July 30, 1940. I. E. COFFEY 2,209,511

CARBURETOR

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FIG. 1.

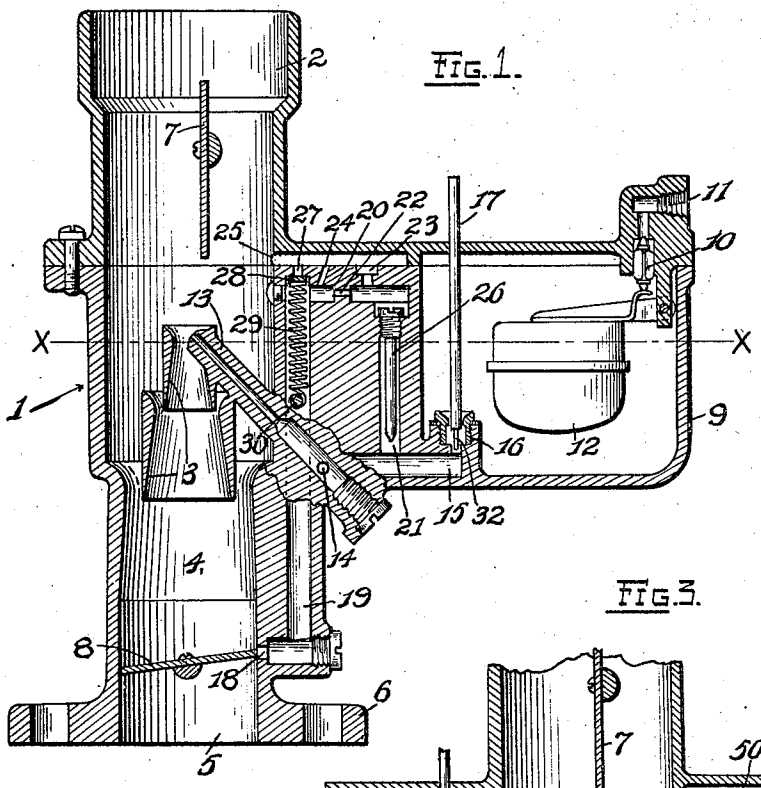


FIG. 3.

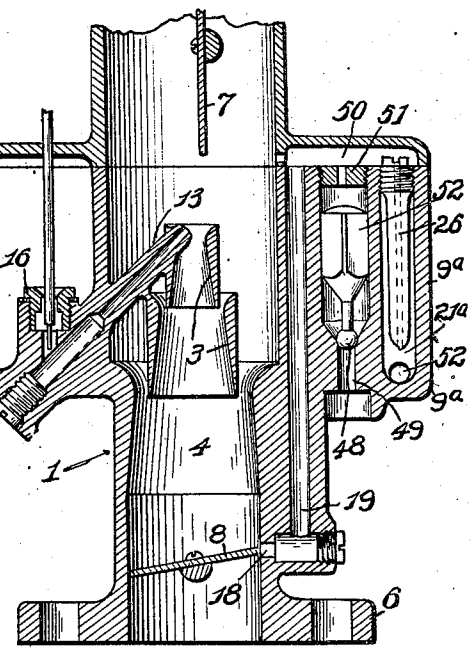
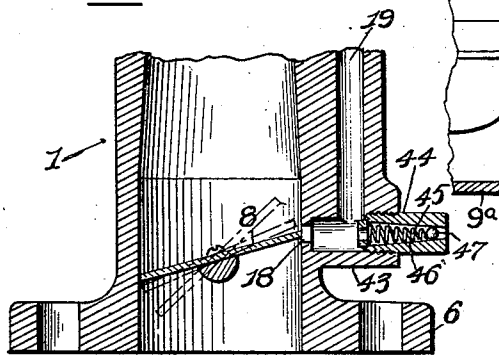


FIG. 2.



