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Hallum

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[54] **ENGINE EMISSION CONTROL DEVICE**

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[52] **U.S. Cl.** ..... **60/324**, 60/307, 123/107, 123/119 A

[51] **Int. Cl.** **F01n 3/10**

[58] **Field of Search** ..... 60/324, 314, 288, 60/273, 307; 123/107, 119 A; 137/808, 809, 810

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[57] **ABSTRACT**

The engine discharges exhaust gases into a vortex chamber that either provides essentially no resistance to discharge of the flow or variably increases the impedance or resistance to flow as a function of the entry of flow from a radial to a tangential direction, the tangential direction applying centrifugal force to the flow and creating turbulance and thus increasing resistance to discharge; the means for switching the flow from a radial to a tangential direction in one instance consisting of a source of compressed air provided by the engine that also combines with the unburned hydrocarbons and carbon monoxide elements to reduce them to less harmful forms; or alternatively, fluidic diverter valves that automatically switch the flow from a stable direction to an alternate direction by means of an electrically actuated tab or air signal force.

8 Claims, 3 Drawing Figures

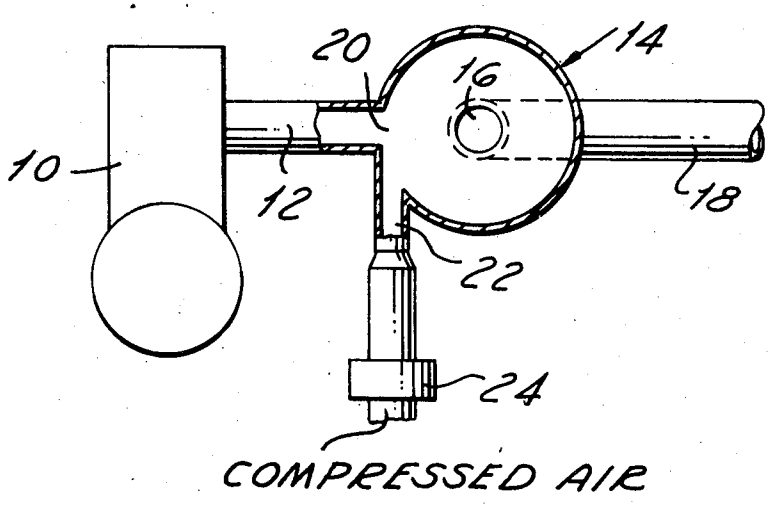

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FIG. 1

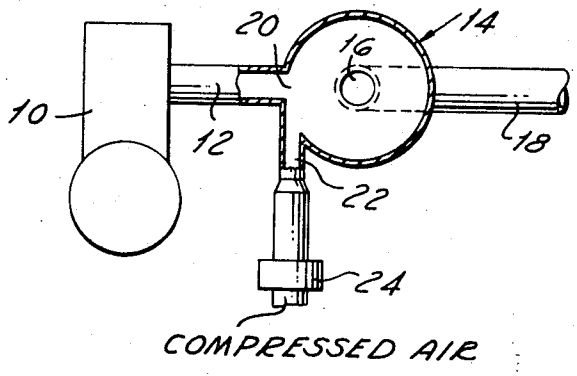


FIG. 3

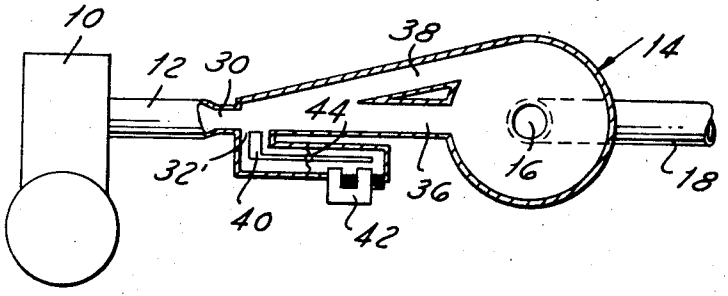
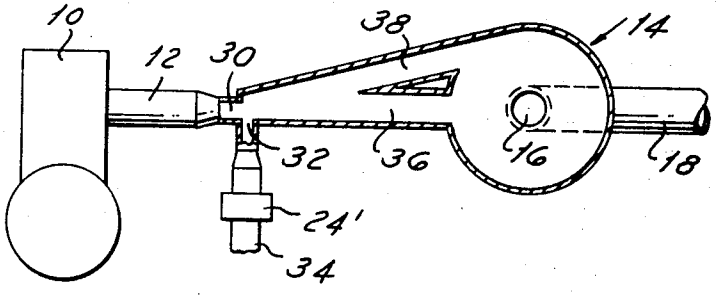


FIG. 2



ENGINE EMISSION CONTROL DEVICE

This invention relates, in general, to a device for reducing undesirable emissions from an internal combustion engine. More particularly, it relates to a device for controlling the flow of exhaust gases from the engine not only to increase the back pressure in the engine cylinders, but also decrease the intake of fresh air and thereby reduce output of oxides of nitrogen.

