

- [54] CARBURETOR WITH AUTOMATIC
AIR-FUEL RATIO ADJUSTMENT CONTROL

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- [52] **U.S. Cl.**..... **261/44 R; 261/DIG. 74**

- [51] **Int. Cl.²** **F02M 9/06**

- [58] **Field of Search**..... 261/44 R, DIG. 74;
123/32 EA

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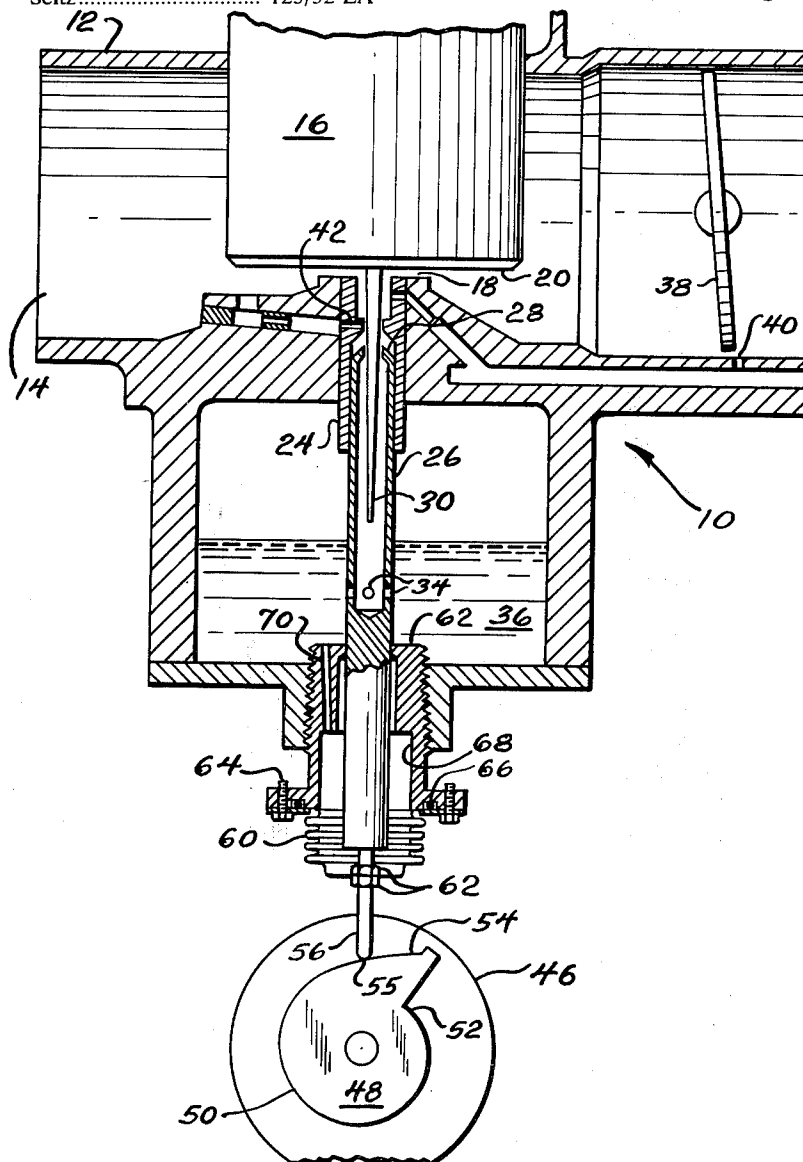
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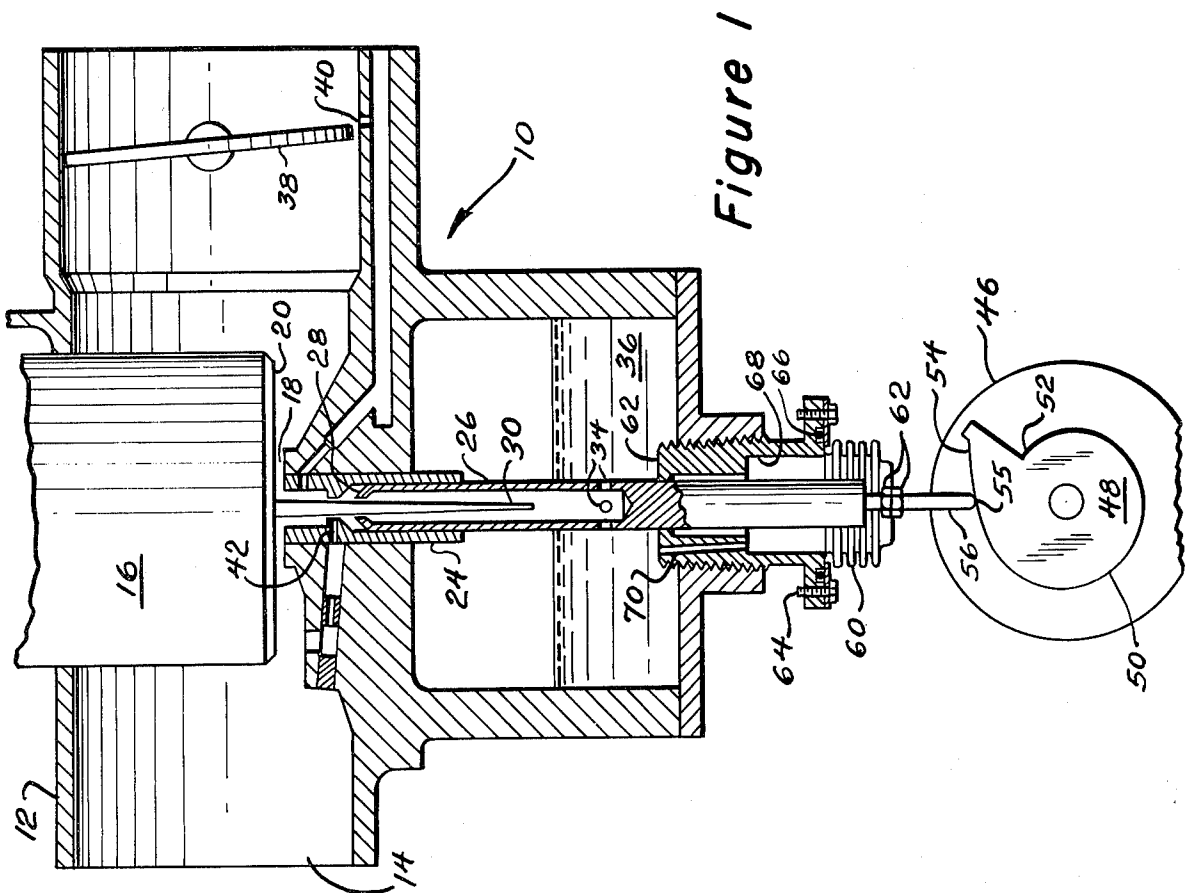
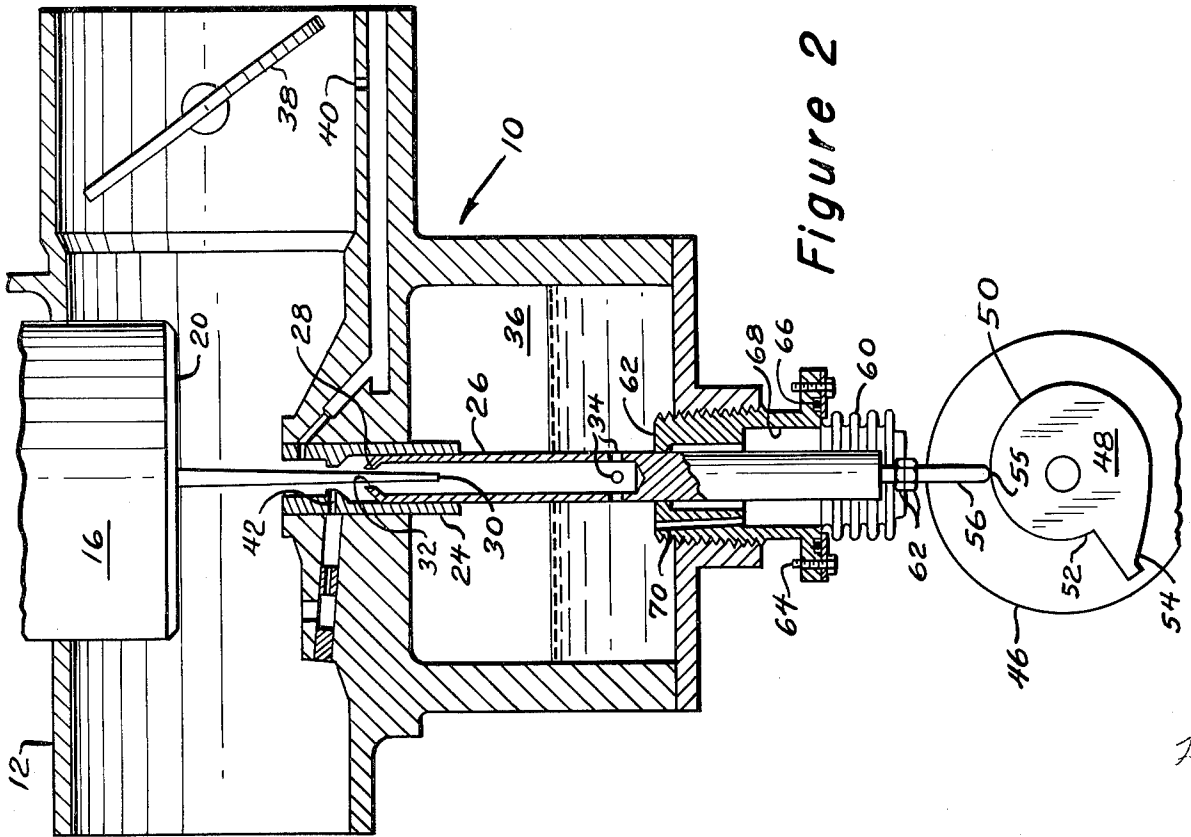
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ABSTRACT

