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Shibanaka et al.

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[54] **CARBURETOR PROVIDED WITH AUXILIARY FUEL FEED MEANS**

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[52] **U.S. Cl.** ..... **261/41 D,** 261/69 A

[51] **Int. Cl.** **F02m 7/04**

[58] **Field of Search** ..... 261/69 R, 69 A, 41 D

[56] **References Cited**

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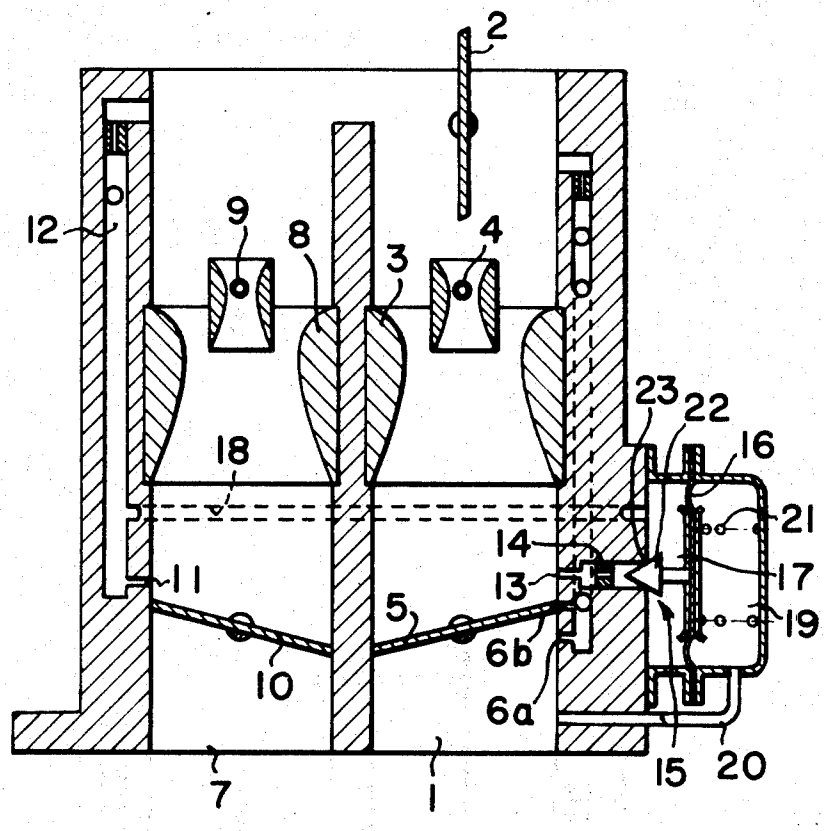
Attorney—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

A carburetor for internal combustion engines having a passage controlled by a throttle valve, in which an auxiliary fuel injection nozzle is provided which is open in said passage at a location which will be upstream of the throttle valve when said throttle valve is in a closed position and downstream of the throttle valve when said throttle valve is in a slightly opened position, and from which auxiliary fuel is injected into said passage during light-load (i.e. throttle valve slighty open), high speed operation of the engine.

