United States Patent [19]

Rock

[11] **3,865,907**

[45] **Feb. 11, 1975**

[54] **NEEDLE VALVE VAPOR INJECTION AND METHOD**

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[22] Filed: **Oct. 9, 1973**

[21] Appl. No.: **404,468**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 324,465, Jan. 17, 1973, abandoned, which is a continuation of Ser. No. 231,988, March 6, 1972, abandoned, which is a continuation-in-part of Ser. No. 60,552, Aug. 3, 1970, abandoned.

[52] **U.S. Cl.** ..... **261/18 A,** 123/25 L, 261/30, 261/41 D, 261/DIG. 38

[51] **Int. Cl.** **F02m 25/02**

[58] **Field of Search** ..... 123/25 L; 261/30, 18 A, 261/41 D, DIG. 38

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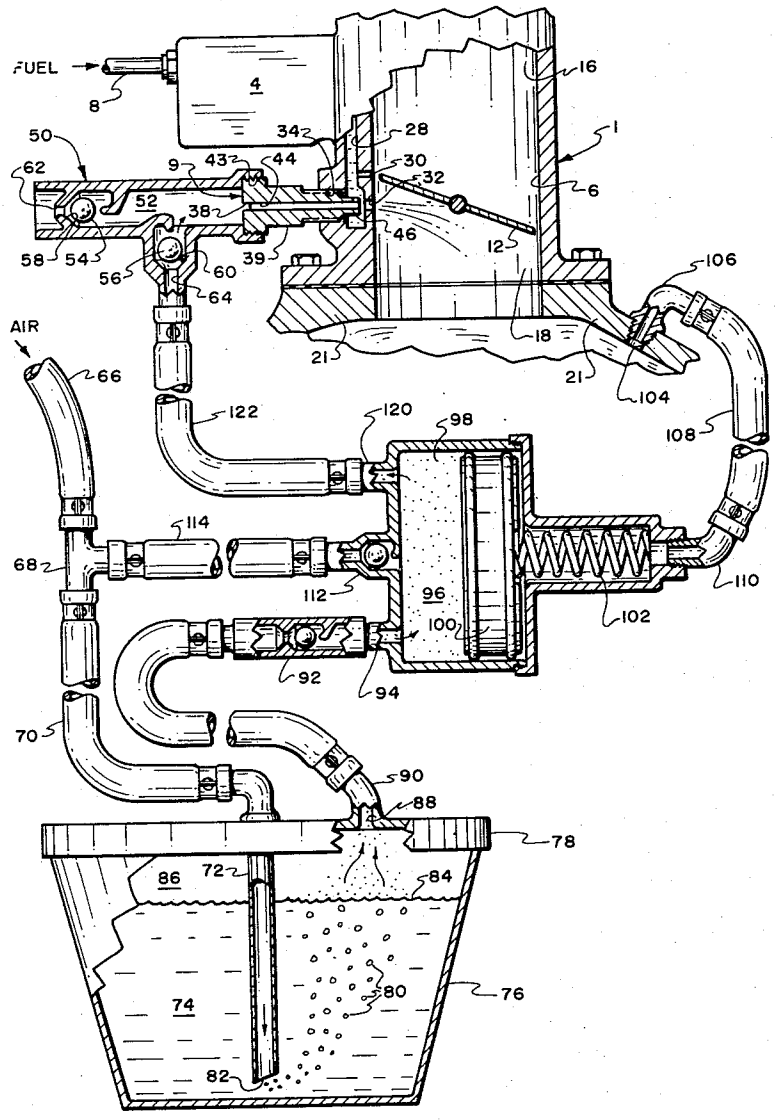
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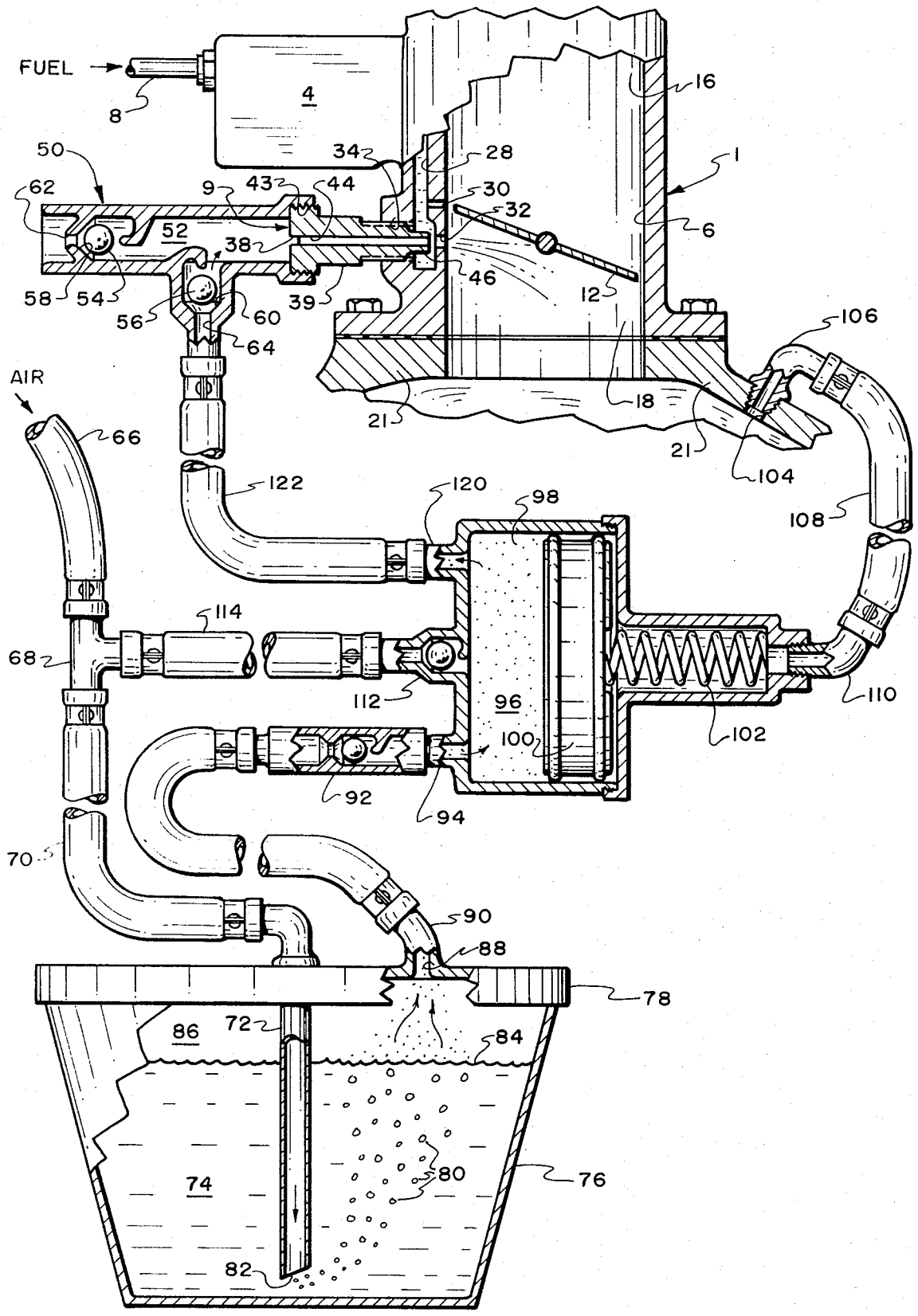
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[57] **ABSTRACT**

