AIR VALVE TYPE CARBURETOR

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Filed: Jan. 5, 1971

Appl. No.: 104,007

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ABSTRACT

An air valve type carburetor in which a nozzle is disposed in an air passage between an air valve and a throttle valve, and said nozzle is communicated with a float chamber through a passage with a check ball disposed therein, whereby at the time of acceleration fuel is injected from the nozzle by making use of a negative pressure appearing in the vicinity of said nozzle.

19 Claims, 4 Drawing Figures
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AIR VALVE TYPE CARBURETOR

This invention relates to an air valve type carburetor. In an air valve type carburetor, the negative pressure at a Venturi portion is constantly maintained at a substantially constant value by holding an air valve, which is operated by making use of said negative pressure, at a degree of opening proportional to the quantity of air supplied to an engine, whereby satisfactory atomization of fuel is obtained throughout the operation range of the engine, without lowering the efficiency of air suction. Further, the flow rate of fuel is varied by the axial position relative to a metering orifice of a needle valve which is operatively connected with the air valve. However, when a throttle valve is opened abruptly to accelerate the engine, the air valve is also suddenly opened, and at that moment, because of the inertia differential between air and fuel, the quantity of air only increased before the fuel increases, with the result that the air-fuel mixture temporarily becomes thin. In order to prevent such phenomenon, an oil damper is usually provided in the air valve so as not to permit the air valve to open abruptly. The effect of such a damper becomes greater as the viscosity of fluid, by which said damper is operated, increases, but the effect of the damper is too great, an undesirable rich air-fuel mixture will be supplied to a cylinder not only at the initial stage of acceleration but also for a relatively long period during the acceleration, and thus the quantity of carbon monoxide in the exhaust gases increases. On the other hand, if the effect of the damper is too small, the air-fuel mixture will become undesirably thin at the initial stage of acceleration, resulting in choking of the engine or back-fire. For such problem, the provision of an acceleration pump is effective which discharges fuel into the intake passage at the time of acceleration. However, if the acceleration pump is provided in addition to the oil damper in the air valve type carburetor, the fuel will be supplied into the air passage not only at the initial stage but also at the latter stage of acceleration, so that the total quantity of fuel supplied at the latter stage of acceleration becomes too large, resulting in wasteful consumption of fuel which is uneconomical.

An object of the present invention, therefore, is to provide an air valve type carburetor which is provided with means capable of supplying fuel during acceleration in such a quantity as will provide an optimum air-fuel ratio.

Another object of the invention is to provide fuel supply means for use during acceleration, which is of simple construction not including a pump, piston or diaphragm which usually renders a carburetor expensive.

The present invention contemplates the provision of fuel supply means for use during acceleration, which makes use of a negative pressure variation between an air valve and a throttle valve. Namely, according to the invention a nozzle is disposed between the air valve and the throttle valve, while a check valve is provided in a passage communicating with a float chamber, whereby fuel is injected into an air passage by the effect of the negative pressure in the vicinity of said nozzle when the throttle valve is abruptly opened.

These and other objects, features and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a vertical cross-sectional view of an embodiment of the air valve type carburetor according to the invention;

FIG. 2 is a diagram illustrating a negative pressure in the vicinity of the nozzle varying with the passage of time after the throttle valve is opened, in the carburetor of the invention (with an oil damper means provided therein); and

FIGS. 3a and 3b are a set of diagrams exemplifying the negative pressures at the respective points between the air valve and the throttle valve in the air passage, in the carburetor of the invention, when the engine is operating at 3,200 r.p.m. and the throttle valve is fully opened.

Referring to FIG. 1, reference numeral 1 designates an air passage of the carburetor, 2 a throttle valve and 3 a variable Venturi portion. An air valve 4 which constitutes a portion of the variable Venturi portion, is vertically moveable within the air passage 1 according to the size of a negative pressure appearing between the throttle valve 2 and said air valve and acting into a suction chamber 5 through a channel 6. An abrupt movement of the air valve 4 is controlled by oil damper means 9, including a piston rod 7 and a plunger 8, and a spring 10. On the other hand, an orifice 13 communicating with a float chamber 12 is open into a bridge 11 which constitutes a portion of the variable Venturi portion 3, and a needle valve 14 integral with the air valve 4 extends into said orifice. Further, a nozzle 15 is open into the air passage 1 at a location intermediary of the air valve 4 and the throttle valve 2. The nozzle 15 is communicated with the float chamber 12 through a channel 16 and a jet 17, and a check valve 20 consisting of a spring 18 and a ball 19 may be provided intermediary of said channel 16 as shown in FIG. 1. This check valve 20 may be so constructed that it is opened when a negative pressure of a size larger than a pre-determined value acts thereon from the air passage, compressing the spring 18.

