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Shiobara et al.

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[54] CARBURETOR OF VARIABLE-AREA VENTURI TYPE

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[52] **U.S. Cl.** .....**261/44 R,** 261/63

[51] **Int. Cl.** **F02m 3/08**

[58] **Field of Search** .....261/44 R, 63, 50 A

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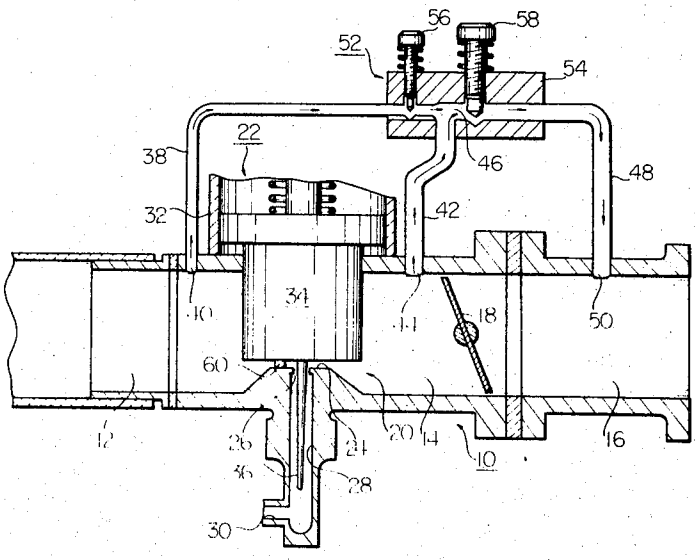
[57] **ABSTRACT**

A carburetor of the variable-area venturi type for an internal combustion engine, adapted to reduce the amount of hydrocarbons in the exhaust gases emitted from the engine during idle operation of the automotive. The carburetor includes additional passages by-passing the carburetor throttle valve and means to adjust an air-fuel ratio and amount of a fuel mixture to be supplied to the engine during the idle operation.

