United States Patent

Elkins

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[54] NON-POLLUTING EXHAUST SYSTEM FOR INTERNAL COMBUSTION ENGINES

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[52] **U.S. Cl.** ..... **123/119 A**
[51] **Int. Cl.** **F02m 25/06**
[58] **Field of Search** ..... 123/119 A

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[57] **ABSTRACT**

Combustion products from the exhaust manifold of an internal combustion engine are recirculated through a filter to a fuel mixing carburetor supplying a fuel mixture to the intake manifold. A metered flow of oxygen under pressure is supplied to the careburetor during engine operation for recharging the exhaust gas being returned to the engine as part of the fuel mixture.

12 Claims, 4 Drawing Figures

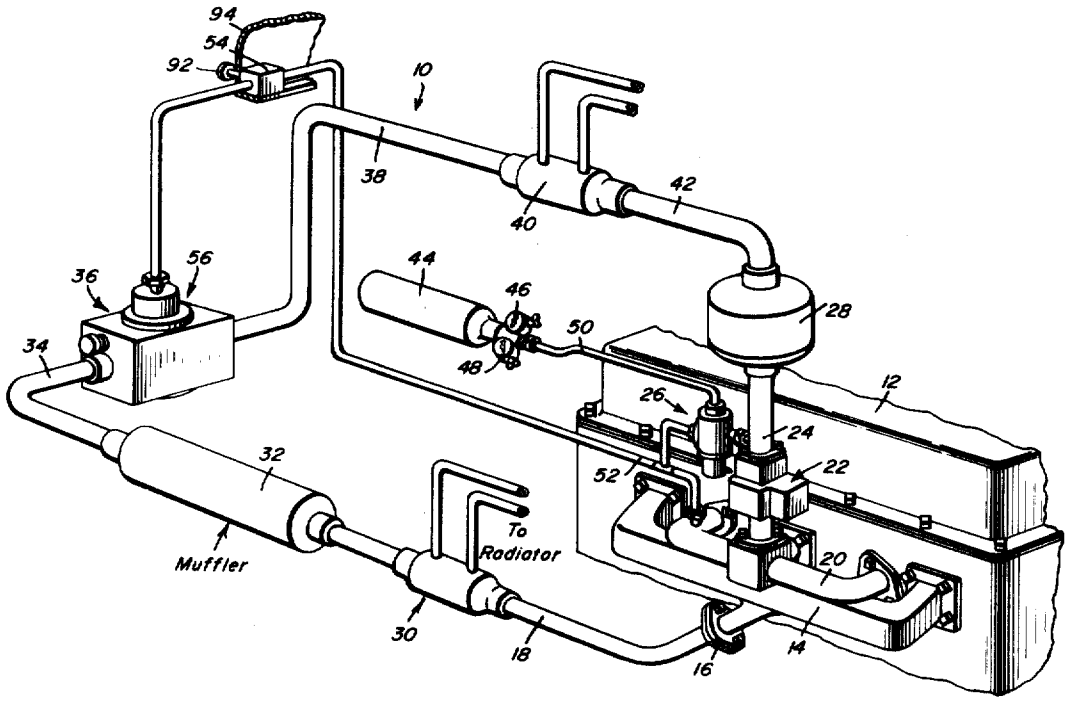

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Fig. 1

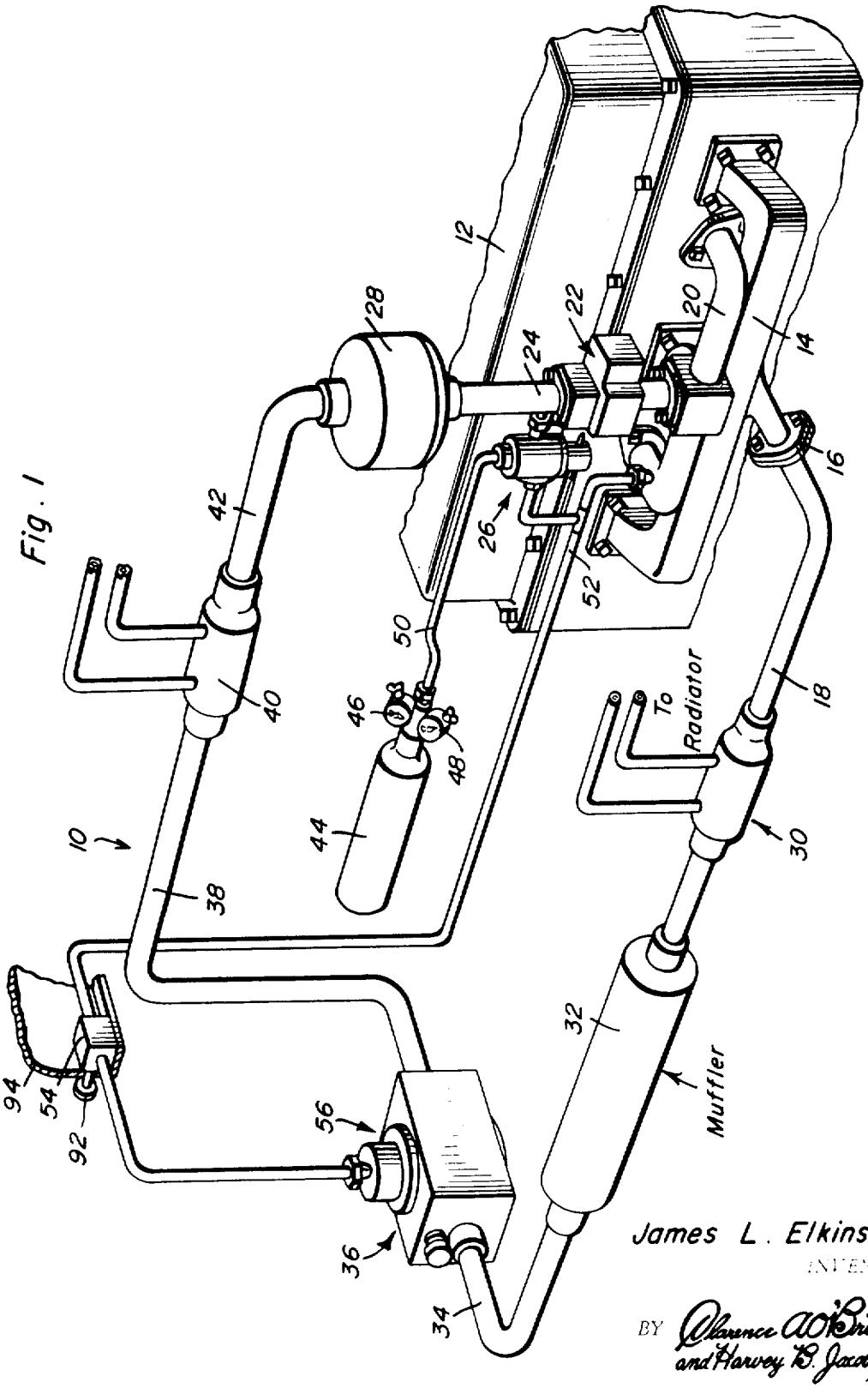

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Fig. 2

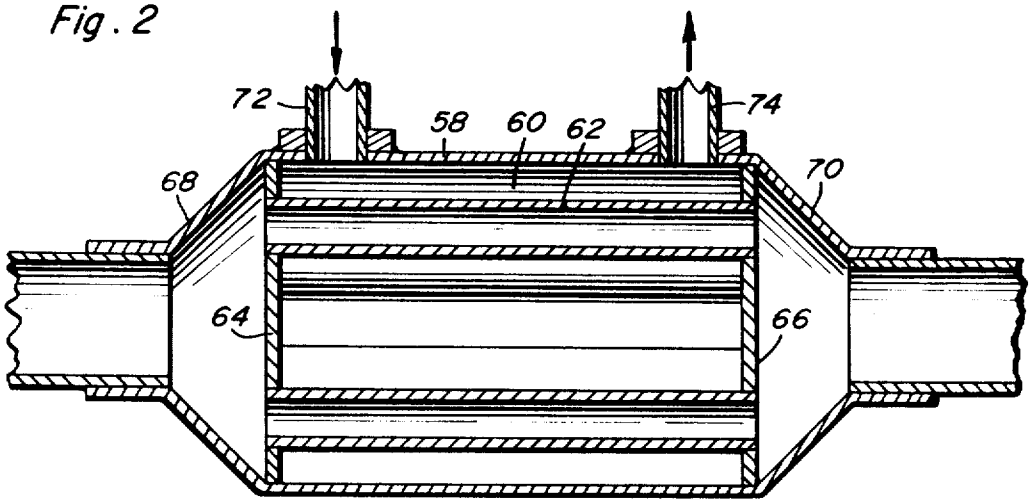


Fig. 3

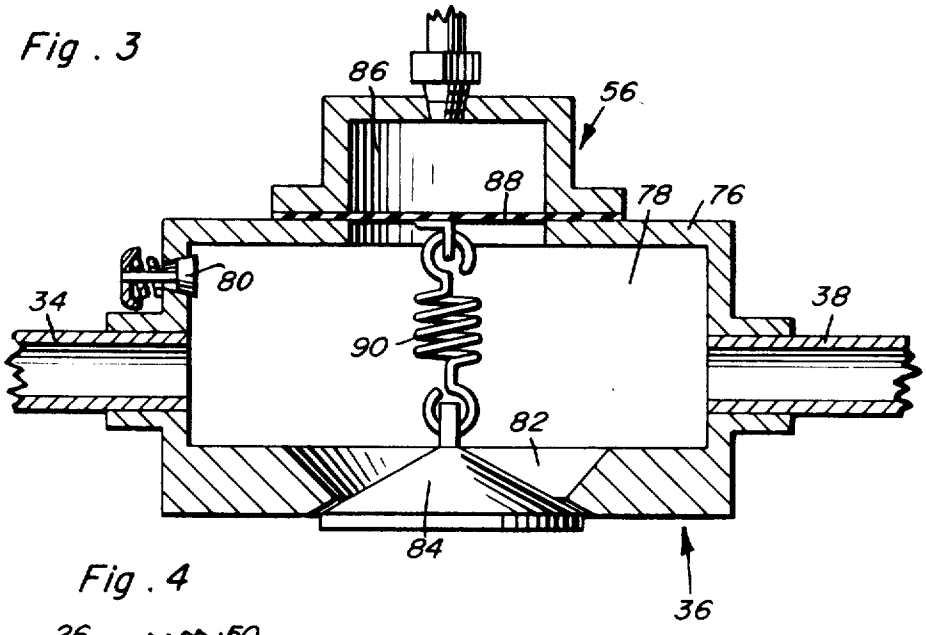
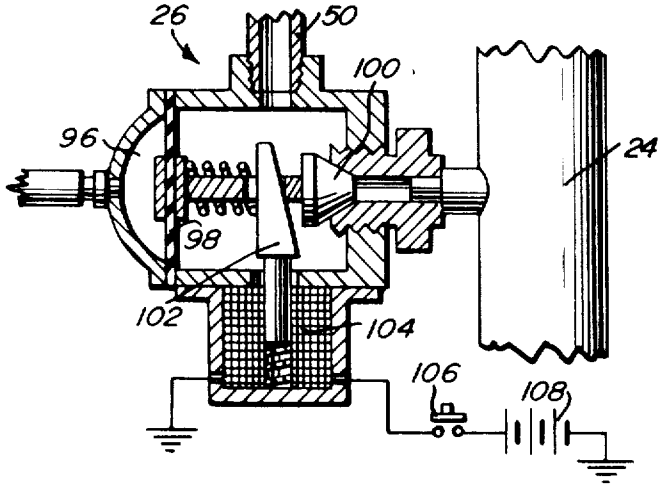


Fig. 4



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NON-POLLUTING EXHAUST SYSTEM FOR INTERNAL COMBUSTION ENGINES

This invention relates generally to an engine exhaust system and deals with the air pollution problem by avoiding the contaminating exhaust of combustion products from an internal combustion engine.

Various methods and apparatus have been devised or proposed in order to reduce pollution resulting from the discharge of exhaust gases from automotive engines. Usually, attempts are made to treat the exhaust gas in order to decrease its polluting effect on the atmosphere. These prior methods are not completely effective however and furthermore become ineffective after prolonged engine operation. It is therefore an important object of the present invention to provide a novel system for avoiding pollution of the air from the exhaust of an internal combustion engine by preventing substantially all of the contaminating exhaust gases from escaping into the atmosphere during engine operation.

