United States Patent

Arikawa

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[54] FLUIDIC TWO-STAGE CARBURETOR

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[52] **U.S. Cl.**.....**261/23 A,** 261/36 A, 261/121 B, 261/69 R, 261/DIG. 69, 123/119 R, 137/81.5

[51] **Int. Cl.**.....**F02m 69/04**

[58] **Field of Search**.....261/DIG. 69, 36 A, 69 R, 121 B, 261/23 A; 123/119 R; 137/81.5

[56] **References Cited**

UNITED STATES PATENTS

3,340,884	9/1967	Warren et al.	261/DIG. 69
3,389,894	6/1968	Binder	261/DIG. 69
3,398,937	8/1968	Stoltman	261/23 A
3,406,951	10/1968	Marks	261/DIG. 69
3,477,699	11/1969	Drayer	261/DIG. 69
3,574,346	4/1971	Sulich	261/DIG. 69

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[57] **ABSTRACT**

The disclosure describes a two-stage carburetor including pure fluid amplifier control elements. The carburetor provides control of fuel flow for idling, normal driving conditions, and for transient conditions, such as acceleration and deceleration. All control signals are derived from nozzles located in the mixing chambers upstream of the throttle valves. During idling and for low-speed operation, all fuel enters the mixing chamber at, or upstream of, a Venturi throat to provide better atomization of the fuel and mixing with the air.

