AIR-FUEL MIXTURE ENRICHING DEVICE FOR CONSTANT VACUUM TYPE CARBURETORS

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ABSTRACT

An air-fuel mixture enriching device for constant vacuum type carburetors adapted to be rendered operative by responding to a negative pressure produced in the manifold of the engine or the movement of a throttle valve when the opening of the throttle valve exceeds a predetermined level. The device includes a secondary fuel outlet port which is provided separately and independently of the main nozzle disposed below the bottom of the vacuum piston and which opens into the induction passage in a suitable position between the main nozzle and throttle valve.

4 Claims, 3 Drawing Figures
AIR-FUEL MIXTURE ENRICHING DEVICE FOR CONSTANT VACUUM TYPE CARBURETORS

This application is a continuation of Ser. No. 868,187, filed 10/21/69 now abandoned.

Control of main flow in a constant vacuum type carburetor is effected by varying the dimension of the clearance between the jet needle secured to the bottom of the vacuum piston and main nozzle. It is not possible however to provide proper proportions of air and fuel over the entire range of vehicle speeds having varying degrees of opening of the throttle valve by varying degrees of opening of the throttle valve by varying the dimension of said clearance alone. More specifically, it would be required to provide an air-fuel mixture ratio suitable for full power engine operation when the throttle valve is fully open and an air-fuel mixture ratio suitable for economical power engine operation when the throttle valve is half open. However, since the amount of main fuel discharged into the induction passage is determined by the elevational position of the vacuum piston, it has hitherto been considered unavoidable that actual proportions of fuel and air of the main fuel provided over the wide range of degrees of opening of the throttle valve from the full open to slightly open condition may deviate to a certain extent from the proportions suited to varying degrees of opening.

When proportions of air and fuel in an air-fuel mixture supplied to the carburetor are considered in relation to the load, an ideal proportion of air and fuel in an air-fuel mixture would be substantially equal to an air-fuel mixture ratio suitable for economical power engine operation when the load applied is a partial load and the richness of the mixture would be increased slightly in advance of a full load level till the mixture reaches the level of an air-fuel mixture ratio suitable for full power engine operation when the load reaches a full load level. If the air-fuel mixture suitable for economical power engine operation were provided for the main fuel system when the load applied is a partial load, the mixture provided when the full load is applied would be also one which is suitable for economical power engine operation. Accordingly, means must be provided for accomplishing enrichment of the mixture by either supplying secondary fuel through another system when the load applied reaches a full load level or restricting to the highest degree the amount of air bleed into the main fuel in cases where air bleed is effected sufficiently.

The end can be attained by using air-fuel mixture enriching devices which are known to include vacuum type and mechanical type devices. An air-fuel mixture enriching device of the vacuum type functions such that when the pressure in the manifold of the engine is reduced below a predetermined value (an increase in negative pressure) the vacuum piston or diaphragm in the carburetor is actuated so that fuel is introduced into the main nozzle system through the jet and added to the fuel supply from the main nozzle to provide an enriched air-fuel mixture. An air-fuel mixture enriching device of the mechanical type operates such that is automatically actuated through a linkage when the degree of opening of the throttle valve reaches a predetermined level near the full open level so that secondary fuel may be supplied to accomplish enrichment of the mixture.

However, it is not possible to attain the desired end of increasing the richness of the mixture by supplying additional fuel through the main fuel system by means of enriching devices of the type described above, since fuel supply is controlled by varying the dimension of the clearance between the jet needle and the main nozzle as aforementioned in conventional constant vacuum type carburetors. No satisfactory results can be achieved in providing proper proportions of fuel and air for the entire range of operations of the vacuum piston even if a main jet is provided to make addition of air bleed into the fuel.