In accordance with the present invention, the exhaust gases from an internal combustion engine are conducted through cooling devices and a muffler to a filter through which the gases pass back into the carburetor of the engine for mixing with the fuel and a metered quantity of oxygen. The inflow rate of oxygen during engine operation is regulated by means of a vacuum control while the recirculating conduit through which the exhaust gases are conducted is vented by a valve mechanism while the engine is inactive and when the exhaust gas pressure becomes excessive. An intake vacuum responsive control closes the vent valve after the engine has started.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. 1 is a perspective view showing the engine exhaust system of the present invention.

FIG. 2 is an enlarged side sectional view through one of the cooling devices associated with the system shown in FIG. 1.

FIG. 3 is a side sectional view through the vent valve mechanism utilized in the system of FIG. 1.

FIG. 4 is a side sectional view through the oxygen metering valve mechanism associated with the system of FIG. 1.

Referring now to the drawings in detail, and initially to FIG. 1, the engine exhaust system generally referred to by reference numeral 10 is shown in association with an internal combustion engine generally denoted by reference numeral 12. The engine 12 is provided with an exhaust manifold 14 connected by the fitting 16 to an exhaust pipe 18 forming part of a recirculating conduit system to be described in detail hereafter. Also associated with the engine 12 is a fuel intake manifold 20 to which a fuel mixing carburetor 22 is connected. The carburetor 22 is of the type which usually mixes atomized liquid fuel with air and supplies the same to the intake manifold 20 through which the fuel mixture is supplied to the engine cylinders (not shown). In the case of automotive vehicles, for example, a liquid fuel is mixed with a gas in accordance with a desired ratio. While air as a combustion supporting gas is mixed with fuel in the case of the usual internal combustion engine, a supply of exhaust gas recharged with oxygen is supplied to the carburetor 22 through the conduit section 24. Oxygen is supplied to the conduit section 24 through a flow metering valve mechanism 26 while recirculated exhaust gas is supplied to the conduit section after passing through a replaceable filter 28.

The exhaust gas upon entering the exhaust conduit 18 from the exhaust manifold 14, passes through a first cooling device 30 and then through a conventional type of muffler 32 for discharge to atmosphere or recirculation through the conduit section 34 and a vent valve mechanism 36 as will be explained hereafter in further detail. When the vent valve mechanism 36 is closed, the exhaust gas rather than escaping to atmosphere, is conducted by the conduit section 38 to a second cooling device 40 from which the cooled exhaust gas is conducted by conduit section 42 to the gas filter 28.

Oxygen for recharging the exhaust gas is obtained from a source of oxygen under pressure such as the pressurized oxygen cylinder 44 associated with a cylinder pressure gauge 46 and a line pressure regulator gauge 48 mounted on the outlet end of the cylinder to which the oxygen supply line 50 is connected. The oxygen supply line conducts oxygen to the carburetor conduit section 24 through the metering valve mechanism 26 to which the supply line is connected. The flow rate of oxygen through the metering valve mechanism is controlled by engine vacuum and toward this end the metering valve mechanism is connected to the intake manifold 20 by means of the vacuum pressure line 52 which is also connected through a control dash panel mounted valve 54 to the valve operating device 56 associated with the vent valve mechanism 36.

As shown in FIG. 2, each of the cooling devices 30 and 40 includes a cylindrical housing 58 enclosing a cooling space 60 through which a coolant is circulated. A plurality of gas conducting tubes 62 extend through the cooling chamber 60 between the end walls 64 and 66. The total flow area of the tubes 62 is made equal to the flow area of the conduit sections connected to the cooling device through the conical transition portions 68 and 70. Accordingly, the exhaust gases will be cooled without any volumetric change. The coolant may in one form of the invention be conducted through the chamber 60 by the inlet and outlet conduits 72 and 74 connected for example to the radiator associated with the engine cooling system. It should of course be appreciated that other cooling facilities may be utilized.

