fuel discharge from the nozzle, and this head or suction is a constant which enters into the relation between the air flow and the fuel flow so as normally to produce a greater proportion of fuel for high velocity flow than for low velocity flow, thus producing too rich a mixture at high speeds and too lean a mixture at low speeds. In addition, upon a sudden change in the velocity of flow, as on a sudden opening of the throttle, the greater inertia of the liquid fuel retards its response to the change, so that momentarily there is an excess of air, producing too lean a mixture, at the very time when, if anything, a rather richer mixture is needed to produce the desired engine acceleration.

It is the object of my present invention to avoid these disturbing effects, and to produce a carburetor which will give the proper proportion of fuel and air under all conditions; and to do so by a carburetor having no normally moving parts save the throttle itself.

The accompanying drawing illustrates my invention. Fig. 1 is a vertical central section through a vertical type carburetor embodying my invention in its preferred form; Fig. 2 is an enlarged section through the main fuel nozzle, being taken on the line 2—2 of Fig. 3; and Fig. 3 is a section on the line 3—3 of Fig. 2.

The main casting of the carburetor has a mixing tube 10 provided with a flange 11 at the top for connection with the intake manifold of the engine, and a float chamber 12 at the side of the mixing tube 10. The float chamber contains a float 13 which operates a fuel inlet valve 14 to control the supply of fuel from any suitable source to the float chamber 12 so as to maintain a constant fuel level therein. The removable cap 15 of the float chamber is provided with a hole 16 sufficiently large so that atmospheric pressure is maintained upon the surface of the fuel in the float chamber. A throttle 17 is mounted on a cross pin or shaft 18 in the upper part of the mixing tube 10, and is provided with a suitable operating arm 19 whereby it may be operated in the usual manner. The lower end of the mixing tube 10 is turned to the horizontal, whereby if desired it may receive a pipe 20 leading from any heating source for heating the air supplied to such tube. All the air to be carbureted travels through the mixing tube 10. If desired a choker valve 21 provided with an operating arm 22 may be provided in the intake or lower end of the tubular portion 10. Within the mixing tube 10, below the throttle 17 but above the choker 21, there is a Venturi tube 23, which is conveniently formed as a separate piece from the mixing tube 10 and is clamped in place by a set screw 24, so that if necessary or desirable the Venturi tube 23 may be removed and one having a different contraction substituted.

The fuel nozzle has various orifices opening into the Venturi tube, as will be explained. As shown, this fuel nozzle is separate from the Venturi tube and located within it, and the orifices thereof do not open through the walls of the Venturi tube; but this separateness is not essential, and the various nozzle orifices do not necessarily open into the Venturi tube from within.

The fuel nozzle projects upward into the mixing tube 10, and has its head 25 within the Venturi tube 23. This nozzle has an inner tube 26, an intermediate tube 27 depending from the head 25, and an outer tube 28. The inner tube 26 projects entirely through the other tubes, at its upper end leading to a central vertical opening 29 in the head 25, from which central opening a number of radial holes 30 project outward to the periphery of the head 25. The lower end of the tube 26 passes with a tight fit through a plug 31 which closes the lower

end of the outer tube 28, and communicates with a passage 32 leading from the float chamber 12, the inlet to such passage 32 being controlled by a needle valve 33 which projects down through the float chamber and is provided at the top with a knurled operating head 34 by the adjustment of which the opening to the central tube 26 is controlled. The upper end of the central vertical opening 29 in the head 25 connects with a tube 35 which leads to a fixed idling nozzle 36 which is supported on the shaft 18 and projects upward through a hole 37 in the throttle 17 when the throttle is closed, the nozzle 36 and hole 37 being located at one side of the shaft 18 so that as the throttle 17 is turned in a clockwise direction to open it an air passage is provided around the idling nozzle 36 through the hole 37, which air passage during the initial opening movement of the throttle increases in size as the opening of the throttle progresses. Preferably the tube 35 leading to the idling nozzle 36 is provided with one or more lateral openings 38 just above the head 25.