The present invention obviates the aforementioned disadvantage of enriching devices of the prior art. Accordingly, the invention has as its object the provision of an air-fuel mixture enriching device for constant vacuum carburetors comprising a secondary fuel outlet passage which is provided separately and independently of the main nozzle and which has an outlet port opening into the induction passage in a suitable position between the lower portion of the vacuum piston and throttle valve, such enriching device being adapted to provide proper proportions of air and fuel over the entire range of degrees of opening of the throttle valve.

The air-fuel mixture enriching device according to this invention may be of the vacuum type which automatically functions in response to a negative pressure produced in the manifold of the engine when the engine operates at high power or of the mechanical type which is automatically rendered operative through a linkage when the degree of opening of the throttle valve exceeds a predetermined level.

Additional objects as well as features and advantages of this invention will become evident from consideration of the description set forth hereinafter when considered in conjunction with the accompanying drawings, in which:

FIG. 1 is a longitudinal sectional view of a carburetor provided with an embodiment of the air-fuel mixture enriching device according to this invention of the vacuum type which automatically functions in response to the negative pressure;

FIG. 2 is a longitudinal sectional view of a carburetor provided with another embodiment of the air-fuel mixture enriching device according to this invention of the mechanical type which is automatically rendered operative through a linkage when the degree of opening of the throttle valve exceeds a predetermined level; and

FIG. 3 is a graph showing the fluid flow rate characteristics of the carburetor provided with the enriching device according to this invention as compared with those of the carburetor having no enriching device.

FIG. 1 shows, in section, a carburetor embodying the present invention. The carburetor comprises an induction passage 10 which has a choke valve 11 mounted on the suction side and a throttle valve 12 disposed on the engine manifold side. The two valves 11 and 12 are supported on respective shafts and adapted to be opened and closed. A venturi 13 is formed in the central portion of said induction passage 10, with a vacuum piston 14 adapted for vertical elevational movement being disposed above said venturi 13. A jet needle 15 attached to the lower end of the vacuum piston 14 is received in a main nozzle 16.
A piston cover 17 for the vacuum piston 14 and a diaphragm cap 18 are provided in the upper portion of the carburetor. A diaphragm 19 is mounted in a vacuum chamber 20 which separates said vacuum chamber 20 from a chamber 21 which maintains communication with atmosphere through an air opening 21A. A spring 22 is mounted between the top of the vacuum chamber 20 and the vacuum piston 14 for normally urging the latter to move downwardly. A negative pressure produced in the manifold of the engine by its rotation is led into the vacuum chamber 20 through a negative pressure outlet port 23. As the negative pressure in the vacuum chamber is increased, the vacuum piston 14 moves upwardly a distance corresponding to the increase in negative pressure against the biasing force of the spring 22, whereby a clearance between the jet needle 15 and main nozzle 16 can be varied in dimension to cause main fuel to be ejected.

Formed in the lower portion of the carburetor is a float chamber 24 in which a float 25 and a fuel sump 26 are provided. Inserted in said fuel sump 26 is an air bleed 27 for converting fuel into atomized particles which air bleed mounts a main jet 28 at its lower end.

Also formed in the float chamber 24 is a fuel inlet passage 29 which mounts a needle valve 30 at its end. The lower portion of the needle valve 30 is maintained in contact with a float arm 31 so as to deliver a constant supply a fuel to the float chamber 24. A bypass 32 for the low speed fuel systems is led from the fuel sump 26 and said bypass extends as far as the throttle valve 12, with an idle port 33 and bypass holes 34 being formed at its end portion. Provided in the idle port 33 is an idling screw 35 which is loaded with a spring 36.