Improved carburetor of the constant depression type incorporates an automatically adjustable seat for the main jet fuel valve. The seat is reciprocated by a rod which is actuated externally of the carburetor housing by a cam. The cam is actuated by a servo motor in response to intermittent electrical signals produced by a closed loop control system when the oxygen content of the exhaust gases varies from stoichiometry or from any other desired value. A bellows assembly seals the rod relative to the housing and also biases the rod into contact with the cam.

5 Claims, 2 Drawing Figures





CARBURETOR WITH AUTOMATIC AIR-FUEL RATIO ADJUSTMENT CONTROL

BACKGROUND OF THE INVENTION

The invention relates to the field of automotive engine emissions controls and particularly to devices for varying the air-fuel ratio of the mixture entering the engine in response to changes in the character of the exhaust gases. Carburetor type fuel supply devices for automotive engines are generally recognized as being simpler and less costly than fuel injection devices. However, the latter have been found to be more easily adapted for use with closed loop control systems which sense the oxygen concentration of the exhaust gases and use the voltage signal developed by a deviation from the stoichiometric oxygen percentage, as measured by an oxygen sensor, to electronically vary the fuel flow. For example, such a device might utilize electronic pulse actuated solenoid injectors where the width of the pulses are varied in response to the oxygen sensor voltage signal.

Countless carburetors have been designed over the years, but to date, it appears that none of them has been able to provide a truly uniform mixture to the cylinders which has a constant air-fuel ratio over the entire range of engine operating conditions. The constant depression type of carburetor is perhaps one of the best designs in that it adjusts the fuel flow by using a cylinder and piston to move the main fuel jet needle and vary the size of the air passage past the fuel jet to achieve a constant pressure difference across the fuel jet. Although the constant depression type of carburetor provides a fairly constant mixture, it cannot begin to approach the accuracy required to achieve a stoichiometric, or other desired air-fuel mixture at all times. In a stoichiometric mixture, there is exactly enough air to cause complete combustion of the fuel. When the mixture leaving the exhaust manifold is stoichiometric, or preferably, just on the rich side of stoichiometry, the amount of exhaust pollutants, CO, HC and NO_x, present will be at a minimum. As previously mentioned, the stoichiometry of the exhaust gases can be maintained by controlling the air-fuel ratio closely with a closed loop control system utilizing an oxygen sensor. An example of such a system is disclosed in co-pending application Ser. No. 436,559, filed Jan. 25, 1974 which is a continuation-in-part of Ser. No. 286,650, filed Sept. 5, 1972 and now abandoned.

SUMMARY OF THE INVENTION

It is among the objects of the present invention to provide a means to automatically and rapidly adjust the air-fuel ratio of a carburetor in response to changes in the character of the exhaust gases detected by repeated samplings of the gas.

The adjustment of the air-fuel ratio is made by continuously moving or adjusting the valve seat of the main fuel jet in a constant depression type of carburetor. The adjustment is made in steps by a stepping motor which rotates an eccentric cam. The stepping motor can make angular cam adjustments of varying size, such as from 1/2° to 10°, depending on the difference between the voltage produced by a solid electrolyte oxygen sensing cell in contact with the exhaust gases and a set point voltage. For example, a voltage difference in excess of 50 mv can be made to provide a maximum 10° adjustment whereas a voltage just in excess of a deadband

voltage of 2-5mv can be made to provide a 1/2° adjustment. These voltage levels can of course be changed and form no part of the present invention. The dead-band voltage is provided to reduce hunting when the measured voltage is extremely close to the desired voltage.