6 Claims, 5 Drawing Figures

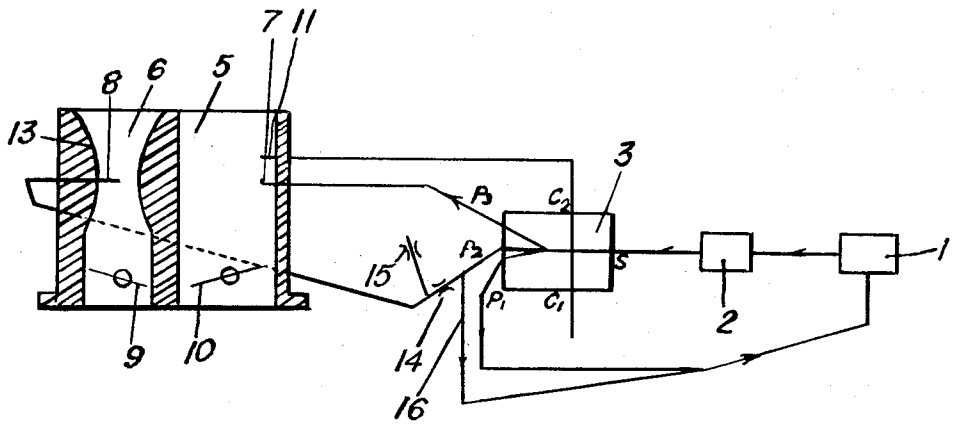


Fig. 1

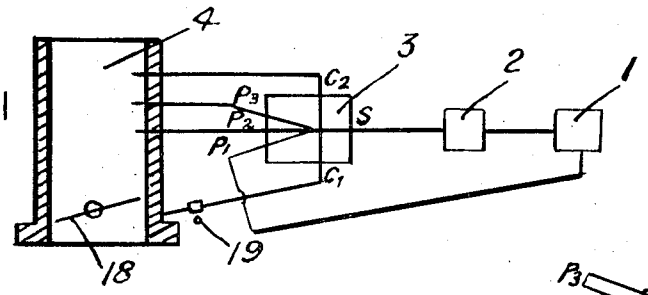


Fig. 3

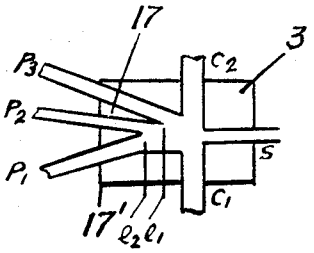


Fig. 2

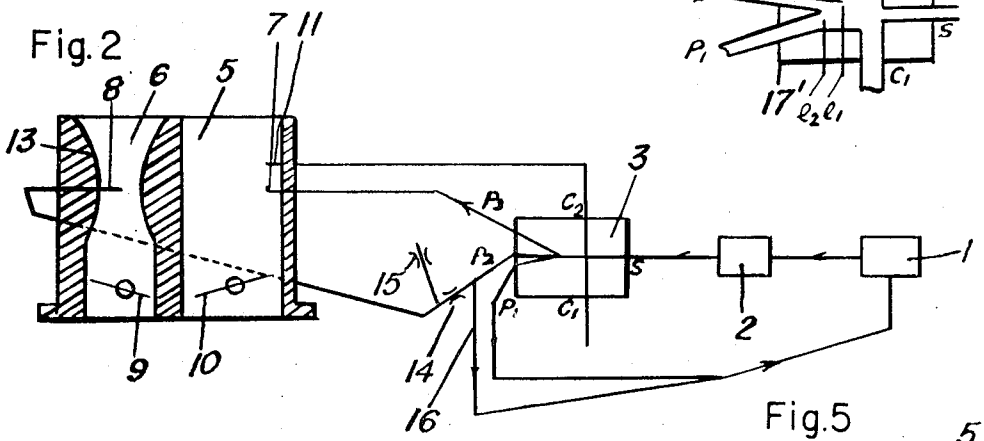


Fig. 5

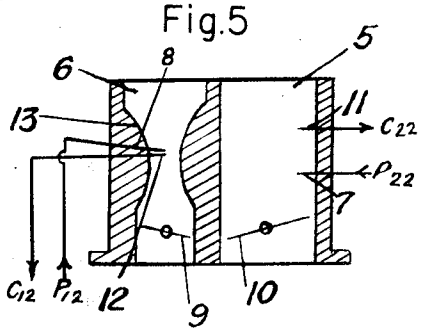


Fig. 4

FLUIDIC TWO-STAGE CARBURETOR

PRIOR ART

The present invention relates to a carburetor employing pure fluid amplifiers as control elements.

A typical prior art carburetor employing a fluid amplifier is shown in FIG. 1 wherein fuel from a fuel tank 1 is supplied by pump 2 to the power stream input S of fluid amplifier 3. The amplifier has three output passages P1, P2 and P3 and two control signal inputs C1 and C2. Output passages P2 and P3 connect with an air intake bore or mixing chamber 4 upstream of a throttle valve 18. Output passage P1 is connected to the fuel supply by a fuel return line. Control input C2 is connected with the mixing chamber 4 upstream of throttle valve, and control input C1 is connected through a pressure regulator 19 to chamber 4 downstream of the throttle valve.

The amount of fuel supplied to the mixing chamber through passages P2 and P3 is controlled by the negative pressure sensed downstream of the throttle valve and applied to control input C1 through the pressure regulator.

This prior art carburetor has the disadvantage of being unable to fully atomize and stably supply a small amount of fuel to an engine during periods of low speed operation such as idling. Furthermore, since the control signals applied to control input C1 are derived from the mixing chamber at a point downstream of the throttle valve excess fuel is supplied to the engine during deceleration. The excess fuel thus supplied reduces fuel economy. Furthermore, the excess fuel is not completely burned in the engine and thus results in excess exhaust emission.

SUMMARY OF THE INVENTION

An object of this invention is to provide a carburetor including fluidic controls but having none of the disadvantages of the prior art devices.

An object of this invention is to provide a fluidic carburetor capable of stably supplying and fully atomizing fuel supplied to an engine during periods of low speed.

Another object of this invention is to provide a fluidic carburetor wherein all control signals for controlling fuel flow are derived from the carburetor bore at a point upstream of the throttle valve.