2 Claims, 2 Drawing Figures



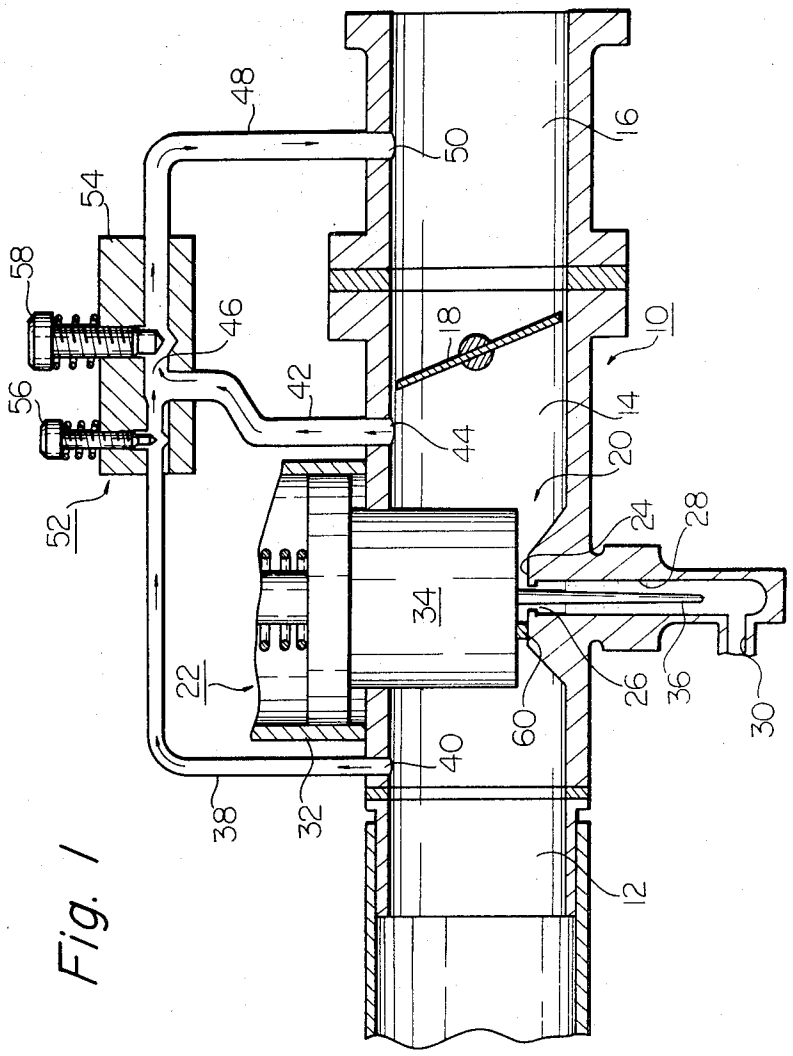


Fig. 1

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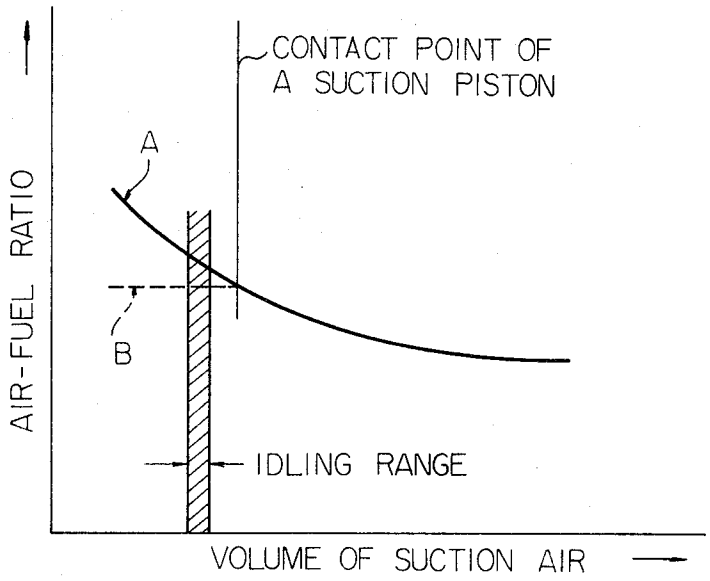
Fig. 2



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CARBURETOR OF VARIABLE-AREA VENTURI TYPE

This invention relates to a carburetor of the variable-area venturi type for an automotive internal combustion engine, and more particularly to an improvement in a carburetor of such type and adapted to supply the engine with a fuel mixture of a selected air-fuel ratio by changing the effective sectional area at the venturi in accordance with the variation in the vacuum existing downstream of the venturi of the carburetor.

In a conventional carburetor of the variable-area venturi type, a throttle valve is substantially closed during idle operation or under a light engine-load condition so that there exists little or no suction around the venturi. This causes the effective sectional area at the venturi to decrease, thereby increasing the velocity of air flowing therethrough. Under this condition, an excess liquid fuel is drawn from the fuel jet, and the fuel mixture to be supplied to the engine becomes too rich, with the result that the engine discharges a large quantity of unburned gases containing noxious hydrocarbons into the atmosphere.

The air-fuel ratio of the air-fuel mixture for the idling operation is controlled, in the conventional carburetor of the variable-area venturi type, by changing the position of the fuel jet relative to the jet needle. Such position of the nozzle critically dictates the air-fuel ratios during engine operating conditions other than idling so that it is extremely difficult to supply the engine with a fuel mixture of an optimum air-fuel ratio during the idle operation without scarificing the air-fuel ratios optimum for other operating conditions.

The present invention therefore contemplates to eliminate this and other drawbacks that are inherent in the carburetor of the variable-area venturi type and it is an object of this invention to provide an improved carburetor adapted to control the air-fuel ratio of the fuel mixture to be supplied to the engine during the idle operation in an economical and simplified manner thereby to preclude the emission of the unburned hydrocarbons from the engine without substantial sacrifice to the air-fuel ratios during other operating conditions of the engine.

In the accompanying drawings:

FIG. 1 is a schematic sectional view of a carburetor of the variable-area venturi type incorporating the improvements according to the invention; and

FIG. 2 is a graph illustrating a typical example of the relationship between the volume of suction air and the air-fuel ratio of the air-fuel mixture, which is attained in the embodiment shown in FIG. 1.