The output of oxides of nitrogen is known to increase with rises in combustion peak temperatures and pressure. Accordingly, exhaust gas recirculation has been used in the past to dilute the incoming gases to lower the temperature and formation of oxides of nitrogen. It has also been known to throttle the exhaust gas passage to reduce engine cylinder scavenging and thereby reduce the intake of fresh air.

The devices known for throttling the exhaust gas flow, however, generally are cumbersome, uneconomical to manufacture, and require many movable parts both mechanical and electrical. The invention is directed to an internal combustion engine exhaust gas flow restrictor that in at least two embodiments has no movable mechanical parts in the exhaust stream and is operated automatically and selectively to variably increase the exhaust gas flow back pressure.

It is an object of the invention, therefore, to provide an internal combustion engine with a vortex chamber located in the exhaust gas outlet conduit combined with control means to vary the flow of exhaust gases into and through the vortex chamber in a manner permitting selective increase of impedance to flow.

It is a further object of the invention to selectively increase the exhaust back pressure of an engine by including in the exhaust conduit a vortex chamber having an inlet controlled by a fluidic flow diverter that normally permits flow of exhaust gases toward the discharge of the vortex chamber with essentially no resistance, or, alternatively, switches the flow from its stable path to one providing increased impedance to flow in proportion to the switching signal strength.

It is a still further object of the invention to provide an internal combustion engine with an exhaust gas back pressure increasing device that includes a vortex chamber having exhaust gas directed therinto either radially directly towards the outlet, or tangentially around the chamber to subject the flow to centrifugal force and thereby impede the flow and increase the exhaust back pressure, an air signal constituting means for switching the paths, the air simultaneously combining with the exhaust gas unburned hydrocarbons and carbon monoxide and other elements to reduce them to less harmful forms.

Other objects, features and advantages of the invention will become more apparent upon reference to the succeeding detailed description thereof, and to the drawings illustrating the preferred embodiments thereof, wherein:

FIG. 1 illustrates schematically a cross sectional view of an internal combustion engine exhaust system embodying the invention;

FIG. 2 is a showing similar to FIG. 1 illustrating a modification thereof; and,

FIG. 3 illustrates schematically a further modification of the invention.

FIG. 1 indicates at 10 an internal combustion engine from which the products of combustion are exhausted

from the conventional exhaust manifold (not shown) to an exhaust pipe or conduit 12 for subsequent discharge into the atmosphere in a conventional manner. In this instance, located in exhaust pipe 12 is a vortex chamber 14 of a known type having a cross section in the shape of a circle in one plane. Chamber 14 has a central discharge outlet 16 connected to an exhaust pipe 18 leading to the atmosphere. The chamber has an exhaust gas inlet 20 peripherally located and attached to exhaust pipe 12 in a manner providing radially inward flow of the exhaust gases directly toward outlet 16. It will be seen, therefore, that essentially no resistance or impedance to flow from pipe 12 to the discharge outlet 16 is provided with the construction as thus far described. A fluid signal inlet 22 is provided attached tangentially to the vortex chamber 14 in the manner shown so that a signal fluid force can be directed tangentially inwardly with respect to the vortex chamber and directly against the normal flow of exhaust gases in the conduit or pipe 12. The flow of fluid in pipe inlet 22 will then divert the flow of exhaust gases in pipe 12 to flow tangentially around the vortex chamber thereby subjecting them to centrifugal forces, which will increase the impedance to flow through outlet 16 in proportion to the strength of the signal force.

The fluid in inlet 22 can be provided by any number of sources; preferably, in this instance, however, being compressed air provided by engine 10. A selective control 24 would be provided so that the air signal can be shut off or permitted to flow as a matter of choice, manually or automatically, such as, for instance, as a function of changes in engine intake manifold vacuum.

In any event, the introduction of air through inlet 22 not only diverts the flow of exhaust gases from its normal path directly towards outlet 16, but since it is air that is being introduced, it will combine with any unburned hydrocarbons and carbon monoxide elements existing in the exhaust gas to reduce them to less harmful forms before passage out through the exhaust pipe 18.

It will be seen, therefore, that when normal flow with little engine back pressure is desired, the diverter valve control 24 will be closed to provide normal flow of exhaust gases from the pipe 12 directly to the outlet 16 with essentially no resistance to flow. When the engine is operating in a range that normally might provide an undesirable output of oxides of nitrogen, the control 24 will be operated either manually or automatically to send a signal of air through port 22 to divert the exhaust gas from the radial path to the tangential one. This, as described previously, will increase the impedance to flow of the exhaust gas toward the outlet 16 and thereby increase the back pressure on the engine 10. This will lessen the scavenging effect in the engine cylinders and thereby restrict the amount of fresh intake air that can be taken into the engine cylinders. This will ultimately reduce the engine combustion peak temperatures and pressures by dilution and result in a lowering of the formation of oxides of nitrogen.

It will be noted, of course, that the restriction or impedance to flow is selectively accomplished as a function of the opening of the control 24. That is, the air signal can be proportioned to provide partial radial and partial tangential flow of exhaust gases so as to vary the exhaust gas back pressure in a variable manner.