The valve seat of the main fuel jet needle valve is mounted for axial sliding movement and is biased away from the needle portion of the valve and into contact with the cam and sealed relative to the carburetor housing by a thin beryllium copper bellows. Although the principal adjustment in the air-fuel ratio is provided by the carburetor's vacuum actuated piston and cylinder which moves the needle valve up and down in response to vacuum conditions in various portions of the carburetor, the movable mounting for the valve seat permits additional adjustments to be made which will achieve a minimum of exhaust pollutants.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary cross-sectional side view of a constant depression carburetor having an adjustable seat for the main jet which can be continuously adjusted during engine operation and showing the carburetor in an idle mode; and

FIG. 2 is a view similar to FIG. 1 except that the carburetor is depicted in a cruise mode.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a conventional constant depression type carburetor 10, such as a Zenith, is depicted fragmentarily. The carburetor 10 includes a body 12 having an inlet opening 14. An air control plunger valve 16 is moved up and down in response to pressure changes on opposite sides of a controlling diaphragm member (not shown) to vary the size of the air passage 18 beneath the lower surface 20 of the plunger valve 16. An insert guide sleeve 24 is pressed into body member 12 where it provides linear guiding for the tubular needle valve seat member 26 which has a needle seat portion 28 at its upper end. The needle seat portion 28 cooperates with the fuel jet needle member 30 carried by plunger valve 16 to vary the size of the orifice 32 between the needle and seat so as to control the amount of fuel which is drawn through holes 34 from fuel bowl 36. In the position shown in FIG. 1 the throttle plate 38 is shown in its closed position corresponding to an idle mode of operation of the engine (not shown). In this mode, sufficient fuel for operation is provided by the idle fuel port 40 which bypasses the throttle plate 38. An additional port 42 in the vicinity of the orifice 32 communicates with the atmosphere and serves to apply a pressure to the fuel bowl 36 which prevents excess fuel from being sucked into the engine as the engine decelerates.

The aforementioned conventional structure is modified by the present invention so that the needle seat 28 and tubular member 26 can be quickly and constantly adjusted during engine operation to adjust the air-fuel ratio in order to minimize the amounts of exhaust pollutants entering the atmosphere. This adjustment is accomplished by means of a transducer, such as a one-revolution stepping motor 46, which periodically rotates eccentric cam 48 in small angular rotational steps in accordance with an electrical signal applied to the transducer by the variation of the oxygen level of the

exhaust gases from a desired set-point. The electrical signal can be provided by a control system such as that disclosed in the aforementioned copending application.

The cam 48 is incrementally adjusted by motor 46 so that various contact points along its cam surface 50 from its low end 52 to its high end 54 are brought into contact with end contact portion 55 of follower member 56. Follower member 56 will move up or down correspondingly since it is biased into contact with the cam surface 50 by means of a corrugated resilient beryllium copper bellows member 60 to which it is attached by nuts 62. The bellows member 60 permits vertical movement of tubular member 26 and the needle valve seat 28 while sealing against any leakage of gasoline from fuel bowl 36. The bellows 60 is sealed to a lower valve seat guide member 62 by means of a plurality of screws 64 and an O-ring 66. To prevent any compression of fluid within the chamber 68 formed within the guide member 62, a passage 70 is provided to permit fuel to be returned to fuel bowl 36 as the bellows 60 is compressed.

Whereas FIG. 1 shows the carburetor 10 with its throttle plate 38 closed and its air plunger 16 in a position for idle operation, the FIG. 2 position of these members is more representative of cruise operation. Although the needle valve seat 28 is shown further down in FIG. 2 than in FIG. 1, and thus in a position to admit more fuel, the position at any one moment could vary widely depending upon the instantaneous composition of the exhaust gases.

I claim as my invention:

1. Apparatus for continuously adjusting the air-fuel ratio of a carburetor of the type having a fuel bowl, a

tubular main fuel jet valve seat mounted in the fuel bowl and a tapered main fuel jet needle valve mounted to move within said tubular main jet valve seat and axially relative thereto to vary the flow of fuel from said jet, said apparatus comprising means for mounting said tubular main fuel jet valve seat for rapid reciprocatory movement along its axis, said mounting means including resilient means comprising a corrugated bellows member for biasing said tubular main jet valve seat in one direction relative to the tapered main jet needle, said mounting means further including a contact portion positioned externally of said fuel bowl and adapted when contacted to move said tubular main jet valve seat in an opposite direction and against the bias of said resilient means, and means periodically operative in response to an electrical signal indicative of a desired change in the air-fuel ratio of the carburetor to contact said contact portion and either drive said tubular main jet a predetermined distance in said opposite direction or permit said resilient means to move said tubular main jet a predetermined distance in said one direction.

2. The apparatus of claim 1 wherein said periodically operative means comprises a movable cam surface.

3. The apparatus of claim 2 wherein said movable cam surface is driven by a stepping motor.

4. The apparatus of claim 2 wherein said cam surface is eccentrically positioned about a movable shaft.

5. The apparatus of claim 1 wherein said contact portion is on the end of a rod which passes through the bellows member and is firmly affixed to the bellows member for movement therewith and to the tubular main jet valve seat.

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