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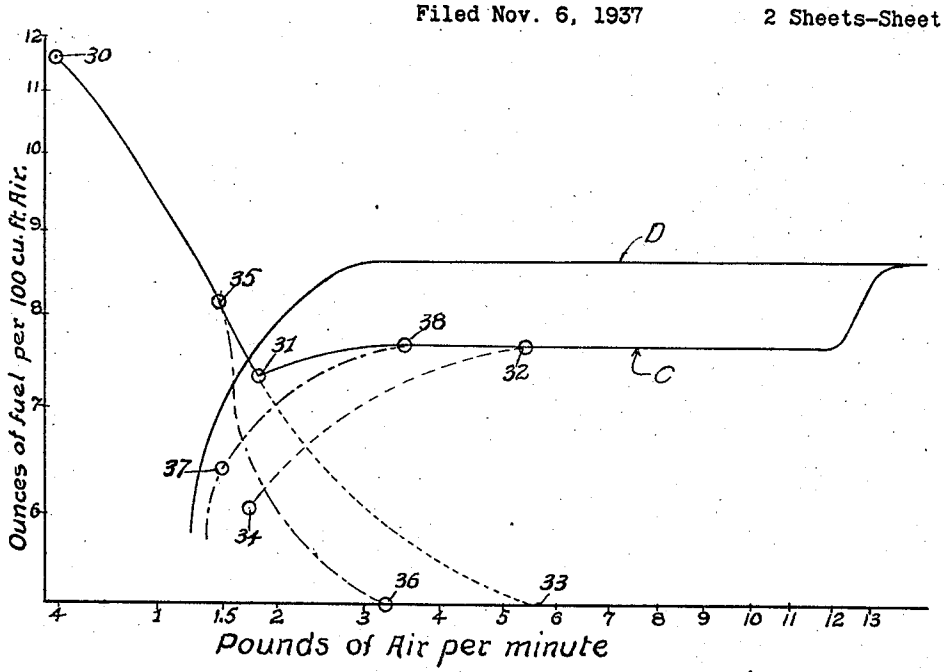


FIG. 4.

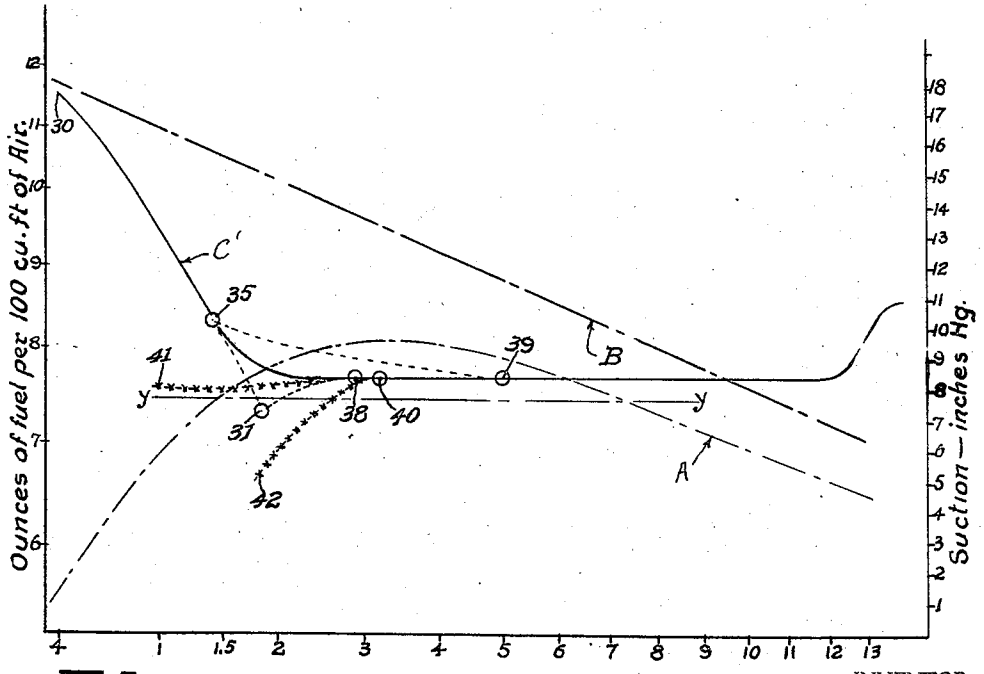


FIG. 5.