Referring now to FIG. 1, a carburetor of the variable-area venturi type incorporating the improvements according to the invention is generally indicated by reference numeral **10**. As shown, the carburetor **10** includes as customary a main air passage **12** leading from the open air, a main upstream mixture passage **14** communicating with the main air passage **12**, a main downstream mixture passage **16** leading to an intake manifold (not shown) of the engine, a throttle valve **18** adapted to control the flow of an air-fuel mixture to be supplied to the engine via the mixture passages **14** and **16**, and a venturi **20** including a flow regulating means **22** and a constriction or bridge **24**. The carburetor **10** also includes a fuel jet **26** for supplying a liquid fuel into the mixture passage **14**. A liquid fuel supply passage **28** terminates in the fuel jet **26** at the venturi **20** of the carburetor **10**. The fuel supply passage **28** communicates through a passage **30** with a float chamber (not shown). The flow regulating means **22** comprises a casing **32** and a movable suction piston **34** of known construction. A jet needle **36** extends from the bottom wall of the suction piston **34** and is inserted through the fuel jet **26** into the fuel supply passage **28**. The jet needle **36** is tapered toward its tip for continuously changing the amount of fuel to be admitted into the venturi **20** as the suction piston **34** and accordingly the jet needle **36** move upwardly and downwardly in response to the fluctuations in the intake manifold to thereby vary the effective venturi area into which the liquid fuel is drawn from the fuel jet **26**.

During the idle operation, as shown in FIG. 1, the throttle valve **18** is substantially kept closed so that the atmospheric pressure obtains upstream of the throttle valve **18**, causing the suction piston **34** to approach the constriction or bridge **24** to limit the flow of air through the venturi **20**. In this instance, the velocity of air flowing through the effective sectional area of the venturi **20** increases with the result that the excess liquid fuel is caused to be drawn from the fuel supply passage **28** into the main upstream mixture passage **14**. Thus, the fuel mixture is enriched and the amount of unburned or partially burned fuel mixture content of the engine exhaust emission is increased during the idle operation due to the incomplete combustion.

In order to supply the engine with the fuel mixture of an optimum air-fuel ratio during the idle operation, this invention proposes to provide on the carburetor an auxiliary air passage **38** which has its inlet port **40** open to the main air passage **12**, an auxiliary primary mixture passage **42** having its inlet port **44** open to the main upstream mixture passage **14** and communicating with the auxiliary air passage **38** at a junction **46** as shown, and an auxiliary secondary mixture passage **48** leading from the junction **46** and having its outlet port **50** open to the main downstream mixture passage **16** or, where desired, to the intake manifold of the engine. The passages **38**, **42** and **48** thus meet each other at the junction **46** where the air drawn from the main air passage **12** through the auxiliary air passage **38** is mixed with the fuel mixture delivered from the main upstream mixture passage **14** and the resultant air-fuel mixture is passed over to the main downstream mixture passage **16** through the auxiliary secondary mixture passage **48**.

For regulating the flow of air through the passage **38** and the flow of fuel mixture through the passage **48**, a flow control unit, generally represented by numeral **52**, is interposed between the passages **38** and **48**.

The flow control unit **52** comprises a casing **54** and an air flow adjusting means **56** to control the flow of the air passing through the passage **38**, and a fuel mixture flow adjusting means **58** to control the flow of the fuel mixture passing through the passage **48**. These adjusting means **56** and **58** are herein shown as adjustable screws by way of example.

The flow control unit **52** is thus adapted to control both the air-fuel ratio and the amount of the fuel mixture to be supplied to the engine during the idle operation. The air flow adjusting screw **56** controls the amount of air supplied to the junction **46** where the air delivered from the main air passage **12** is mixed with the fuel mixture delivered from the main upstream mixture passage **14** into a relatively lean fuel mixture. The fuel mixture produced at the junction **46** is metered by the screw **58** and admitted into the intake manifold of the engine through the port **50** and the main downstream mixture passage **16**.

When, in operation, the throttle valve **18** is substantially closed during the idle operation or under a light engine-load condition, a high vacuum develops downstream of the throttle valve **18** so as to cause a pressure difference across the throttle valve **18**. This causes the air in the main air passage **12** to pass through the port **40** and the passage **38** to the junction **46**. Since, on the other hand, an atmospheric pressure obtains upstream of the throttle valve **18**, the suction piston **34** approaches the constriction **24**, decreasing the effective sectional area at the venturi **20**. The air is passed through the venturi **20** into the mixture passage **14**, so that the liquid fuel is drawn from the fuel supply passage **28** into the mixture passage **14** and mixed with the air therein.

It is important in this instance that the throttle valve **18** be completely or substantially fully closed so as to cause the fuel mixture to pass completely through the passage **48** in an optimum volume and at an optimum mixture ratio into the intake manifold of the engine during the idle operation for thereby eliminating the emission of the noxious unburned hydrocarbons.

