

[54] APPARATUS FOR REDUCING SMOG
PRODUCING EMISSION FROM INTERNAL
COMBUSTION ENGINES

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123/140 MC; 60/276

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UNITED STATES PATENTS

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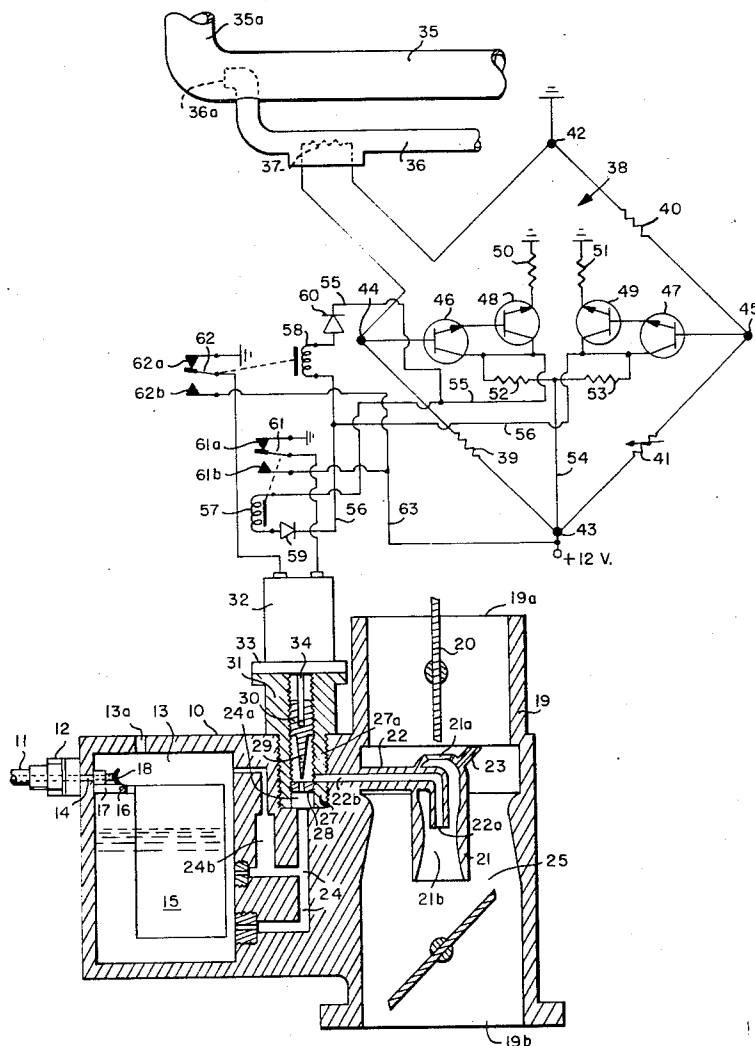
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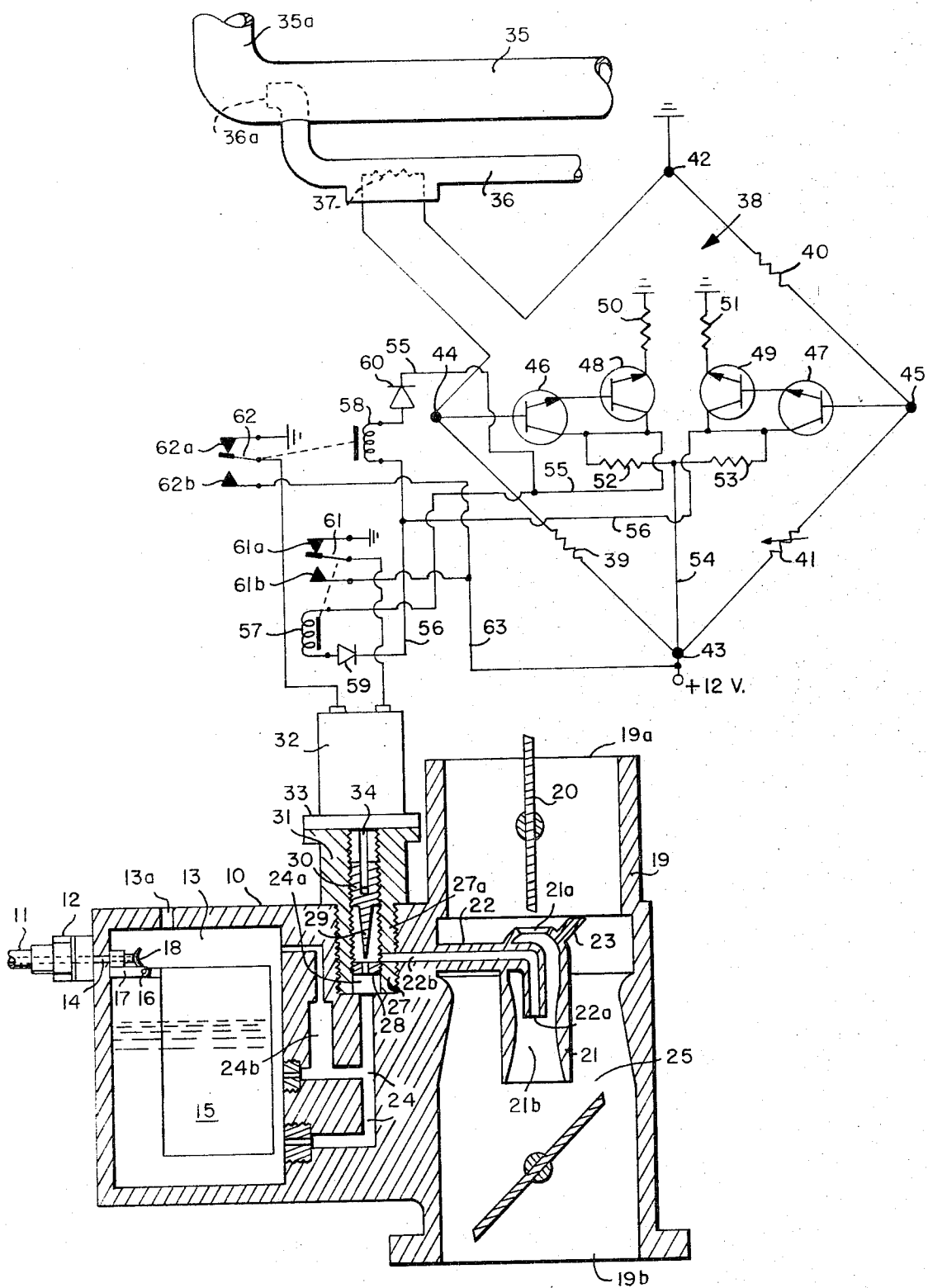
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[57] ABSTRACT