A needle valve vapor injection system for use in connection with the idle port of a carburetor, said injection system causing vaporization of a liquid comprising water using influent air and thereafter loading a charge of the resulting vapor into a cylinder under force of a vacuum-driven piston. The vapor charge is discharged from the cylinder by the piston when the vacuum pressure is low, passing through the needle valve and issuing with atomized fuel into the carburetor barrel to alleviate NOX. The needle valve has an unobstructed passage extending axially completely through the needle valve to permit movement of said vapor charge during low vacuum at the intake manifold movement of air at atmospheric pressure through said passage into the barrel during normal vacuum.

7 Claims, 1 Drawing Figure




FUEL
8
4
16
1
50
62
34
28
9
43
44
30
32
52
38
6
58
54
56
60
39
46
12
64
106
AIR
66
18
21
21
104
122
120
98
108
114
68
112
96
110
102
100
92
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70
90
88
78
86
72
84
74
80
76
82

NEEDLE VALVE VAPOR INJECTION AND METHOD

BACKGROUND

Continuity

This application is a continuaton-in-part of application Ser. No. **324,465,** filed Jan. **17, 1973** and now abandoned, which is a continuation of application Ser. No. **231,988,** filed Mar. **6, 1972** and now abandoned, which is a continuation-in-part of application Ser. No. **60,552,** filed Aug. **3, 1970** and now abandoned.

FIELD OF INVENTION

This invention relates to internal combustion engines and is particularly directed to means for controlling the mixture of fuel-and-air and/or air-fuel-and-vapor delivered through the carburetor to the intake manifold of an internal combustion engine.

PRIOR ART

As is well known, carburetors are employed with internal combustion engines to provide an appropriate mixture of fuel and air for combustion within the engine. Conventionally, at most operating speeds, fuel is drawn through the main jet or jets of the carburetor into the throat, by the action of the air flowing past the Venturi, and the ratio of fuel to air is determined by the position of the butterfly valve in the throat of the carburetor. At idle speeds, the butterfly valve is closed so that only a fixed, minimum amount of air flows through the throat of the carburetor. However, this minimum amount of air does not create enough vacuum, in passing the Venturi, to draw sufficient fuel to support combustion. Therefore, it is customary to provide an idle port in the carburetor throat having a needle valve therein which is adjustably positionable to allow a desired amount of gas to trickle down the wall of the carburetor throat and into the engine. This is caused by the restriction of the idle screw itself. Since this gas is not drawn into the air flow, it does not become completely mixed with the air and some of the gas is delivered to the motor in liquid form. As a result, when combustion occurs in the cylinders, the gas does not burn uniformly or completely. Thus, "hot spots" are created which tend to burn valves and the products of the incomplete combustion are passed out through the exhaust to pollute the atmosphere.

Even when the engine is not idling, gas is allowed to trickle through the idle port and, hence, causes the improper combustion described above at all speeds. This is wasteful of gas and, as noted above, causes serious pollution of the atmosphere. In recent years, there has been growing concern over such pollution and numerous techniques have been proposed to reduce such pollution. However, most of the prior art techniques have been ineffective or have required complicated or expensive modification of the engine. Thus, it has been proposed to recycle a portion of the exhaust through the intake to cause the products of incomplete combustion to be reburned. In addition, numerous devices have been proposed for filtering the exhaust. However, none of the prior art techniques have been entirely satisfactory.

In addition, effective and economical ways of alleviating NOX have not been proposed by the prior art.

BRIEF SUMMARY AND OBJECTS OF INVENTION

These disadvantages of the prior art are overcome with the present invention and means are provided for assuring proper mixing of idle gas with the air flowing through the throat of the carburetor at all speeds and accommodates vapor injection using vacuum pressure variations of the intake manifold, thereby greatly reducing air pollution and effecting significant savings in gas usage. Furthermore, the implementation of the present invention is simple and inexpensive to install and requires virtually no maintenance.

The advantages of the present invention are preferably attained by providing a vapor injection system using a needle valve at the idle port, the needle having an unrestricted passage extending completely through the needle valve to permit free flow of air, driven by atmospheric pressure to atomize and blow idle gas into the air stream flowing through the throat of the carburetor during normally high intake manifold vacuum and also infusion of vapor laden air-fuel during periods of engine acceleration when intake manifold vacuum pressure is relatively low, whereby NOX production is greatly alleviated. Other products of incomplete combustion are reduced in amount and gasoline mileage is improved.

Accordingly, it is an object of the present invention to provide a method and apparatus for reducing air pollution by internal combustion engines.

Another object of the present invention is to provide a method and apparatus for improving the gas consumption of internal combustion engines and reducing undesired products of combustion, including NOX.

A further object of the present invention is to provide a method and apparatus for introducing a charge of vapor into the carburetor of an engine during acceleration.

An additional object of the present invention is to provide a method and apparatus for assuring introduction of a vapor/fuel/air mixture into the carburetor of an engine during acceleration.

These and other objects and features of the present invention will be apparent from the following detailed description, taken with reference to the accompanying drawing.