The above stated and other objects of the invention are accomplished by providing a carburetor bore including low speed and high speed mixing chambers, each having a throttle valve therein. The low speed mixing chamber is provided with a Venturi throat. Control nozzles located upstream of the throttle valves sense the pressures in the mixing chambers to control a fluidic circuit through which fuel is supplied to the mixing chambers. In one embodiment a single fluid amplifier controls all fuel flow. In a second embodiment, a separate fluid amplifier controls the flow of fuel to each mixing chamber. In both embodiments, fuel is supplied to the low speed mixing chamber at, or upstream of, the Venturi throat.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 shows a prior art fluidic carburetor;

FIG. 2 shows a first embodiment of a two-staged fluidic carburetor having a single fluid amplifier for controlling fuel flow to both the low and high speed mixing chambers;

FIG. 3 illustrates a suitable fluid amplifier for use in the embodiment of FIG. 2;

FIG. 4 shows a second embodiment of a two-stage fluidic carburetor having separate fluid amplifiers for controlling fuel flow to the low and high speed mixing chambers; and,

FIG. 5 illustrates a modification of the embodiment of FIG. 4 wherein a fuel injection nozzle is located at a Venturi throat.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. 2, a two-stage fluidic carburetor according to the present invention comprises a carburetor bore having first and second mixing chambers 5 and 6, first and second throttle valves 9 and 10, and a pure fluid amplifier 3.

Fuel from a fuel tank 1 passes through a pump 2 and is applied under pressure to the power stream input S of amplifier 3. The amplifier has a control input C1 which is vented to the atmosphere and a control input C2 that terminates at a control nozzle 11 in high speed mixing chamber 5.

Amplifier 3 has three output passages P1, P2, and P3. Output P1 is connected by way of a return duct to the fuel supply 1. Output P2 is connected through a flow restrictor 14 to a fuel injection nozzle 8 located in low speed mixing chamber 6. Mixing chamber 6 includes a Venturi and nozzle 8 is located near the center of the Venturi throat. Output P3 of the amplifier is connected to a fuel injection nozzle located in the high speed mixing chamber 5.

As shown in FIG. 3, the fluid amplifier has an internal configuration such that the flow splitter 11 which separates outputs P2 and P3 is positioned nearer to the power stream input S than is the flow splitter 12 which separates outputs P1 and P2. Furthermore, the internal configuration is such that in the absence of any control signals at control inputs C1 and C2 the power stream flows toward outputs P1 and P2 with the major portion being directed toward output P1. Fluid amplifier 3 is a convention proportional flow amplifier and may be constructed in accordance with the teachings of the prior art.

The embodiment of FIG. 2 functions as follows. At idling speed just after the engine is started, the throttle valve 9 is partially open whereas throttle valve 10 is closed. With throttle valve 10 closed, the pressure in mixing chamber 5 is substantially atmospheric pressure hence no control signal is applied to control input C2 of the fluid amplifier. With throttle valve 9 partially opened, air is drawn downwardly through mixing chamber 6 to the engine intake manifold (not shown). The air passing through the Venturi throat creates a negative pressure at control nozzle 8 and this negative pressure is used to control fuel flow at low engine speeds.

As previously stated, the power stream of amplifier 3 is normally directed toward outputs P1 and P2. All of the power stream directed toward P1 is returned to the fuel supply. Because of flow restrictor 14, a major portion of the power stream directed toward output P2 is also returned to the fuel supply by way of the return line 16. Flow restrictor 14 and an air bleed 15 may be made adjustable to thereby adjust the rate of fuel flow at idling speed. Once the idling adjustments have been made, the rate at which fuel passes from output P2 through restrictor 14 to mixing chamber 6 is determined by the negative pressure at the Venturi throat. This pressure becomes more negative as throttle valve 9 is opened further to admit more air to the engine manifold through the mixing chamber. The fuel is atomized as it enters mixing chamber 6 and is mixed with the air before entering the engine manifold. It will be understood that throttle valves 9 and 10 are controlled by a single control element (not shown) such that throttle valve 10 begins to open once throttle valve 9 has been opened beyond some predetermined point. As throttle valve 10 is opened, air flows through mixing chamber 5 and past throttle valve 10 to the engine manifold. The air flow creates a negative pressure that is sensed by nozzle 11 and transmitted to control input C2 of the fluid amplifier where it tends to draw the power stream toward output P3. When throttle valve 10 is slightly opened, only a small portion of the power stream flows to output P3 and is injected into mixing chamber 5 through nozzle 7. The remainder of the power stream still flows toward P2 and P1 with a smaller portion flowing to P1 than before valve 10 was opened. As the throttle valve 10 is opened further, more of the power stream flows toward output P3 and less is returned to the fuel supply through output P1. While fuel is still supplied to mixing chamber 6 through output P2, the major flow of fuel is through output P3 once valve 10 is opened. Stated differently, the pressure in the Venturi throat 13 is the primary control over fuel flow at lower speeds but the negative pressure applied to control input C2 becomes the primary control at higher speeds.