The air valve type carburetor of the construction described above operates in the following manner.

The air valve 4 moves up and down according to the size of the negative pressure in that portion of the air passage between it and the throttle valve 2, to maintain the negative pressure at the variable Venturi portion 3 constant. Therefore, the position of the needle valve 14 integral with the air valve 4 is shifted relative to the orifice 13, whereby the fuel discharged into the air passage is controlled. The oil damper means 9 acts to prevent a large variation in air-fuel ratio caused by variation in the opening and closing velocity of the throttle valve 2 due to the inertia differential between air and fuel. Owing to such action of the damper means, a large variation in air-fuel ratio can be prevented to some extent even when the throttle valve 2 is opened abruptly, but even with the damper means, a temporary lowering of the proportion of fuel in the air-fuel mixture is inevitable at the initial stage of acceleration, due to the delay in fuel supply.

In the carburetor according to the instant invention, fuel is promptly discharged through the nozzle 15 under such condition and hence an air-fuel mixture optimum for acceleration is supplied to cylinders. Namely, the negative pressure in the vicinity of the nozzle varies as shown in FIG. 2, with the passage of time after the throttle valve 2 is opened abruptly. As seen, when the rotation of the engine is accelerated such that
a negative pressure upstream of the throttle valve varies from 12 mmHg to 15 mmHg, the negative pressure temporarily rises up to 350 mmHg at the initial stage of acceleration, so that the fuel in the float chamber is supplied through the channel 16 into the air passage 1 from the nozzle 15 under the effect of such a large negative pressure. Where the check valve 16 is provided intermediary of the channel 16 as stated previously, the fuel is supplied into the air passage when the negative pressure has reached a predetermined value. It is only after the negative pressure has passed the peak in FIG. 2 that the quantity of air supplied to the engine increases. It will, therefore, be seen that by suitably reflecting the strength of the spring 18, it becomes possible to inject the fuel into the air passage immediately after the negative pressure has passed its peak and thereby to supply a rich air-fuel mixture to the engine at the time of acceleration.

Upon passage of a certain period after the acceleration, the negative pressure between the air valve 4 and the throttle 2 decreases and the fuel supply for acceleration through the nozzle 15 terminates. At this point, however, the air valve 4 has already been lifted and the gap between the needle valve 14 and the nozzle 13 has been increased, so that a larger quantity of fuel is supplied through said nozzle 13, providing for the normal operation of the engine at a higher r.p.m.

It is to be noted that the absolute value of the negative pressure between the air valve 4 and the throttle valve 2, during the normal operation, varies largely at locations, as shown in FIGS. 3a and 3b. During acceleration, a tendency of negative pressure variation similar to that shown in the above figures is seen. Therefore, the nozzle 15 is provided preferably at a point downstream of the needle valve 14 and a negative pressure which enables the fuel to be supplied in a quantity sufficient to accelerate the engine, can be obtained at said point.

What is claimed is:

1. An air valve type carburetor of the type wherein an air valve and a throttle valve are provided in an air passage, the degree of opening of said air valve being controlled by a negative pressure appearing between said air valve and said throttle valve, and an orifice communicating with a float chamber is opened into said air passage, while a needle valve for metering the flow rate of fuel passing through said orifice is provided on said air valve, said air valve type carburetor comprising a nozzle disposed in the air passage between said air valve and said throttle valve and directly communicating with the float chamber through a channel, wherein a check valve is provided in said channel communicating said nozzle with the float chamber, said check valve having the negative pressure between the air valve and throttle valve acting directly thereon through said channel, said channel being normally closed but opened under a high negative pressure created between the air valve and throttle valve when said throttle valve is opened abruptly, thereby allowing fuel to flow through said nozzle into said air passage.

2. A carburetor according to claim 1, wherein said nozzle is located closer to said throttle valve than to said needle valve so as to assure sufficiently high negative pressures to open said check valve upon abrupt opening of said throttle valve.