As stated, the lower end of the outer tube 28 of the nozzle is closed by the plug 31. The intermediate tube 27 depends from the head 25 to a point fairly close to the bottom of the outer tube 28, so that the space 40 between the outer tube 28 and intermediate tube 27 communicates under the lower end of the intermediate tube 27 with the space 41 between the intermediate tube 27 and the inner tube 26. The tube 26 is provided with a small hole 42 opening into the space within the outer tube 28 below the lower end of the intermediate tube 27. The upper end of the space 41 between the inner and intermediate tubes 26 and 27 communicates by holes 43 with a number of radial holes 44 interspersed with and larger in combined cross section than the hole 42. The holes 44 lead to the periphery of the head 25, but do not open into the central vertical opening 29. The outer tube 28 is provided at its upper end with a series of lateral holes 45, and the head 25 is provided with a depending apron 46 projecting downward past the holes 45 and spaced from the outer tube 28 to provide an annular space 47 which communicates through the holes 45 with the upper end of the space 40, thus providing in effect the entrance end of a Pitot tube.

The operation is as follows:

When the engine is at rest, the fuel level within the tube 26 and in the spaces 40 and 41 is the same, save for capillarity, as in the float chamber 12, the fuel being supplied thereto through the passage 32 and hole 42.

When the engine is idling, the throttle 17 is almost completely closed, so that very little air travels up through the venturi 23, and there is a high vacuum above the throttle 17. In consequence of this high vacuum, fuel is drawn from the float chamber 12 through the passage 32, inner tube 26, central vertical opening 29, and tube 35, to the idling nozzle 36, whence it is discharged through the hole 37 into the space above the throttle 17 and carried on to the engine by the engine suction, being mixed with whatever air is drawn through the opening 37 around the idling nozzle 36 as well as with any air that passes the edge of the throttle 17; and is also mixed with air drawn in by this suction through holes 30 and 38, which air is mixed with the fuel and discharged therewith from the idling nozzle. This produces a rich mixture, which is essential for idling, and applicant believes that it serves to break the surface tension and in effect to eliminate the head which is necessary to start the flow of fuel. During this idling, when there is only an exceedingly slight reduction of pressure within the venturi 23, the liquid level in the space 41 is raised above that in the float chamber only very slightly, and the liquid level in the space 40 is lowered only very slightly, below that in the float chamber.

As the throttle 17 is opened, more air is drawn upward through the Venturi tube 23, and the vacuum above the throttle is reduced. At the same time, more air is allowed to pass through the hole 37. For the time, the diminished suction, and in applicant's belief the flow of air through the hole 37, maintain the discharge from the idling nozzle 36, though in diminished proportion. However, as the opening of the throttle 17 continues, air ceases to be drawn in through the openings 30, and later through the openings 38, and the openings 30 instead of having air drawn inward through them begin to have fuel drawn outward through them by reason of the reduced pressure due to the flow of air through the Venturi tube 23. For a time there is a discharge from both the openings 30 and from the idling nozzle 36. During this opening movement of the throttle, the liquid level rises in the space 41 and falls in the space 40, for reasons to be explained later, and soon the holes 44 also begin to discharge fuel. This discharge from the holes 44 begins at about the same time as that from the holes 30, or perhaps slightly later, and continues for all wider openings of the throttle; but, save upon acceleration as later described, the discharge from the holes 44 is determined by the size of the small hole 42 near the lower end of the tube 26, and for conditions which continue constant the liquid level in the space 40 does not change. As the throttle 17 is now opened still farther, the discharge from the idling nozzle 36 ceases, and the total discharge of fuel into the passing air is from the openings 30

and 44; and perhaps there is even a backward flow of air (or rather explosive mixture) through the idling nozzle 36 and tube 35, because of the fact that the lowest pressure or highest vacuum on open throttle is at the contracted portion of the Venturi tube 23, at which contracted portion the holes 30 are located. The amount of fuel thus discharged from the openings 30 and 44 varies with the opening of the throttle 17 and with the velocity of the air stream through the Venturi tube 23, and is substantially in proportion to such velocity. As a matter of fact, this arrangement of nozzles is found in practice to produce a rich mixture at idling, a leaner mixture for normal running, and a somewhat richer mixture than at normal running at extremely high speeds, which is found to be extremely desirable.