As more clearly seen in FIG. 3, the vent valve mechanism 36 includes a housing 76 enclosing a chamber 78 through which exhaust gases may pass between the conduit sections 34 and 38 aforementioned. The chamber 78 may be vented when desired by depression of a spring bias valve element 80. Furthermore, the chamber 78 is ordinarily vented through a vent valve opening 82 adapted to seat a vent valve element 84. Thus, exhaust gases will be vented to atmosphere from the chamber 78 during engine starting. However, when the engine has started, and sufficient vacuum is established in the intake manifold 20, vacuum pressure is applied to the vacuum chamber 86 associated with the valve actuating mechanism 56. The vacuum chamber is closed by a diaphragm element 88 to which the vent valve element 84 is connected by the spring 90. Thus, the vacuum developed in the intake manifold of the engine after it has started, will close the vent valve element 84 so that exhaust gases must then be conducted to the carburetor filter 28 as aforementioned. Closing or opening of the vent valve mechanism through the actuator 56 may furthermore be controlled by the vehicle operator through the valve 54 placed in the vacuum pressure line as shown in FIG. 1 and having a valve operator 92 projecting from the control dash 94 within reach of the vehicle operator. Thus, after the engine has started, the vehicle operator may open the valve device 54 so that vacuum pressure is available to close the vent valve mechanism 36 through the vacuum actuator 56.

The vacuum pressure line is also connected to a vacuum chamber 96 closed by a valve actuating diaphragm 98 associated with the metering valve mechanism 26 as shown in FIG. 4. Vacuum pressure is therefore operative to withdraw a valve element 100 from its valve seat by an amount dependent upon the vacuum pressure developed in order to permit restrictive flow from the oxygen supply line 50 to the carburetor conduit section 24. The valve element 100 is however normally held in a closed position as illustrated in FIG. 4 by a solenoid controlled member 102 adapted to be retracted to permit opening of the valve 100 when the solenoid coil 104 is energized. The solenoid coil is energized in response to engine operation by any suitable means such as an oil pressure switch 106 through which current is conducted from a suitable source of voltage 108 to the solenoid coil.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A system for preventing contamination of air by exhaust from an internal combustion engine having a fuel mixing device, a fuel intake manifold, an exhaust manifold and engine cooling means, comprising recirculating means interconnecting the exhaust manifold and the fuel mixing device for returning fuel exhaust gas from the engine to the fuel mixing device, and means for recharging the exhaust gas supplied to the fuel mixing device, said recharging means comprising a source of oxygen under pressure, metering means connecting the source to the fuel mixing device for supplying a restricted flow of oxygen thereto and engine operation responsive means connected to the metering means for cutting off said flow oxygen while the engine is in an inactive condition.

2. The combination of claim 1 including valve means connected to said recirculating means for venting the same.

3. The combination of claim 2 including valve operating means connected to the intake manifold for closing the valve means during operation of the engine to prevent venting of the recirculating means.

4. The combination of claim 3 including means for cooling the exhaust gas passing through the recirculating means.

5. The combination of claim 4 including flow regulating means connected to the intake manifold for varying the flow rate of oxygen conducted through the metering means.

6. The combination of claim 5 wherein the fuel mixing device includes a carburetor to which the recharging means is connected and gas filtering means connecting the recirculating means to the carburetor.

7. The combination of claim 1 including flow regulating means connected to the intake manifold for varying the flow rate of oxygen conducted through the metering means.

8. The combination of claim 7 wherein the fuel mixing device includes a carburetor to which the recharging means is connected and gas filtering means connecting the recirculating means to the carburetor.

9. The combination of claim 1 wherein the fuel mixing device includes a carburetor to which the recharging means is connected and gas filtering means connecting the recirculating means to the carburetor.

10. A system for preventing contamination of air by exhaust from an internal combustion engine having a fuel mixing device to which fuel is fed, a fuel intake manifold, an exhaust manifold and engine cooling means, comprising recirculating means interconnecting the exhaust manifold and the fuel mixing device for returning substantially all fuel exhaust gas from the engine during operation to the fuel mixing device, means for recharging the exhaust gas entering the fuel mixing device independently of the supply of fuel thereto, valve means connected to said recirculating means for venting the same while the engine is inoperative, and valve operating means connected to the intake manifold for closing the valve means only during operation of the engine to prevent venting of the recirculating means.

11. A system for preventing contamination of air by exhaust from an internal combustion engine having a fuel mixing device to which fuel is fed, a fuel intake manifold, an exhaust manifold and engine cooling means, comprising recirculating means interconnecting the exhaust manifold and the fuel mixing device during operation to the fuel mixing device, means for recharging the exhaust gas entering the fuel mixing device independently of the supply of fuel thereto, and means for passing the exhaust gas in heat exchange relation to the engine cooling means while conducted through the recirculating means.

12. The combination of claim 11 including gas filtering means through which substantially all of the exhaust gas is conducted during operation of the engine into the mixing device.

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