BRIEF DESCRIPTION OF DRAWING

The FIGURE is a partial vertical section through the carburetor and intake manifold of an engine and also illustrating one presently preferred embodiment according to the present invention.

DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENT

In that form of the present invention chosen for purposes of illustration, the FIGURE shows part of a carburetor, indicated generally at **1,** having a float housing **4** and a barrel **6.** The float housing **4** receives fuel from a suitable tank, not shown, through fuel line **8** under the control of a float (not shown) which is within the housing **4.** The barrel **6** is, essentially, an open-ended cylinder which receives air at its upper end **16** and delivers a mixture of air and fuel or of air, fuel and vapor through its lower end **18** into an intake manifold **21** of an internal combustion engine. The barrel **6** may be provided with a Venturi cross section, if desired.

Fuel in the float housing passes under atmospheric pressure into an idle fuel passage **28.** Fuel exits from the chamber **28** through a pair of idle ports **30** and **32** which communicate with the barrel **6** adjacent a butterfly valve **12.** Fuel flows under force of gravity through idle ports **30** and **32** into the barrel **6.** The rate of fuel flow through the idle ports **30** and **32** is controlled by a needle valve **9** threadedly disposed in an internally threaded opening **34,** of greater diameter than the idle port **32.** The needle valve **9** can be adjusted in the threaded bore **34** to control fuel discharge at port **32,** including completely closing the idle port **32.** The needle valve **9** is formed with a slotted head **38** which permits initial adjustment of the needle valve **9** and with an octagonal face at **39** for subsequent wrench adjustment. Thus, the rate of flow of fuel through the idle port **32** into the barrel is regulated. However, the idle ports **30** and **32** usually communicate with the barrel **6** in a lower region **40** of the carburetor **1.** Consequently, fuel introduced into the barrel **6** through the idle port **32** would, without the needle valve **9,** trickle down the wall of the barrel **6** in liquid form.

The needle valve **9** comprises a passage **44** of uniform cross section extending axially in unobstructed fashion, completely through the needle valve **9** from the head **38** to the tip **46.** As is well known, internal combustion engines are run on air at atmospheric pressure, 14.7 pounds per square inch and the needle valve **9** creates air speeds of 400 feet per second more or less through the passage **44** and idle port **32** and serves to drive the fuel away from the wall and well into the barrel **6** as an atomized spray. This provides more uniform burning of the air-fuel mixture which tends to eliminate "hot spots" and the resultant damage to the engine. Consequently, the engine performs better and requires less maintenance. In addition, gas mileage is improved approximately 40%.

The outer periphery **43** of the needle valve head **38** is threaded for connection to a T-shaped dual check valve **50.** The check valve **50** comprises a central chamber **52** together with a pair of balls **54** and **56** which respectively seat at **58** and **60** during low intake manifold vacuum and high intake manifold vacuum respectively. The influent orifice **62** introduces air into the chamber **52** and through the bore **44** of the needle **9** during normal operation while the secondary orifice **64** introduces a vapor charge into the chamber **52** and through the central bore **44** of the needle **9** during acceleration where the vacuum of the intake manifold is low.

Vapor charge is obtained by introducing air along hose **66,** obtained from the air cleaner, through a T **68,** a hose **70** and a bubble tube **72** into the lower regions of a liquid **74** which comprises water and may also include alcohol.

The liquid **74** is held in a vapor container **76,** the top of which is entirely enclosed by lid **78,** except for the herein mentioned access openings. The air issuing from the end **82** of tube **72** in the form of bubbles **80** lift to the surface **84** of the liquid **74** there carrying some of the liquid into the space **86,** which combination of air and liquid is hereinafter referred to as vapor.

Vapor from space **86** is displaced through lid port **88,** hose **90,** check valve **92** and port **94** into the chamber **96** of cylinder **98.**

A free piston **100** is disposed within the cylinder **98** and moves reciprocably left and right within the chamber **96.** The piston **100** is urged toward the left as shown in the FIGURE by a return spring **102** and toward the right by vacuum pressure originating at intake manifold **21,** which is communicated through port **104,** elbow **106,** hose **108,** and adapter **110** and is effective against the right side of the piston **100.** A value of the spring **102** is selected such that the negative or vacuum pressure from the intake manifold during normal cruising conditions of the engine will create a greater force toward the right than the spring **102** creates towards the left and, thus, the piston will be in the position illustrated in the FIGURE. Left to right movement of the piston will fill the left portion of the chamber **96** of the cylinder **98** with vapor from vapor container space **86** as mentioned, with a relief valve **112** serving to communicate air per se through hose **114** also into the left portion of the chamber **96.** In this fashion, the chamber **96** is charged with adequate vapor preparatory to injection into the carburetor **1.**