As the velocity of the air flow through the carburetor increases, as from opening the throttle or for any other reason, it is accompanied by a corresponding depression of the liquid in the space 40; and vice versa. The rise or fall of the liquid level in the space 40 continues until equilibrium is obtained. The pressure in the Venturi tube at the point where the space 47 opens into it is reduced below atmospheric pressure during engine operation, (as is well understood) by an amount depending upon the speed of air flow through the carburetor, sometimes involving a pressure reduction (or the production of a partial vacuum) of as much as 15 inches of mercury. When I speak merely of "pressure" I mean the pressure exerted in a direction perpendicular to any air flow, as is usual; as distinguished from "impact pressure". The space 47, however, opens directly against the air flow, and, acting as a Pitot tube, receives the full impact of the rushing air. This impact creates a pressure in the space 47; and this impact pressure adds itself to the reduced pressure at the point where such space 47 opens into the Venturi tube, so that the pressure in such space 47 and on the surface of the fuel in the space 40 is much higher than the pressure in the Venturi tube 23, and almost if not quite equal to the pressure of the atmosphere, though such space is not in direct communication with the atmosphere. Because of this differential between the total pressure in the space 47 and the pressure in the Venturi tube where the discharge openings 44 open thereinto, and of the restriction provided by the small hole 42, the fuel level in the space 40 is depressed upon such increase in air-flow velocity.

Since in the preferred form of my invention the space 47 and the openings 44 communicate with the Venturi tube very close to each other, at points where the pressures are very nearly equal, the differential between the total pressure in the space 47 and the pressure at the outlet of the holes 44 is substantially equal to the impact pressure due to the Pitot-tube effect of the space 47.

Upon any change in the air speed, there is also a change in the differential pressure. Thus upon an increase in air velocity, there is an increase in this differential pressure; whether that increase be considered as due to a decrease in the pressure at the openings 44 or to an increase in the impact pressure on the space 47. As the pressure in the Venturi tube falls, such impact pressure rises. This relative increase in the total pressure in the space 40 is what directly pushes down the liquid level in such space; and such liquid level is pushed down until a new condition of equilibrium is reached.

During this time, of course, fuel is being drawn out from the holes 44, due to the reduced pressure within the venturi; and (after equilibrium has been obtained) this delivery of fuel from the holes 44 is directly dependent upon any such reduction of pressure for any set of conditions while they remain constant and upon the size of the hole 42, which limits the amount of fuel supplied to the spaces 40 and 41.

For gradual changes in throttle opening, or in the speed of air flow through the carburetor, the change in liquid level in the space 40 is correspondingly gradual; because of the relatively slow rate of change in such differential pressure, or in such impact pressure. Upon sudden changes in such air speed, however, there is a correspondingly sudden change in such differential pressure, or in such impact pressure. In other words, although there is little or no change of absolute pressure within the space 40, (since the sum of its static and impact components remains substantially constant,) there is a sudden relative increase in the pressure in such space 40 as compared to the pressure at the outlets of the holes 44. This sudden change in differential pressure, or in impact pressure, in cooperation with the restriction of the hole 42 in relation to the holes 44, acts to produce a relatively rapid forcing down of the liquid level in the space 40, accompanied by an increased rate of fuel discharge from the holes 44 as the fuel flows out therefrom by reason of the forcing down of the liquid level in the space 40. This increased rate of fuel discharge from the holes 44 exceeds the normal rate of the discharge from such holes for the new rate of air flow through the venturi, and continues until the liquid level in the space 40 has attained its new and lower equilibrium level; and furnishes the additional fuel for acceleration. In other words, upon a sudden opening of the throttle, additional fuel is forced up

through the space 41 and out through the holes 44 into the passing air, in greater amount temporarily than would be caused by the normal venturi suction due to the increased air-speed under constant or equilibrium conditions. This momentary supply of additional fuel is during the well recognized interim during which there is a tendency toward impoverishment of the mixture during acceleration, and compensates for such tendency during the vitally important period of acceleration.