FIG. 2 shows a modification of the invention. In this case, exhaust pipe 12 is connected to vortex chamber

14 by a fluidic diverter device providing two paths for inlet of the gases to the vortex chamber. The diverter includes a reduced diameter fluid inlet 30 increasing the fluid velocity and decreasing the pressure adjacent a control fluid pressure signal port 32. The port is connected by a conduit 34, in this case, to a source of compressed air, for example, in a manner similar to that described in connection with FIG. 1. A valve 24' is used to selectively or automatically control the flow of the signal fluid pressure into the diverter valve per se.

The diverter valve includes a first path 36 for exhaust gas flow that is connected to vortex chamber 14 to flow the gases radially toward the outlet 16 in the same manner as described in connection with FIG. 1. A second path 38 is branched to path 36 and connected to vortex chamber 14 at its periphery in a tangential manner so that flow discharged therefrom will swirl around the vortex chamber 14 creating centrifugal forces and an impedance to flow through outlet 16 in the same manner as described in connection with the tangential inlet 22 in FIG. 1.

The fluidic device per se may be of a known construction. Fluid normally flows in one or the other of the paths 36 or 38; that is, the flow generally is stable in one direction or the other and is only diverted from that path by means of a small control signal in port 32 breaking the flow away from the passage wall. In this instance, flow through the path 36 is chosen to be the stable direction, and exhaust gas will normally flow through this path at all times except when divereted partially or wholly into path 38 by injected air through port 32. The required air control signal is a fraction of that required for the FIG. 1 embodiment.

FIG. 3 shows a still further modification of the invention. In this instance, the conduits and piping are essentially the same as that shown in FIG. 2, the difference being in the control actuation or switching of the flow from path 36 to path 38. A tab type actuator 40 is shown in this instance projecting into control port outlet 32'. Movement of the tab vertically into the path of normal flow of the exhaust gas will disturb the boundary layer of fluid and cause the flow to switch from path 36 to path 38 in the desired manner.

In this instance, tab 40 is adapted to be moved by means of a solenoid 42 controlled selectively or automatically by the vehicle operator or as a function of changes of operation of the internal combustion engine, as the case may be. The tab 40 is mounted on a spring centered floating pivot 44 so that energization of the solenoid will move the tab into the flow circuit and thus create the switching desired.

From the above, it will be seen that the invention provides an internal combustion engine exhaust gas back pressure increasing device that is simple in construction and operates essentially without moving mechanical parts. It will also be seen that the invention increases the exhaust gas back pressure and thereby reduces output of oxides of nitrogen.

While the invention has been described and illustrated in its preferred embodiments, it will be clear to those skilled in the arts to which it pertains that many changes and modifications may be made thereto without departing from the scope of the invention.

I claim:

1. Emission control means for reducing the output of undesirable elements from an internal combustion engine comprising in combination an engine having an output conduit for conveying exhaust gases discharged from the engine, a vortex chamber means in the conduit for selectively impeding the flow of exhaust gases through the conduit to increase the back pressure in the cylinders of the engine and thereby reduce exhaust gas scavenging with a resultant lowering of the engine combustion temperature and formation of oxides of nitrogen, the vortex chamber having a central discharge opening and a peripheral inlet portion with the inlet normally directing fluid in a path creating little resistance to flow, means directing the fluid in a second path tangentially interiorly of the chamber increasing impedance to flow through the outlet, and control means to divert the flow in selective proportions from the first to the second paths.

2. An emission control means as in claim 1, the first path directing flow radially inwardly of the vortex chamber directly towards the outlet in a smooth manner, the second path directing the fluid tangentially with respect to the vortex chamber to subject the fluid to centrifugal forces creating impedance to flow towards the outlet.

3. A control means as in claim 2, the means for switching the flow paths comprising a fluidic diverter valve.

4. A control means as in claim 3, including tab means movable into or out of the diverter inlet to switch the flow paths.

5. A control means as in claim 1, in which the paths are switched by an injected air signal.

6. A control means as in claim 1, the switching means comprising a source of injected air that also combines with the exhaust gases to reduce emissions of unburned hydrocarbons and carbon monoxides.

7. Emission control means for reducing the output of undesirable elements from an internal combustion engine comprising in combination, an engine having an exhaust gas outlet connected to an exhaust conduit for the discharge of gases therefrom, a vortex chamber in the conduit having a cross section in the shape of a circle in one plane, the vortex chamber having a radially directed peripheral inlet and a central outlet, and fluid containing signal conduit means having an output tangentially arranged with respect to the vortex chamber and joined to the inlet whereby introduction of a fluid signal force in the signal conduit means diverts the exhaust gases from a normal radially directed minimum resistance flow path into the vortex chamber to a tangential path providing impedance to the output, the flow impeding path increasing the engine exhaust back pressure to decrease output of oxides of nitrogen, the fluid signal means being selectively activated.

8. A control as in claim 1, including fluidic diverter means adjacent the inlet to the vortex chamber and including the first and second paths, the paths being connected respectively to discharge fluid radially and tangentially into the vortex chamber to provide smooth flow or create turbulence, respectively, with respect to the exhaust gases towards the outlet as a function of signal means controlling the switching of the fluidic diverter.

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