A smog control provided with a heat sensor that is exposed to the exhaust gases of an internal combustion engine. Means is also provided for recirculating a portion of the exhaust gases back through the engine. The carburetor is provided with a needle valve that is operated by an electric motor. The heat sensor resistor forms one leg of a Wheatstone bridge which is normally balanced. Electronic controls are connected to the bridge to control the energization of the electric motor so that the motor either opens or restricts the needle valve to increase or decrease the fuel air ratio to the engine in response to the unbalancing of the Wheatstone bridge by the heat sensor resistor.

5 Claims, 1 Drawing Figure





APPARATUS FOR REDUCING SMOG PRODUCING EMISSION FROM INTERNAL COMBUSTION ENGINES

DESCRIPTION OF THE INVENTION

This invention relates to apparatus for reducing the smog producing exhaust emission of an internal combustion engine by controlling with solid state electronics the fuel-air ratio to the engine in accordance with the thermoconductivity of the engine exhaust gases and/or the catalytic reactions of these gases with appropriate sensors.

An object of this invention is to provide an improved apparatus for reducing smog producing exhaust emission.

Another object of this invention is to provide an improved control for controlling the fuel-air ratio to the internal combustion engine.

Another object of this invention is to provide an improved arrangement for reducing the smog producing exhaust emission by controlling the fuel-air ratio input to an internal combustion engine, said arrangement including an electric motor for operating the fuel valve in accordance with characteristics of the exhaust gases released by the internal combustion engine.

Still another object of this invention is to provide a system for controlling the feeding of fuel to an internal combustion engine in accordance with exhaust gas characteristics; said system including a heat sensor resistor subjected to the exhaust gases from the engine for producing signals supplied to an electronic circuit to control the energization of an electric motor that either increases or decreases the fuel-air ratio to the internal combustion engine depending upon said characteristics of the exhaust gas.

Other and further objects of this invention will be apparent to those skilled in the art to which it relates from the following specification, claims and drawing.

In accordance with this invention I have provided a system for reducing the smog producing exhaust emission of internal combustion engines. My system functions to control the feeding of fuel to an internal combustion engine depending upon the heat conductivity characteristic of the exhaust gas released from the engine. In this invention I employ a heat sensor resistor which is part of a Wheatstone bridge and is supported in the exhaust pipe of the internal combustion engine. Two such resistors are connected to the Wheatstone bridge and form opposing legs thereof. A variable resistor is connected into another leg of the bridge so that the bridge may be balanced with currents of the same values passing through both sides of the bridge whereby these resistors are normally heated to the same temperature. This bridge is similar to the Cambridge carbon iodide indicator and recorder as described on pages 117 and 118 of the book entitled "Testing of High Speed Internal Combustion Engines" by Arthur W. Judge, published in 1955. The resistance of the heat sensitive resistor located in the engine exhaust depends on the heat conductivity and hydrocarbon content of the exhaust gas media surrounding it which in the case of the exhaust gas of the internal combustion engine is a function of the composition of this gas. Any change in the composition of the exhaust gas results in an unbalance of the Wheatstone bridge and a signal is thus transmitted to the electronic controller connected to