Provided in the bottom of the float chamber 24 is an air-fuel mixture enriching device 40 according to this invention. The enriching device 40 comprises a chamber 44 which maintains communication with the float chamber 24 through a passage 42 formed with an enrichment jet 41, a fuel sump 54 disposed below said chamber 44, a valve 47 mounted between said chamber 44 and said fuel sump 54, a vacuum chamber 45 disposed below said fuel sump 54, and a diaphragm 43 mounted between said fuel sump 54 and said vacuum chamber 45. Provided in the chamber 44 is a valve seat 46 at which the valve 47 is seated, said valve 47 being connected to said diaphragm 43. A secondary fuel outlet passage 48 is led from the fuel sump 54 to the induction passage 10 so that the outlet passage 48 may have a secondary fuel discharge port 49 opening into the venturi 13 in a suitable position nearer to the throttle valve than to the main nozzle 16. The vacuum chamber 45 partitioned from the fuel sump 54 by the diaphragm 43 is provided with a spring 50 which tends to urge the valve 47 to open. A negative pressure detection passage 52 connects the vacuum chamber 45 with a negative pressure detection port 51 which opens into the air-fuel mixture passage between the throttle valve 12 and the engine manifold.

The operation of the enriching device according to this invention will be described.

FIG. 1 shows the carburetor in a state in which the engine is inoperative. It will be seen that when this is the case the vacuum piston 14 is in its lowermost position and the valve 47 of the enriching device 40 is open, with the fuel sump 54 being filled with fuel.

When the engine is idling, the throttle valve 12 remains closed with the fuel being discharged through the idle port 33 in an amount which is sufficient for idling of the engine. A negative pressure produced in the engine manifold due to idling of the engine acts on the negative pressure detection port 51, so that the diaphragm 43 is drawn by suction to cause the valve 47 to close, thereby disconnecting the fuel sump 54 from the float chamber 24. Thus, the valve 47 remains closed while the engine is idling and also while the engine is operating at low speeds with the throttle valve 12 being slightly open, so that no secondary fuel is discharged through the secondary fuel discharging port 49.

If the degree of opening of the throttle valve 12 is increased above the intermediate level and the engine begins to rotate at high speeds, then the negative pressure in the engine manifold is increased and introduced into the vacuum chamber 20 through the negative pressure inlet port 23, so that the vacuum piston 14 is moved upwardly to a position in which the negative pressure in the vacuum chamber 20 and the biasing force of the spring 22 balance. This results in the clearance between the jet needle 15 and main nozzle 16 being increased in dimension so that the amount of main fuel discharged through the main nozzle 16 is increased. On the other hand, if the throttle valve 12 is open and the engine begins to operate at high speeds, then the negative pressure applied to the negative pressure detection port 51 is relatively reduced because the difference between said negative pressure and the negative pressure applied to the main nozzle is substantially removed. This causes the spring 50 of the enriching device 40 to restore the diaphragm 43 to its original position by its biasing force and open the valve 47, thereby causing secondary fuel to be discharged through the secondary fuel outlet port 49. Said outlet port 49 is provided independently of the main nozzle 16 and disposed nearer to the throttle valve 12 rather than immediately below the vacuum piston 14. Because of this arrangement, the secondary fuel discharged through the secondary fuel outlet port 49 is added to the principal fuel discharged through the main nozzle to attain the end of accomplishing enrichment of the air-fuel mixture when the engine operates at high speeds.

In FIG. 1, the secondary fuel outlet port 49 is disposed nearer to the throttle valve 12 than the main nozzle 16. Since substantially the same negative pressure prevails in the portion of the air-fuel mixture passage between the vacuum piston 14 and throttle valve 12 when the engine operates at high speeds, the outlet port 49 may be made to open in a suitable position between the minor diameter portion of the venturi and the throttle valve 12. However, the portion of the induction passage below the bottom of the vacuum piston 14 is a constant vacuum zone in which there is little variation in negative pressure and small increase in the amount of excess fuel due to an increase in the amount of air. This makes it preferable to make the outlet port 49 open as near to the bottom of the vacuum piston as possible in order that fuel may be increased following a fuel flow rate curve similar to the fuel flow rate curve obtained when no air-fuel mixture enriching device is provided.
FIG. 3 is a diagram illustrating fuel flow rate curves obtained when the degree of opening of the throttle valve 12 is varied by plotting fuel flow rates per hour as ordinates against the numbers of revolution of the engine per minute as abscissa. The curve A is obtained when the degree of opening of the throttle valve 12 is 10 percent and the negative pressure of the venturi 13 is 400 mmHg and the curve B is obtained when the degree of opening of the throttle valve 12 is 20 percent and the negative pressure is 300 mmHg. If the degree of opening of the throttle valve and the negative pressure in the venturi are up to the values described above, fuel is discharged through the outlets ports 33 and 34 of the low speed operation system. This is similar to the operation of a conventional carburetor.