3. A carburetor according to claim 1, wherein said check valve is biased during steady state high speed operation and acceleration with an opened throttle due to a reduction in said high negative pressure shortly after said abrupt opening, said orifice including means for supplying sufficient fuel for optimizing said steady state high speed operation and acceleration once the fuel flow through the orifice has overcome the inertia lag which prevents sufficient immediate fuel flow through said orifice due to delays inherent in the response of said air valve to said abrupt opening of said throttle and in the flow through said orifice once opened.

4. A carburetor according to claim 1, wherein a biasing means of said check valve closes said check valve during steady state high speed operation and acceleration with an opened throttle due to a reduction in said high negative pressure shortly after said abrupt opening, said orifice including means for supplying sufficient fuel for optimizing said steady state high speed operation and acceleration once the fuel flow through the orifice has overcome the inertia lag which prevents sufficient immediate fuel flow through said orifice due to delays inherent in the response of said air valve to said abrupt opening of said throttle and in the flow through said orifice once opened.

5. An arrangement according to claim 6, wherein a float chamber for holding a supply of fuel, a main fuel orifice communicating with said air passage at a location directly adjacent said movable air valve, main fuel orifice control means for controlling the opening in said main fuel orifice in response to movement of said air valve, a secondary fuel nozzle communicating with said air passage at a location between said air valve and said throttle valve, a channel directly connecting said secondary fuel nozzle with said float chamber, and check valve means arranged in said channel, said channel and secondary fuel nozzle directly communicating the negative pressure in said air passage at the location of said secondary fuel nozzle with said check valve means, said check valve means being operable only in the event of a predetermined excessively high negative pressure in said air passage at the location of said secondary fuel nozzle, which excessively high negative pressure occurs only during a short time period immediately after abrupt opening of said throttle valve to accelerate the engine; whereby additional fuel is supplied to said air passage to assist in the acceleration by way of said secondary fuel nozzle in direct and immediate response to opening of said throttle valve.

6. An arrangement according to claim 6, wherein main fuel orifice includes means for supplying sufficient fuel for optimizing said steady state high speed operation and acceleration once the fuel flow through the orifice has overcome the inertia lag related to the difference in weight of air and fuel and the response of said air valve which prevents sufficient immediate fuel flow through said orifice after an abrupt movement of said air valve and corresponding abrupt adjustment of
said orifice by said fuel orifice control means occurring immediately after said abrupt opening of said nozzle.

8. An arrangement according to claim 6, wherein said channel extends uninterruptedly between said check valve and said float chamber.

9. An arrangement according to claim 6, wherein said check valve means includes a biasing means for closing said check valve means during steady state high speed operation and acceleration with an opened throttle due to a reduction in said high negative pressure at said nozzle which occurs shortly after said abrupt opening of said throttle valve.

10. An arrangement according to claim 9, wherein said main fuel orifice includes means for supplying sufficient fuel for optimizing said steady state high speed operation and acceleration once the fuel flow through the orifice has overcome the inertial lag related to the difference in weight of air and fuel and the response of said air valve which prevents sufficient immediate fuel flow through said orifice after an abrupt movement of said air valve and corresponding abrupt adjustment of said orifice by said fuel orifice control means occurring immediately after said abrupt opening of said nozzle.

11. An arrangement according to claim 10, wherein said channel extends uninterruptedly between said check valve and said float chamber.

12. An arrangement according to claim 10, wherein said main fuel orifice control means is a needle valve attached to said air valve and extending into said main fuel orifice.

13. An arrangement according to claim 12, wherein said secondary fuel nozzle is located closer to said throttle valve than to said needle valve so as to assure sufficiently high negative pressure to open said check valve upon abrupt opening of said throttle valve.

14. An arrangement according to claim 13, wherein said channel opens into a bottom portion of said float chamber, and wherein said needle valve extends downwardly into said float chamber.

15. An arrangement according to claim 14, wherein said air valve is provided with a control passage extending into said air passage for communicating the negative pressure in said air passage with said air valve to control movement of said air valve.

16. An arrangement according to claim 15, wherein said control passage is positioned intermediate said needle valve and said secondary fuel nozzle along the length of said air passage.

17. An arrangement according to claim 16, wherein said channel extends uninterruptedly between said check valve and said float chamber.

18. An arrangement according to claim 16, wherein said check valve means includes a spring biased ball controlling the opening in said channel.

19. An arrangement according to claim 18, wherein said air valve includes an oil damper means for damping the movement of said air valve.

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