this bridge to cause the energization of the electric motor which is provided for purpose of adjusting the needle valve controlling the fuel fed in the carburetor. Thus too much nitrous oxide, hydrocarbons or carbon monoxide in the exhaust gas causes the electronic circuit to energize the motor so that the valve feeding the fuel is restricted and fuel fed to the engine is controlled.

Further features and details of this invention will be set forth in the following specification, claims and drawing in which, briefly:

The sole FIGURE in the drawing illustrates one embodiment of this invention.

Referring to the drawing in detail reference numeral 10 designates the housing of a carburetor and a fuel line 11 connected thereto by the coupling 12 so that fuel is fed into the cavity 13 of the housing through the passage 14. A float 15 which is positioned in the cavity 13 is supported by the pivot pin 16 on the bracket 17. A valve member 18 is attached to the float 15 and this valve member is located adjacent to the inner end of the passage 14 so that when the float 15 is raised by the fuel in the cavity 13 it functions to press the valve member 18 against the inner end of the passage to prevent further fuel from being fed into the chamber until the fuel level therein decreases sufficiently so that the float is lowered. Thus, the valve member 18 is moved away from the sealing engagement with the inner end of the passage until the fuel level is again raised in the chamber 13.

The pipe 19 is attached to a side of the housing 10 or it may be made integral therewith as shown in the drawing. Air is fed into the inlet end 19a of the pipe 19 and the amount of air flowing into this pipe is controlled by the butterfly type valve 20 which is pivotally attached to the wall of the pipe. Suitable linkage (not shown) is provided to the valve 20 so that the valve may be either automatically or manually controlled. A fuel intake nozzle 21 is supported in the tube 19 by the tubular member 22 and the bracket 23. An opening 21a is provided in the upper end of the nozzle 21 and the portion 21b is constructed so that suction is produced at the mouth 22a of the tubular member 22 when air flowing through the nozzle 21 pass said mouth 22a. Thus, fuel is drawn out of the chamber 13 through the passages 24 and 22b and this fuel is discharged from the nozzle 21 into the compartment 25 to be mixed with air flowing through this compartment. The portion 24a of the passage 24 is enlarged to receive the threaded plug 27 which is provided with valve seat 28 that cooperates with the needle valve 29 so that the fuel flowing through passages 22b and 24 may be controlled by this needle valve.

The needle valve 29 is integral with the member 30 that is threaded into the member 31 which is integral with the threaded plug 27a. The housing of the motor 32 is provided with a flange 33 and a similar flange is provided to the upper part of the member 31 to which a motor flange is attached by suitable bolts (not shown). The motor 32 is provided with suitable reduction gearing for driving a spline shaft 34 at reduced speed. This spline shaft fits into a spline hole in the member 31 carrying the needle valve 29. Thus when the motor 32 is energized the shaft 34 thereof rotates the threaded plug 30 and moves this plug with respect

to the member 31 so that the needle valve 29 carried by the plug 30 is either advanced into the valve seats 28 or withdrawn therefrom. As a result the amount of fuel fed from the passage 24 and cavity 24a into the passage 22b is controlled.

The fuel mixture from the outlet 19b of the tube 19 is fed to the intake manifold of the internal combustion engine (not shown) and the exhaust gas from the internal combustion engine is fed to the pipes 35 and 36. For this purpose the inlet end 35a of the exhaust pipe 35 is connected to the exhaust manifold (not shown) of the engine and the inlet end 36a of the smaller exhaust pipe 36 is positioned in the larger exhaust pipe 35 to receive a small portion of the exhaust gas released from the exhaust manifold of the engine. The resistor 37 supported in the exhaust pipe 36 is a thin wire of materials, such as platinum, nickel, iron and the like having low electrical resistance and high temperature coefficient. This is sensitive to the heat of the exhaust gas and it is connected as one leg of the Wheatstone bridge circuit 38. Another resistor 40 which is the same as resistor 37 is connected to an opposing leg of the bridge so that the bridge may be balanced in ambient temperature. Thus when the element 37 is heated by the exhaust gas passing through the pipe 36 the bridge is unbalanced and the degree of unbalance indicates a thermconductivity of the gas passing through the pipe 36 so that the quantity and amount of carbon dioxide gas in the exhaust gas may be indicated.