During the idle operation, as previously mentioned, the flow rate of the fuel mixture through the venturi **20** is so low that,

when the flow rate of the air through the passage **38** is increased by turning the screw **56**, the flow of air passing through the venturi **20** further decreases and accordingly the suction piston **34** further approaches the constriction **24**. At this instant, an excess liquid fuel is drawn from the fuel supply passage **28** into the main upstream mixture passage **14**, whereby the fuel mixture is excessively enriched as shown by the curve A in FIG. **2**.

To avoid such a difficulty, a stop **60** may be mounted on the constriction **24**. The stop **60** is adapted to limit the movement of the suction piston **34** whereby the air is permitted to pass through the venturi **20** at a limited, constant rate once the suction piston **34** has abutted against the stop **60** for thereby maintaining the air-fuel ratio at a constant level as shown by broken line B in FIG. **2**. The air-fuel ratio of the air-fuel mixture is thus adjusted by turning the screw **56** after the suction piston **34** has abutted against the constriction **24** so as to eventually eliminate the emission of the unburned hydrocarbons.

When the throttle valve **18** is moved toward open position during a high speed operation or under a heavy engine-load condition, the subatmospheric pressure prevailing downstream of the venturi **20** causes the suction piston **34** to move away from the constriction **24**, thereby increasing the flow of air and fuel through the venturi **20**. Thus, the engine is supplied with the fuel mixture of an optimum volume and an optimum mixture ratio during the high speed operation. Since, in this instance, the pressure difference between the main air passage **12** or the main upstream mixture passage **14** and the main downstream mixture passage **16** decreases as the open area of the throttle valve **18** increases, the amount of fuel mixture passing through the passage **48** decreases and accordingly exerts no significant influence on the performance efficiency of the engine during the high speed operation.

This will be accounted for by the fact that the hydrocarbon content which is about 7 percent where the conventional carburetor is used can be reduced to about 0.2 percent during the idle operation where the carburetor incorporating the improvement according to the present invention is used, and that the hydrocarbon content is reduced from 0.5 to 0.2 percent when the vehicle is driven at the speed of 60 km/h.

It will be appreciated from the foregoing that the air-fuel ratio is adjusted in an economical and simplified manner by turning the screw **56** during the idle operation for thereby eliminating the emission of the noxious hydrocarbon in the exhaust gases and that the air-fuel ratio determined to specifically suit the idle operation does in no way effect the power output of the engine when the vehicle is driven at high speeds or under heavy engine-load condition.

What is claimed is:

1. In a carburetor for an automotive internal combustion engine having a main air passage, a throttle valve, a venturi intervening between said main air passage and said throttle valve and including a constriction and a flow regulating means to continuously reduce the effective sectional area at the venturi as said throttle valve closes, a main upstream mixture passage intervening between said venturi and said throttle valve, a main downstream mixture passage positioned downstream of said throttle valve and leading to an intake manifold of said engine, and a fuel jet opening into said venturi and communicating with a fuel supply passage, the improvement comprising an auxiliary air passage leading from said main air passage, an auxiliary primary mixture passage leading from said upstream mixture passage, said auxiliary passages meeting each other at a junction whereby air drawn from said main air passage through said auxiliary air passage is mixed with a fuel mixture drawn from said upstream mixture passage through said auxiliary primary mixture passage, an auxiliary secondary mixture passage leading from said junction to said intake manifold through said main downstream mixture passage for supplying said fuel mixture to the engine, and a flow control means interposed between said auxiliary air passage and said auxiliary secondary mixture passage and including an air flow adjusting means provided in said auxiliary air passage to control the rate of air passing through said auxiliary air passage for determining an air fuel ratio of said fuel mixture and a fuel mixture adjusting means provided in said auxiliary secondary mixture passage for controlling the rate of said fuel mixture passing therethrough.

2. The improvement according to claim **1**, wherein said constriction has mounted thereon a stop to limit movement of said flow regulating means toward said constriction to permit air to pass through said venturi at a limited, constant rate for thereby preventing the supply of an excess liquid fuel from said jet during the idle operation.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,669,424 Dated June 13, 1972

Inventor(s) Shiobara et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet the following should be added:

[30] Foreign Application Priority Data

December 9, 1969 Japan.....44/98517

Signed and Sealed this

Nineteenth Day of October 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

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Commissioner of Patents and Trademarks