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CARBURETOR

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Application November 6, 1937, Serial No. 173,143

3 Claims. (Cl. 261—41)

This invention relates to carburetors for internal combustion engines and consists particularly in novel means for controlling the combustible mixture supplied thereby.

The modern automotive carburetor is usually provided with interconnected main and idling fuel supply systems, the main system discharging through a nozzle anterior of the throttle and the idling system discharging through one or more ports located abreast the edge of the throttle valve when closed. The idling system is constructed to supply a small quantity of fuel and air mixture to keep the engine running when the throttle is closed or nearly closed. As the throttle is opened admitting more air to the engine cylinders, the portion of the idle port exposed to engine suction is increased and this results at first in increased suction being applied to the idling system and more fuel being supplied thereby. As the suction applied to the main nozzle increases, fuel is discharged therefrom and gradually the suction in the idle system decreases and the discharge therefrom becomes inconsequential or nil.

By means of the interconnected idling and main fuel systems, proper blending of the discharges from the nozzle and port is facilitated, but this also results in holding back the main nozzle discharge longer than would otherwise be the case due to suction in the idling system drawing against or counteracting the suction applied to the nozzle. The result is frequently a substantial falling off in richness at the transfer point, producing a dip in the mixture curve. Moreover, the interconnected systems limit the power obtainable with small throttle openings since only very small quantities of fuel can be drawn through the idling restrictions and the suction applied to the main nozzle is necessarily low at such times. With the use of independent main and idling fuel systems, the nozzle can be made to discharge at relatively low suctions resulting in desirable enrichment of the mixture supplied under such conditions. This advantage is incidental to the cutting down or elimination of the U-tube effect where the suction applied to one fuel branch tends to retard the discharge from the other branch. However, with an independent idling system, it is very difficult to properly blend the discharges from the main and idling systems, particularly at the transfer point when the main nozzle starts to discharge, since the idling system discharges unrestrictedly at all times.

An object of the present invention is to provide means for supplying a very rich fuel mixture through the idling port at such times as the suction applied to the main nozzle is insufficient to induce adequate discharge therefrom.

A more detailed object is to facilitate smooth transfer and blending of the fuel discharges from the main and idling systems in both independent and interconnected idling carburetors.

Another detailed object is to provide means permitting discharge from the main nozzle at substantially lower suction than has heretofore been possible with the use of interconnected main and idling systems.

Another object is to provide means for controlling the effective suction applied to the idling system.

These objects and others hereafter appearing are attained substantially by the structures illustrated in the accompanying drawings in which

Fig. 1 is a sectional view of an internal combustion engine carburetor, represented somewhat schematically and showing applied thereto the invention.

Fig. 2 is a fragmentary sectional view of a carburetor showing another form.

Fig. 3 is a sectional view similar to Fig. 1 but showing a modification.

Figs. 4 and 5 are graphical representations to be described in detail hereafter.

The carburetor in Fig. 1 includes a barrel 1, forming a downdraft mixture conduit including air inlet horn 2, venturis 3, mixing chamber 4, and outlet portion 5 flanged as at 6 for attachment to the intake manifold (not shown) of an associated engine. The usual choke valve 7 and throttle valve 8 are mounted in the mixture conduit and provided with any suitable means for operation. Adjacent the mixture conduit is a bowl 9 within which fuel is maintained at a substantially constant level x—x by needle valve 10 controlling fuel inlet 11 and itself controlled by float 12.

A main fuel nozzle 13 discharges into the interior of the smallest venturi 3 and communicates with bowl 9 through passages 14 and 15 and calibrated metering orifice member 16. Orifice member 16 is controlled by a stepped metering rod 17 which may be operated from the throttle valve in a well known manner. Fuel for idling is supplied through an elongated port 18 abreast the edge of the throttle valve when closed and communicating with the bowl through passages 19, 20, 21 and 15 and member 16. A restriction 22 is interposed in passage 20 between air vents 23 and 24 communicating with the interior of the

mixture conduit through hole 25. A metering tube 26 is provided in passage 21.