The other legs of the bridge 38 are provided with resistors 39 and 41 which have predetermined values so that the bridge may be electrically balanced and resistor 41 is variable to facilitate balancing thereof. A source of current supply (not shown) which may be the battery provided to an automobile internal combustion engine is connected between the terminals 42 and 43 of the bridge 38. The other terminals 44 and 45 of the bridge are connected to the bases of transistors 46 and 47, respectively, and the emitters of these transistors are connected to the bases of transistors 48 and 49, respectively. The emitters of transistors 48 and 49 are connected to ground through resistors 50 and 51, respectively. The collectors of transistors 46 and 48 are connected together and to one end of the resistor 52. Likewise, the collectors of transistors 47 and 49 are connected together and to one end of resistor 53. The other ends of resistors 52 and 53 are connected together to line 54 which leads to the terminal 43 of the bridge. The collectors of transistors 46 and 48 are also connected to line 55 which leads to one end of the winding of relay 57 and the collectors of transistors 47 and 49 are also connected to line 56 which leads to one end of the winding of relay 58. Line 56 is also connected to the cathode of the diode 59 and the anode of this diode is connected to the other side of the winding of relay 57. Likewise, line 55 is connected to the cathode of the diode 60 and the anode of this diode is connected to the other terminal of the winding of relay 58. Relay 57 is provided with armature 61 which is associated with contacts 61a and 61b. Contact 61a is connected to ground and contact 61b is connected to line 63 which leads to the terminal 43 of the bridge. Relay 58 is provided with an armature 62 which is associated with contacts 62a and 62b. Contact 62a is connected to ground and contact 62b is connected to the line 63 which leads to the terminal 43 of the bridge. Relays 57 and 58 control the energization and direction of energization of the motor 32 so that this motor drives the valve member 30 through a suitable reduction gearing at reduced speed.

While I have shown and described one method of constructing the invention, it will be apparent that the invention is capable of many variations and modification so that its scope should be limited by the scope of the claims appended hereto.

I claim:

1. In apparatus for reducing the smog producing emission from an internal combustion engine, the combination comprising an electrical resistor supported in exhaust pipe means of the internal combustion engine, the electrical resistance of said resistor varying with the thermal conductivity of the exhaust gas passing through said exhaust pipe means, an electric motor, a carburetor having a valve through which fuel is fed from the carburetor to the intake manifold of said engine, mechanical means coupling said valve to said motor, and electrical bridge circuit, said resistor being connected to form one leg of said bridge circuit, a source of current supply connected across said bridge circuit, the current from said source heating said resistor to a predetermined temperature at which the resistance of said resistor is such that said bridge circuit is balanced, amplifying means comprising a pair of amplifiers, means connecting the individual ones of said pair of amplifiers to opposite sides of the output of said bridge circuit, said amplifying means being responsive to the unbalancing of said bridge circuit so that one of said amplifiers is activated when the resistance of said resistor is increased by said exhaust gas and the other of said amplifiers is activated when the resistance of said resistor is decreased, means controlling the energization of said motor connected to said amplifying means, said motor controlling said valve and varying the feeding of fuel to said carburetor in accordance with the thermal conductivity of the engine exhaust gas.

2. In apparatus for reducing the smog producing emission from an internal combustion engine, the combination as set forth in claim 1, further characterized in that said mechanical means comprises speed reducing means driven by said motor, a shaft driven by said speed reducing means, said valve comprising a threaded member engaging threaded means supporting said threaded member on said carburetor, said threaded member having a pointed end opposing a valve seat, said shaft being axially slidable in said threaded member to move said pointed end with respect to said valve seat when said motor is energized.

3. In apparatus for reducing the smog producing emission from an internal combustion engine, the combination as set forth in claim 1, further characterized in that said means controlling the energization of said motor comprises means controlling the direction of rotation of said motor including relay means connecting said motor to said source of current supply to achieve said direction of rotation.

4. In apparatus for reducing the smog producing emission from an internal combustion engine, the combination as set forth in claim 3, further characterized in that said relay means includes a pair of relays and said amplifying means includes separate outputs connected to said relays separately and diodes connected to said relays to limit energization of said relays by current flowing only in a predetermined direction.

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5. Apparatus for reducing the smog producing emissions from an internal combustion engine, the combination comprising an electrical exhaust sensor, sensitive to some elements and thermal conductivity of the exhaust gas, which comprises two legs of a Wheatstone bridge and an electronic means amplifying the bridge error, a valve controlling the fuel to the engine, an electric motor operating said valve, said electronic means

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comprising two amplifiers, one of said amplifiers supplying a signal for activating said motor to rotate in one direction and the other of said amplifiers supplying a signal for activating said motor to rotate in the opposite direction, said motor operating said valve for controlling the fuel-air ratio to the engine.

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