4 Claims, 2 Drawing Figures



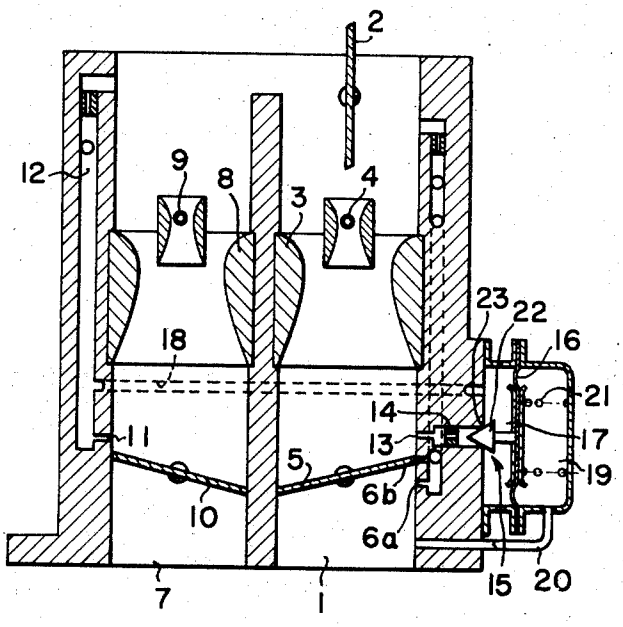

2
12
9
8
3
4
23
22
16
18
21
14
17
11
13
5
19
6b
10
6a
15
20
7
1

FIG. 1

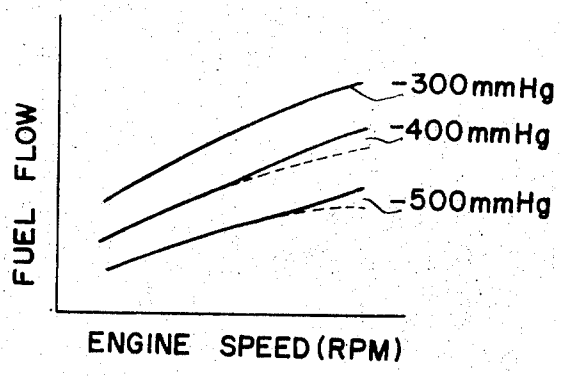

300mmHg
400mmHg
500mmHg
FUEL FLOW
ENGINE SPEED (RPM)

FIG. 2

CARBURETOR PROVIDED WITH AUXILIARY FUEL FEED MEANS

This invention relates to a carburetor for automobile internal combustion engines which contributes to the prevention of misfire or irregular combustion in the engine and to the prevention of the car knocking phenomonon, and more specifically to a carburetor provided with auxiliary fuel feed means by which the intake mixture is maintained at an adequate mixing ratio during the high speed operation of the automobile with a throttle valve being slightly opened.

A carburetor for automobile internal combustion engines is generally set such that an intake mixture of an adequate mixing ratio will be obtained in the low speed or low r.p.m. region of the engine in which the engine is mostly operated. Therefore, there is the tendency that the fuel-air mixing ratio becomes somewhat lower than actually required, in the high r.p.m. region of the engine. Particularly in the light load, (i.e., throttle valve slightly open) high speed operation or the high r.p.m. region of the engine the mixture becomes excessively thinner than required because the quantity of the intake air is relatively small and the quantity of fuel injected from the main fuel injection nozzle of the Venturi is relatively small though the manifold vacuum pressure is high, and thus car knocking has resulted due to misfire or irregular combustion.

The object of the present invention is to provide a carburetor in which is provided means for correcting the mixing ratio of the mixture so as to meet the demand of the engine during the high r.p.m. region of said engine with the throttle valve being slightly open (light load), by feeding auxiliary fuel to the engine, and thereby to eliminate the disadvantage set forth above.

According to the present invention, an auxiliary fuel injection nozzle of an auxiliary fuel feed means is provided adjacent the throttle valve at a location which will be upstream of the throttle valve when said throttle valve is in a fully closed position and downstream of the throttle valve when said throttle valve is in a slightly opened position. Valve means is also provided to permit a fuel supply to said nozzle when the manifold vacuum pressure downstream of said thorttle valve reaches a value greater than a set value. Fuel is injected from said auxiliary fuel injection nozzle when the throttle valve is oened to a certain degree and the manifold vacuum pressure is higher than the set value, whereby the intake mixture of a mixing ratio suitable for such operating condition of the engine can be obtained.

The above and other objects and advantages of the invention will become apparent from the following description and the accompanying drawings:

FIG. 1 is a cross-sectional view of an embodiment of the carburetor according to the present invention which is provided with auxiliary fuel feed means; and

FIG. 2 is graph showing the relationship between the engine r.p.m. and the fuel flow, using the manifold vacuum pressure as a parameter.