FIG. 4 shows a different embodiment wherein a first fluid amplifier 3' supplies fuel to the low speed mixing chamber 6 and a second fluid amplifier 3'' supplies fuel to the high speed

mixing chamber 6. Fuel from a fuel supply 1 is applied by means of a pump 2 to the power stream inputs of amplifiers 3' and 3''.

Amplifier 3' has a first control input C11 which is vented to the atmosphere, and a second control input C12 that is connected to a control nozzle 12 located in the Venturi throat formed in mixing chamber 6. Amplifier 3' has a first output P11 that is connected by a return line to the fuel supply, and a second output P12 that is connected with a fuel injection nozzle 8 located upstream of the Venturi throat. If desired, the nozzle 8 may be located at the Venturi throat, as shown in FIG. 5, rather than being located upstream therefrom.

Amplifier 3'' has a first control input C21 which is vented to the atmosphere, and a second control input C22 that is connected to a control nozzle 11 located in mixing chamber 5 upstream of throttle valve 10. The amplifier 3'' has a first output P21 that is connected by a return line to the fuel supply, and a second output P22 that is connected with a fuel injection nozzle 7.

The fluid amplifiers 3' and 3'' are proportional amplifiers of conventional design. In the absence of any control signals at their control inputs, the power stream of amplifier 3' is directed toward output P11 and the power stream of amplifier 3'' is directed toward output P21 so that both power streams are returned to the fuel tank 1.

As the engine (not shown) is started, throttle valve 9 is partially opened so that air flows downwardly through mixing chamber 6 and past the throttle valve to the engine manifold. The flow of air through the Venturi throat creates a negative pressure that is sensed by nozzle 12 and transmitted to control input C12 of amplifier 3'. The negative pressure at the control input draws the power stream of the amplifier toward output P12 so that part of the power stream enters output P12 and the remainder enters output P11 for return to the fuel tank. The portion of the power stream entering output P12 flows to nozzle 8 and is injected into the downwardly flowing air stream. The fuel is atomized and mixed with the air in chamber 6 before flowing past the throttle valve 9 to the engine.

As the throttle valve 9 is opened further, the pressure in the Venturi throat becomes more negative and when this pressure is transmitted to input C12 it causes even more of the power stream of amplifier 3' to be directed through output P12 to mixing chamber 6.

At low speeds, throttle 10 is fully closed. However, as throttle 9 approaches its fully opened position, throttle valve 10 begins to open. Air rushes downwardly through mixing chamber 5 thereby creating a negative pressure that is sensed at nozzle 11 and transmitted to control input C22. The negative pressure at this control input deflects the fuel applied to the power stream input of the amplifier so that part of the fuel flows toward output P22 with the remainder flowing back to the fuel supply through output P21. That portion of the fuel entering output P22 enters chamber 5 through nozzle 7 and is mixed with the air flowing through the chamber to the engine manifold.

As the throttle 10 is opened further, more of the power stream of amplifier 3'' is directed toward output P22 and less is returned to the fuel supply.

In the embodiment of FIG. 4, an adjustable air bleed 15 is provided between the control input C12 of amplifier 3' and the control nozzle 12. This air bleed serves as an idle adjustment by determining what portion of the negative pressure sensed at nozzle 12 will be applied to the amplifier 3'.