When the degree of opening of the throttle valve 12 is gradually increased to 35 percent, 50 percent and 75 percent and the negative pressure is also gradually increased to 200 mmHg, 100 mmHg and 50 mmHg and finally the throttle valve is fully open, flow rate curves shown in solid lines C, D, E and F are obtained with constant vacuum type carburetors of the prior art. However, the fuel flow rates obtained with a carburetor provided with the enriching device of this invention are expressed by curves SC, SD, SE and SF shown in broken lines indicating that secondary fuel is added to main fuel, because the enriching device is rendered operative when the negative pressure is less than 200 mmHg so that secondary fuel is discharged into the induction passage through the discharge port other than the main nozzle.

Since the enriching device according to this invention is constructed as aforementioned, it will be understood that if an air bleed is inserted midway in the secondary fuel outlet passage 48, it is possible to obtain an atomized fuel in the required boost zone or when the degree of opening of the throttle valve is in a suitable level.

FIG. 2 shows another embodiment of the air-fuel mixture enriching device which is adapted to be rendered operative automatically through a linkage when the degree of opening of the throttle valve exceeds a predetermined level.

In FIG. 2, the enriching device shown at 60 comprises a chamber 44 maintained in communication with the float chamber 24 through a passage 42 formed with an enrichment jet 41 therein. Mounted in said chamber 44 is a valve 67 which is seated at a valve seat 66. A fuel sump 64 is formed below a diaphragm 63 provided with a spring 70. A passage 68 is directed upwardly from the fuel sump 64 and opens through a secondary fuel outlet port 69 into the induction passage. Said outlet port 69 is disposed away from the main nozzle on the downstream side of the venturi, but is disposed nearer to the main nozzle as shown in FIG. 1.

A lever 76 is pivotally mounted on a shaft 75 fixed to a member 71 supporting said diaphragm 63. Said member 71 is formed with a cutout 77 in which a forward end 76a of the lever 76 is adapted to be engaged. On the other hand, an arm 73 is mounted on a shaft 72 supporting the throttle valve 12. A connector 74 is fixed at one end to said arm 73 and received at the other end in one of a plurality of openings 78 formed in a rear portion 76b of the lever 76. It will be understood that by selecting a suitable one of said plurality of openings 78 for receiving said other end of the connector 74, it is possible to vary the angle of pivotal movement of the lever 76 or the stroke of the forward end 76a of the lever.

The operation of the embodiment shown in FIG. 2 will be explained. Actuation of the throttle valve 12 results in the lever 76 being moved in pivotal motion through the arm 73 and connector 74. The forward end 76a of the lever 76 is engaged in the cutout 77 but does not abut against the lower end of the valve 67 till the degree of opening of the throttle valve 12 reaches a predetermined level. The valve 67 remains closed in this state, with no secondary fuel being discharged through the secondary fuel outlet port 69.

If the degree of opening of the throttle valve 12 exceeds a predetermined level, then the forward end 76a of the lever 76 is brought into abutment against the lower end of the valve 67 and the lever 76 pivoted at the shaft 75 moves the valve 67 upwardly to thereby bring the fuel sump 64 into communication with the float chamber 24. With the valve 67 being open as aforementioned, the negative pressure in the induction passage causes the fuel in the fuel sump 64 to move upwardly through the passage 68 to be moved through the secondary fuel outlet port 69 into the induction passage. The embodiment of the invention shown in FIG. 2 also permits to add secondary fuel to main fuel when the degree of opening of the throttle valve exceeds a predetermined level as shown in FIG. 3.