The space 47 may be varied quite considerably in size, and also in location along the Venturi tube, without affecting the operation, for the pressure within it seems to be a resultant of the pressure at the point to which it opens in the Venturi tube and the impact of the rushing air, and the fall in such pressure and the impact are corresponding functions of the velocity of the air, the pressure falling and the impact increasing as the square of such velocity; so that such resultant is constant, and nearly if not quite equal to atmospheric pressure, for all locations of such space along the Venturi tube. The spaces 40 and 41 are partly or wholly filled with fuel, by gravity, through the opening 42, whenever the engine is allowed to slow down below a certain speed or to stop, so as to be ready to furnish a momentary supply of fuel upon sudden acceleration.

In order to regulate the proportional amount of fuel and air, it is necessary merely to adjust the needle 33 by its knurled head 34, thus controlling the amount of fuel admitted to the inner tube 26 of the nozzle for a given suction. It is not ordinarily necessary to change this setting of the needle 33.

In order to facilitate starting, the choker 21, if provided, may be partly or wholly closed in the usual manner, so as to cut down the amount of air admitted to the lower end of the mixing tube 10 and thus increase proportionately the amount of fuel.

I claim as my invention:

1. A carburetor, comprising a mixing tube having an air inlet opening, a throttle controlling the flow through said mixing tube, a fuel nozzle discharging into said mixing tube between said air inlet opening and the throttle, said throttle being provided with an opening through it, a supplemental fuel nozzle which when the throttle is closed projects into and substantially fits said opening for priming and as the throttle is opened leaves said opening to provide an air passage through said opening around said supplemental nozzle, a fuel conduit supplying said first fuel nozzle, and a second conduit passing through said mixing tube and leading from said first fuel nozzle to said supplemental fuel nozzle as a branch to the outlet of said first fuel nozzle.

2. A carburetor, comprising a mixing tube having an air inlet opening, a throttle controlling the flow through said mixing tube, said mixing tube having a venturi contraction between said air inlet opening and said throttle, a fuel nozzle discharging into said mixing tube at said venturi contraction between said air inlet opening and the throttle, a fuel conduit leading to said nozzle, and a supplemental fuel chamber which has a restricted supply of fuel and has a Pitot inlet opening directly against the air flow to receive the impact of the fluid flow through said mixing tube at a point between the air inlet opening and the normal nozzle discharge and is arranged to discharge fuel into said mixing tube.

3. A carburetor, comprising a mixing tube having an air inlet opening and a venturi contraction, a throttle controlling the flow through said mixing tube, a fuel nozzle discharging into said mixing tube at such venturi contraction between said air inlet opening and the throttle, a fuel conduit leading to said nozzle, and a supplemental fuel chamber which has a restricted supply of fuel and has a Pitot inlet receiving the impact of the fluid flow through said mixing tube and is arranged to discharge fuel into said mixing tube, said discharge from said supplemental chamber being through an opening separate from the main nozzle discharge.

4. A carburetor, comprising a mixing tube having an air inlet opening, a throttle controlling the flow through said mixing tube, said mixing tube having a venturi contraction between said air inlet opening and said throttle, a fuel nozzle discharging into said mixing tube at said venturi contraction between said air inlet opening and the throttle, a fuel conduit leading to said nozzle, a valve controlling such conduit, a supplemental fuel chamber supplied through a restricted opening from said fuel conduit at a point beyond such valve as a branch to the supply of the nozzle, said supplemental chamber having a Pitot inlet which is connected to it above the liquid level therein and receives the impact of the fluid flow through said mixing tube, and a tube communicating with said supplemental fuel chamber below the normal fuel level therein and arranged to discharge fuel into said mixing tube at a point above said normal level and at said venturi contraction.

In witness whereof, I have hereunto set my hand at Indianapolis, Indiana, this 27th day of April, A. D. one thousand nine hundred and seventeen.

EARL A. BESSOM.