Referring to the drawings, a two stage dual barrel type carburetor has an auxiliary fuel feed device on a primary barrel **1**. Although the drawings show a two stage dual barrel type carburetor, since the barrel of an ordinary one stage carburetor corresponds to the primary barrel of such a two stage dual barrel type carburetor, the present invention can be practiced by providing the auxiliary fuel feed device on the barrel of the ordinary one stage carburetor.

The primary barrel **1** comprises a choke valve **2**, a Venturi **3**, a main fuel nozzle **4**, a butterfly throttle valve **5**, and an idling fuel port **6***a* and a slow port **6***b*. A secondary barrel **7** is provided with a Venturi **8**, a main fuel nozzle **9**, a throttle valve **10** and a slow **11** located slightly upstream of a fully closed position of said throttle valve **10**. The slow port **11** is connected with a low speed fuel passage **12** formed in the side wall of the barrel **7**. The above-described construction is the same as that of conventional carburetors.

In the primary barrel **1** is formed an auxiliary fuel injection nozzle **13** adjacent the throttle valve **5** at a location which will upstream of the throttle valve **5** when said throttle valve is in a fully closed position and downstream of the throttle valve **5** when said throttle valve is in a slightly opened position. The auxiliary fuel injection nozzle **13** communicates through a jet **14** and an on-off valve **15** with fuel chamber **17** the wall of which is partially constituted by a diaphragm **16**. Auxiliary fuel is supplied from the air bled, low speed fuel passage **12** in the secondary barrel through a branched passage **18** into the fuel chamber **17**. On the other side of the diaphragm **16** is formed a vacuum chamber **19** which communicates through a vacuum passage **20** with an inlet passage downstream of the throttle valve **5** and including the inlet manifold of the engine, to take the manifold vacuum pressure therefrom. The on-off valve **15** has a valve body **22** connected to the diaphragm **16**. The valve body **22** is urged by a spring **21** into mating engagement with a valve seat **23** to shut down the auxiliary fuel supply to the injection nozzle **13**. The arrangement is such that the on-off valve **15** will be opened when the vacuum pressure introduced into the vacuum chamber **19** through the vacuum passage **20** reaches a value greater than a set value.

The manifold vacuum pressure is extremely high when the engine is in the idling operation or the engine brake is in effect, with the throttle valve **5** being fully closed. In this case, therefore, the valve body **22** is disengaged from the valve seat **23** under the effect of the vacuum pressure acting in the vacuum chamber **19** through the vacuum passage **20**. However, since the auxiliary fuel injection nozzle **13** is located upstream of the throttle valve **5**, the manifold vacuum pressure does not act at the injection nozzle **13** and hence auxiliary fuel is not injected from said injection nozzle.

In the operation of the engine with the throttle valve **5** being slightly opened, the auxiliary fuel injection nozzle **13** is located downstream of the throttle valve **5**. In this case when the engine r.p.m. is low although somewhat higher than idling speed (for example 1,000 to 2,000 r.p.m.) in the manifold vacuum pressure is lower than the set value, so that the on-off valve **15** is held in the closed position and auxiliary fuel is not fed in spite of the fact that the injection nozzle **13** is located downstream of the throttle valve **5**. On the other hand, in this case when the engine r.p.m. is high enough to be greater than the set value, the injection nozzle **13** is opened by way of the diaphragm **16** and thus auxiliary fuel is sucked into the intake mixture to be mixed therewith. Namely, a mixture of a mixing ratio suitable for the high speed operation of the engine with the throttle valve being slightly open can be obtained with high combustion efficiency.

As the throttle valve **5** is further opened, the manifold vacuum pressure becomes lower than the set value, so that the on-off valve **15** is closed under the biasing force of the spring **21** and the feeding of auxiliary fuel is interrupted.

Namely, in the present invention auxiliary fuel is fed only when the engine is in the so-called light-load, high speed operation wherein the throttle valve **5** is in the slightly opened position and the manifold vacuum pressure is higher than the set value, as in the case when the automobile is driven on a slow descending slope with a slight pressure being applied to the accelerator pedal.