An additional, automatically controlled air vent for the idling system is provided at 27. Cooperating with vent 27 is a check valve 28 yieldingly urged against its seat surrounding the vent by a compression spring 29 supported at its lower extremity on pin 30 in passage 19. Valve 28 is exposed to suction in the idling system and is calibrated to close only when this suction is below a predetermined value. During normal operation with the throttle closed or only slightly open, valve 28 will be opened and the three vents 23, 24, and 27 and tube 26 are calibrated to provide the proper idling mixture.

The device of Fig. 1 operates as follows:

When the throttle valve is fully closed, or, in other words, in the normal idling position, as shown in solid lines in Fig. 2, only a relatively small portion of port 18 is exposed to the engine suction posterior to the valve. This results in the application of relatively low suction to the idling system which must be calibrated to supply a small quantity of very rich mixture under such conditions. As the throttle valve is opened and the engine accelerates, the suction in the idling system at first increases and then decreases, approximately as indicated by curve A in Fig. 5, which represents the suction in inches of mercury for varying rates of air flow through the carburetor mixture conduit. Curve B in this figure represents the intake manifold suction. Fuel, in appreciable quantities, is discharged from the idling port only when the throttle is closed and during the first part of the opening movement thereof. The suction on the main nozzle becomes sufficient to cause a discharge therefrom when the air flow rate through the carburetor barrel reaches two and a half or three pounds per minute and thereafter the idling discharge decreases, becoming leaner as the suction on the port drops.

Since the power obtainable with the use of a combustible fuel mixture depends upon the ratio of fuel to air in the mixture, the efficiency of a carburetor as a charge forming device may be graphically illustrated by means of mixture quality curves, as shown in Figs. 4 and 5. These curves are obtained with the use of conventional flow measuring apparatus by plotting under different conditions the richness of mixture supplied by the carburetor in ounces of fuel per hundred cubic feet of air plotted against the rate of flow in pounds of air per minute. The solid line C (Fig. 4) represents the part throttle flow curve of a properly calibrated carburetor and line D represents the full throttle curve. In the case of a standard idling interconnected system, not using the novel automatic bleed, the portion 30—31 of curve C would be formed by discharge from the idle port alone, the portion 31—32 would be formed by the combined flows from the idle port and the main nozzle, and the remainder of the curve C to the right of the numeral 32, and the entire curve D, represents discharge from the main nozzle alone. The dotted line 31—33 (Fig. 4) represents the idling port discharge after the main nozzle starts to function and the dotted line 34—32 represents the main nozzle discharge up to the point where the idling port ceases to function.

On part throttle curve C, the transfer point 31, where the main nozzle starts to function, occurs at about two and a half pounds per minute air flow and shows a richness of about 7½ ratios, this point being in a sharp dip in the curve, a characteristic of interconnected idling and main fuel systems. On the full throttle curve D, however, the mixture at one and one half pounds per minute air flow has a richness of about 7½ ratios, indicating that the main nozzle can be made to discharge at lower suctions when the interference due to the idling system is eliminated.

The novel automatic air bleed functions as a pressure limiting valve to prevent the suction in the idling system from exceeding a predetermined value represented by the dot and dash line y—y in Fig. 5, which is the top of curve A with the automatic bleed in operation. The effect of opening of the automatic airbleed is to sharply lean out the idling port discharge, as indicated by the dot and dash line 35—36 (Fig. 4). The continued leaning out of the discharge from the idling system is caused by the counteraction of the main nozzle, which, due to the automatic bleed, starts to discharge at substantially lower suction than would otherwise be the case, as indicated by the dot and dash line 37—38. The net effect due to the combination of the discharges from the main and idling systems represented by idling curve 30—35—36 and main nozzle curve 37—38—32 is the solid line curve 30—35—38—39 (Fig. 5) which is the same as the part throttle curve in Fig. 4 except that the dip at point 31 is eliminated. The smoother transfer from idling port to main nozzle as represented by curve C' in Fig. 5, results from limiting the suction in the idling system, permitting functioning at lower suction of the main nozzle which has substantially greater capacity than the idling port.