From the foregoing description, it will be appreciated that the air-fuel mixture enriching device according to this invention is constructed such that it comprises a secondary fuel outlet passage provided separately and independently of the main nozzle of the carburetor which secondary fuel outlet passage has at its end an outlet port opening into the induction passage in a suitable position between the bottom of the vacuum piston and throttle valve. This arrangement permits to obviate the disadvantage of conventional enriching devices which permit to increase the richness of the mixture only in at least the upper half of the operation range of the vacuum piston. The air-fuel mixture enriching device according to this invention is effective to correct the aforesaid defect of constant vacuum type carburetors by permitting to provide proper proportions of air and fuel at all times over the entire range of engine speeds.

It is to be understood that the form of the invention herewith shown and described is to be taken as preferred embodiments. Various changes may be made in the shape, size and arrangement of parts. For example, the enriching device according to this invention may be adopted a plunger type without using any diaphragm.

What we claim is:

1. An air-fuel mixture enriching device for a constant vacuum type carburetor, comprising wall means forming an axially extending induction passage having a suction end and an oppositely disposed engine manifold end and containing a venturi intermediate its ends, a throttle valve located within said induction passage between the venturi and the engine manifold end, a vacuum piston extending into said induction passage intermediate its ends and transversely of its axis and being located opposite said venturi, a float chamber
located exteriorly of said induction passage, a first sump located within said float chamber, a main fuel nozzle opening into said induction passage at said venturi and arranged in communication with said float chamber through the medium of said first sump, a separate air-fuel enriching device fixed to and extending below the lower end of said float chamber, a chamber in said air-fuel enriching device, a passageway connecting said chamber and said float chamber, an enrichment jet located within said passage intermediate said float chamber and said chamber, a second fuel sump located within said device, a second passageway interconnecting said chamber and said second fuel sump, said chamber having a valve seat therein at the opening to said second passageway, a valve located within said second passageway and having a first part located within said chamber which part is displaceably engageable with the valve seat therein and a second part extending through said second passageway into said fuel sump, a secondary fuel outlet passage formed separately and independently of said main fuel nozzle and connected at one end to the upper portion of said fuel sump and at its other end into said induction passage between said main fuel nozzle and said throttle valve, a second chamber within said enriching device located below said second fuel sump, a diaphragm disposed within said enriching device and forming a separating partition between said second chamber and said second fuel sump, a second part of said valve being secured to said diaphragm, spring means associated with said valve for resiliently biasing said valve, and means associated with said second chamber for opening said valve and effecting a flow of secondary fuel into said second sump and then from said second sump into said secondary fuel outlet passage for supplying the secondary fuel into said induction passage when the engine to which the carburetor is attached is operated at higher speeds.

2. An air-fuel mixture enriching device, as set forth in claim 1, wherein said wall means having an idle port and by-passing holes communicating with said induction passage adjacent said throttle valve, a by-pass line communicating between said first fuel sump and said idle port and by-passing holes, and a spring biased idling screw positioned within said idle port for controlling the flow of fuel into said induction passage during low speed conditions.

3. An air-fuel mixture enriching device, as set forth in claim 1, wherein said means associated with said second chamber for opening said valve comprises a negative pressure detection passage connected at one end to said second chamber and at its other end to said induction passage at a point between said throttle valve and the engine manifold end of said induction passage.

4. An air-fuel mixture enriching device, as set forth in claim 1, wherein said means associated with said second chamber for opening said valve comprises a lever pivotally fixed to said enriching device and having an arm displaceably engageable with said valve in said second chamber, linkage means connected between said lever and said throttle valve so that after said throttle valve exceeds a predetermined level said valve is displaced by said arm of said lever.

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