In the embodiment of FIG. 2, the air bleed 15 not only serves as an idle adjustment but serves another function. Air entering the system through air bleed 15 mixes with or breaks up the fuel flowing from outlet P2 to the injection nozzle 8. This aides in creating a fine spray at nozzle 8, even at low fuel flow rates.

In summary, the present invention provides a fluidic carburetor wherein fuel is fully atomized and mixed with air at low speeds because the fuel is supplied to the low speed mixing chamber at, or upstream of, the Venturi throat. Furthermore, since all control nozzles are located upstream of the throttle valves, excessive fuel is not supplied to the engine during deceleration since the throttle valves isolate, or partially isolate, the control nozzles from the high negative pressure of the engine manifold.

While preferred embodiments of the invention have been shown and described, various modifications may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A two-stage fluidic carburetor comprising:
- a carburetor bore including a low speed and a high speed mixing chamber through which air may flow to the intake manifold of an engine said, low speed mixing chamber having a Venturi throat formed therein;
- a first throttle valve in said low speed mixing chamber and a second throttle valve in said high speed mixing chamber said second throttle valve being operable only at higher engine speeds;
- a pure fluid amplifier having a power stream input, a control input, and first, second and third outputs,
- means for supplying fuel to said power stream input, said fluid amplifier having an internal configuration whereby its power stream is normally directed toward said first and second outputs,
- first fluid passage means terminating at an opening upstream of said first throttle valve, said fluid passage means connecting with said second output;
- a flow restrictor in said fluid passage means intermediate said opening and said second output,
- second fluid passage means terminating at an opening upstream of said second throttle valve, said second fluid passage means connecting with said third output; and,
- pressure sensing means upstream of said second throttle valve for applying fluid pressure signals to said control input to thereby direct more of said power stream into said third output as engine speed is increased.

2. A two-stage carburetor as claimed in claim 1 and further comprising an air bleed for admitting air to said first fluid passage means, said air mixing with the fuel flowing therethrough.

3. A two-stage carburetor as claimed in claim 1 wherein said means for supplying fuel to said power stream input comprises a fuel source and a pump, said carburetor further comprising:
- first fuel return means connected between said first output and said fuel source; and,
- second fuel return means connected to said first fluid passage means intermediate said flow restrictor and said second output, said second fuel return means also connecting with said fuel source.

4. A two-stage carburetor as claimed in claim 3 wherein the terminating opening of said first fluid passage means is located no further downstream than said Venturi throat.

5. A two-stage carburetor comprising:
- a carburetor bore including low speed and high speed mixing chambers through which air may flow to an engine manifold;
- said low speed chamber having a Venturi throat;
- a first throttle valve in said low speed mixing chamber for controlling air flow therethrough;
- a second throttle valve in said high speed mixing chamber, said second throttle valve being closed except at higher speeds;
- first and second fluid amplifiers each having a power stream input for receiving fuel, and a first output and a control input connecting with one of said mixing chambers for applying fuel thereto upstream of said throttle valves in response to the pressure sensed therein;
- a fuel source;
- a pump connected to said fuel source and the power stream inputs of said amplifiers whereby said fuel is applied as the power streams of said amplifiers

each said amplifier having a second output to which said fuel flows in the absence of a signal at its control input;

means for returning fuel from said second outputs to said fuel source; and,

an adjustable air bleed connecting with the control input of said first amplifier for adjusting the rate of fuel flow to said low speed mixing chamber in response to a predetermined negative pressure sensed therein,

a negative pressure in said low speed mixing chamber being determined by the positioning of said first throttle valve, said negative pressure deflecting the power stream of said first amplifier so that more fuel flows to its first output as said first throttle valve is opened.

6. A two-stage carburetor as claimed in claim 5 wherein a negative pressure in said high speed mixing chamber is determined by the positioning of said second throttle valve, said negative pressure deflecting the power stream of said second amplifier so that more fuel flows to its first output as said second throttle valve is opened.

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