If the throttle valve were opened slowly from the normal idling position and the loaded valve 28 were prevented from opening, an excessively rich composite mixture quality curve, somewhat as represented by dotted line 35—39 (Fig. 5), would be obtained. However, in case the throttle were locked and the air flow, and consequently the suction, decreased from a point such as 40, the additional richness resulting from automatic closing of the loaded valve would tend to hold up richness of the mixture supplied, as represented by the line of x's 40—41. The line of x's 40—42 shows how the mixture curve would indicate excessive leanness under these conditions if the automatic valve were omitted or held open.

In Fig. 2, the idling passage 19 discharges through port 18 adjacent throttle 8, as in the previous form. Threadedly secured in apertured boss 43, which facilitates formation of the idling port, is a plug 44 having a tapered internal orifice 45 receiving the compression spring 46 and ball check 47. Ball 47 functions the same as check 28 in Fig. 1 to limit the suction in the idling system.

In Fig. 3 a ball valve 48 controls atmospheric air bleed or vent 49 communicating with idling passage 50 through apertured plug 51. A weight 52 yieldingly resists opening of valve 48 and replaces spring 29 in Fig. 1. The weight may be integral with or separate from the valve. In this form, idling passage 21a communicates with the fuel bowl 9a through an orifice 52 and is independent of the main nozzle 13 which communicates with the bowl through metering orifice member 16, as in Fig. 1. The automatic vent arrangement permits control of the idling system

to permit blending of the discharge therefrom with the main nozzle discharge without the necessity of an interconnection as previously provided. This arrangement produces part and full throttle mixture curves as at C' in Fig. 5 and D in Fig. 4. The main nozzle being subject to no restraint from the idling system, will start to discharge at lower suctions than an interconnected nozzle, with no pressure limiting valve as at 25 in Fig. 1.

In each of the forms, the novel valve control vent permits accurate calibration and control of the idling discharge and consequent smooth blending of the same with the main nozzle discharge whether the main and idling systems are independent or interconnected. The device also provides for additional power under the conditions represented by the line of x's 40—41 in Fig. 5 to permit smoother, easier operation of the associated engine under part throttle.

In the various forms, the air bleeds and metering orifices must obviously be calibrated in accordance with the requirements of a particular engine and these calibrating devices may be varied as is well known in the art. Moreover, the general features and arrangement of the carburetor are not essential. In Figs. 4 and 5 no attempt has been made to construct the curves accurately as to detail values, these curves representing merely general characteristics and tendencies. The exclusive use of all modifications which come within the scope of the appended claims is contemplated.

I claim:

1. In a carburetor, an induction conduit having a Venturi tube, a constant level fuel reservoir, a butterfly throttle valve in said conduit, a main fuel supply passage discharging into said Venturi tube, an idling system opening into said conduit by means of a port extending on both sides of the edge of said throttle when closed whereby the portion of said port directly exposed to engine suction by the inwardly moving edge of said throttle valve is increased as said throttle valve is opened from dead idle position during normal acceleration and the effective suction in said idling system is at first increased and then decreased, an air bleed orifice in said idling system above the normal fuel level therein, and a loaded, normally closed valve in said orifice adapted to open under the influence of said increased effective suction in said idling system so as to limit the effective suction in said system.

2. A carburetor as specified in claim 1 further including a metering orifice in said main fuel passage, said idling system extending from said passage posterior to said restriction to said port.

3. In a carburetor, a mixture conduit having a Venturi tube, a throttle valve in said conduit, a constant level fuel reservoir, a main fuel passage opening into said Venturi tube, a metering restriction in said passage, an elongated idling port in the wall of said conduit extending on both sides of the edge of said throttle valve when closed, so that increasing portions of said port are exposed to engine suction by the inwardly moving edge of said throttle valve during throttle opening movement and the effective suction in said port increases and then decreases as said throttle is opened, an idling fuel passage extending from said main fuel passage posterior to said restriction to said port whereby the fuel supply to said conduit is transferred gradually from said idling system to said main fuel system as said throttle valve is opened during normal acceleration, an air bleed orifice in said idling passage, and a loaded valve in said orifice adapted to open to admit air to said idling passage responsive to said increased effective suction in said idling passage so as to limit the effective suction in said idling passage and the consequent restraining effect upon said main fuel passage.

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