FIG. **2** shows the relationship between the engine r.p.m. and the adequate fuel flow when the manifold vacuum pressure is -500, -400 and -300 mmHg which pressures are adjusted by controlling the opening degree of the throttle valve. In the graph of FIG. **2**, the solid curves represent the characteristic of the subject carburetor provided with the auxiliary fuel feed device and the dotted curves represent the characteristic of the conventional carburetor not provided with such auxiliary fuel feed device. The three curves are all for the case when the degree of opening of the throttle valve becomes greater with the manifold vacuum pressure lowering. It will be understood from the graph that in the so-called heavy-load operation of the engine wherein the throttle valve is largely opened, the fuel flow increases substantially in proportion to the increasing engine speed in both cases of the subject carburetor and the conventional carburetor (the curves of both carburetors are exactly overlapped in the chart). In the so-called light-load operation wherein the degree of opening of the throttle valve is small (e.g., in the case of the manifold vacuum pressure being -400 or -500 mmHg in FIG. **2**) and when the engine speed is high, the fuel flow does not increase to the required quantity in case of the conventional carburetor as indicated by the dotted curves, so that the mixture becomes excessively thin causing various objectionable phenomena as set forth previously. However, in the case of the subject carburetor auxiliary fuel is added under such operational condition of the engine and the fuel increases substantially in proportion to the engine speed as indicated by the solid curves. Therefore, a mixture to meet the demand of the engine can be obtained and the conventional disadvantages can be eliminated.

Although in the embodiment described herein the fuel is supplied to the auxiliary fuel injection nozzle through the low speed fuel passage **12** formed in the wall of the secondary barrel, it should be understood that the fuel may be supplied to said injection nozzle directly from the float chamber or the main fuel passage. The fuel passage conncting the auxiliary fuel injection nozzle with the fuel source is preferably provided independently from a passage which supplies fuel to the idling fuel port or the slow port, so that the idling operation of the engine is not disturbed by the auxiliary fuel supplied to the auxiliary fuel injection nozzle.

Further, although the present invention has been described and illustrated herein with reference to a specific embodimnt thereof, it should be understood that the invention is not restricted to the details of the embodiment but many modifications and changes are possible within the scope of appended claims. For instance, the on-off valve **15** in the embodiment described may be replaced by a diaphragm switch which operates upon sensing the manifold vacuum pressure and a solenoid valve which opens and closes a passage leading to the auxiliary fuel injection nozzle.

We claim:

1. A carburetor including at least one barrel having a first passage therethrough, a main fuel nozzle, a Venturi, an idling fuel port and a throttle valve for controlling a supply of intake mixture to an engine wherein the improvement comprises:

a. an auxiliary fuel injection nozzle open to said first passage, said injection nozzle being located at a position which is upstream of said throttle valve when said throttle valve is in a closed position and which is downstream of said throttle valve when said throttle valve is in a slightly open position;

b. a second fuel passage connecting said auxiliary fuel injection nozzle with a fuel source; and

c. valve means connected to said second fuel passage for opening and closing said second fuel passage, said valve means including means responsive to the manifold vacuum pressure downstream of said throttle valve for opening said second fuel passage when the manifold vacuum pressure exceeds a predetermined value, said second fuel passage being open to allow auxiliary fuel to be added to the intake mixture when the engine is in a relatively high speed operation with the throttle valve slightly open.

2. A carburetor according to claim **1** wherein said barrel has a slow port open to said first passage, said slow port being adjacent said throttle valve, said auxiliary fuel injection nozzle being located adjacent said slow port.

3. A carburetor according to claim **1** wherein said valve means comprises a vacuum chamber having a diaphragm as one wall, a third vacuum passage connected to said vacuum chamber for introducing the manifold vacuum pressure into said vacuum chamber, a valve body secured to said diaphragm and adapted to open and close said second fuel passage incident to movement of said diaphragm, and a spring urging said valve body into a closed position.

4. A carburetor according to claim **1** wherein said second fuel passage connecting said auxiliary fuel injection nozzle with said fuel source is provided independently from a fuel passage leading to said idling fuel port.

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