Injection occurs during engine acceleration at which time the vacuum at the intake manifold **21** decreases such that the vacuum force from the intake manifold on the piston **100** is less than the force of spring **102.** Thus, the free piston **100** moves from right to left discharging the charge of vapor from chamber **96** through elbow **120,** hose **122** through the secondary orifice **64** of the check valve **50** into the chamber **52** and through the bore **44** of the needle valve **9,** resulting in a fuel-/air/vapor atomized spray being issued into the barrel **6** of the carburetor **1.** This greatly reduces unburned products of combustion, particularly NOX, since such are normally created during points in time of high engine temperature and acceleration. Improved fuel economies are also obtained.

Obviously, numerous variations and modifications may be made without departing from the present invention. Accordingly, it should be clearly understood that the form of the present invention described above and shown in the accompanying drawing is illustrative only and is not intended to limit the scope of the invention.

What is claimed is:

1. In combination:

a carburetor having a barrel communicating with an intake manifold and a fuel passage and idle port communicating fuel to the barrel, said port being in the wall of the carburetor;

a threaded bore of greater diameter than the port axially aligned with the port, the threaded bore spanning between the port and the exterior of said carburetor;

a threaded needle valve adjustably received in said threaded bore and comprising a distal end portion seatable against said wall around said port to close said port, and external means at or near the exposed proximal end of the needle valve for adjusting the spacing of said distal end from the wall, said needle valve further comprising a central axial passageway through the entire needle;

means delivering a charge of vapor comprising water through the axial passageway of the needle valve into the carburetor at predetermined engine conditions.

2. The combination of claim **1** wherein said means for delivering the charge of vapor comprises:

means initially creating vapor by bubbling air through liquid;

two way vapor displacing means;

means selectively communicating vapor from said creating means via the displacing means through the passageway of the needle valve;

means interposed between the displacing means and the engine whereby low vacuum pressure at the engine causes said displacing means to express a charge of vapor into the carburetor via the passageway of the needle valve.

3. The combination of claim **2** wherein the creating means comprise:

a container with liquid therein and a space above the liquid;

air delivery means interposed between the air cleaner of the engine and the container, the effluent end of the air delivery means being submerged within the liquid whereby air bubbles vaporize liquid into said space.

4. The combination of claim **2** wherein the displacing means comprise vapor influent conduit means, vapor effluent conduit means and accumulator means interposed between said two conduit means, said accumulator means comprising a vapor storage chamber and a piston reciprocably disposed within the chamber, said accumulator means further comprising means communicating vacuum pressure from the engine to one side of the piston and bias means applying force to the piston counter to said vacuum force, said bias force being of a magnitude intermediate the extremes of said vacuum pressure whereby a charge of vapor is loaded into the chamber by piston displacement in one direction while vacuum pressure is relatively high and a loaded charge of vapor is expressed from the chamber by piston displacement in the opposite direction while vacuum pressure is relatively low.

5. The combination of claim **2** wherein said interposed means comprise dual check valve means communicating air through the dual check valve means and the passageway of the needle valve during high vacuum and vapor during low vacuum.

6. The combination of claim **1** wherein the delivering means comprise means selectively displacing vapor to and through the passageway of the needle valve and means communicating engine vacuum pressure, the magnitude of which varies, to the selectively displacing means causing said vapor displacement to occur at low vacuum only.

7. A method of alleviating NOX discharge from an intermal combustion engine, comprising the steps of:

providing a source of vapor comprising water;

displacing a charge of vapor from said source to storage responsive to engine suction of a relatively high magnitude;

storing said vapor charge so long as said engine suction is high and at the same interval of time introducing air through a needle valve into the interior of the carburetor to atomize fuel;

issuing said vapor charge from storage through the needle valve and into the interior of the carburetor responsive to engine suction of a relatively low magnitude occurring during engine acceleration.

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