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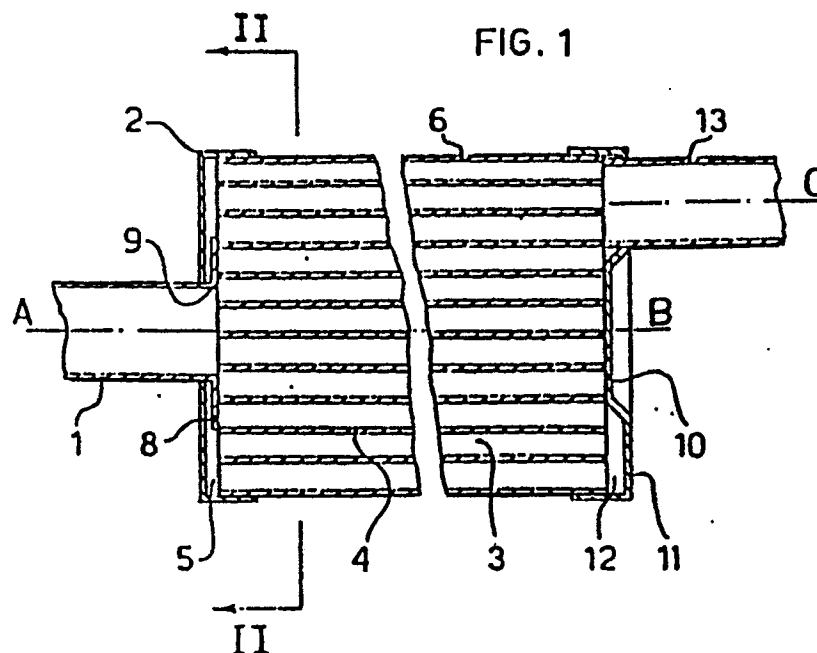
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(54) **An anti-pollution device for treating the exhaust gases from internal combustion engines and burners in general, functioning also as exhaust silencer.**

(57) The device, which serves both to control harmful emissions and to lower the noise levels of exhaust gases from internal combustion engines and burners in general, comprises a duct (3) created between the coils (4, 4') of a spiral element and open at either

one or both ends; the element is fashioned in a material of low thermal conductivity, and the coiled surfaces exposed to the exhaust gases can be coated with catalytic materials capable of speeding up the reduction or oxidation of pollutants.



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The present invention relates to an anti-pollution device for the treatment of exhaust gases from internal combustion engines and burners generally, which also performs the function of a silencer, i.e. a device for incorporation into the pipeline through which fumes generated by the combustion of fuel are exhausted from internal combustion engines or from the combustion chambers of burners, to the end of controlling or eliminating harmful emissions (CO, HC, NO_x and particulate matter), and at the same time of reducing exhaust noise levels.

The prior art embraces devices for the control of exhaust emissions, utilizing catalytic converters in which gases are brought into contact with porous surfaces containing catalytic elements such as platinum, palladium and rhodium, able to promote the oxidation of carbon monoxide and hydrocarbons that have escaped combustion, and the reduction of oxides of nitrogen. Such devices have little or no ability to damp sound waves however, and must be used in conjunction with a conventional silencer if lower exhaust noise levels are to be achieved.

The art further embraces exhaust silencer devices as disclosed in US 4579195, IT 1195502, IT 1189816, IT 199088, IT 199262, IT 206501 and IT 207680, in the name of the present applicant, wherein the flow of hot gases is directed entirely or partly into a flat spiral duct or channel of constant or variable pitch, thence into an exhaust chamber connecting with a tail pipe or directly into one or more tail pipes; sound waves carried by the gases are damped principally by collision with the internal surfaces of the spiral duct, and with those of the exhaust chamber or of the inlets to the tail pipes.

None of the devices reflecting the current state of the art is capable of performing the dual function of controlling emissions in exhaust gases from an internal combustion engine or a burner and damping the sound waves carried in such gases.

The prior art thus stands in need of improvement, with the end in view of uniting two functions - viz, of eliminating pollutants from the exhaust gases generated by internal combustion engines and by burners, and of damping the sound waves carried by such gases, in a single device.

Accordingly, the object of the present invention is to provide a device capable of lowering harmful emissions in the exhaust gases produced by internal combustion engines or burners, and of bringing about a notable reduction in exhaust noise levels at one and the same time.

The stated object is realized in a device through which to direct the flow of exhaust gases from an internal combustion engine or burner, consisting essentially in a duct created between the coils of a flat spiral element open at one or both ends and fashioned in material having a low coefficient

of thermal conductivity, such as a ceramic, or sheet metal with a suitably treated surface, for example coated with a layer of aluminium oxide (Al₂O₃); advantageously, the surfaces of the spiral element exposed to the gases can be coated with catalytic materials such as platinum, palladium or rhodium, able to promote the oxidation or reduction of pollutants in the exhaust gases.

In the case of exhaust gases containing notable quantities of so-called particulate matter, i.e. the solid combustion residue as produced typically by Diesel engines, the surface of the spiral coils of material exposed to the hot gases is undulated, or embodied with projections of sawtooth profile, so as to trap and thus favour the combustion of such particulate matter.

The advantages of the present invention are: the facility of utilizing a single device to control emissions in and reduce the noise level of exhaust gases; simplicity in construction; marked reduction in manufacturing costs; greater efficiency.

Two embodiments of the present invention will now be described in detail, by way of example, with the aid of the accompanying drawings, in which:

- fig 1 is a longitudinal section through a device according to the invention, in which the spiral element is fashioned in sheet metal with a suitably treated surface;
- fig 2 is the section through II-II, fig 1;
- fig 3 is a longitudinal section through a device according to the invention, in which the spiral element is fashioned in ceramic material;
- fig 4 is the section through IV-IV, fig 3.

In the drawings, 1 denotes a pipe through which exhaust gases are directed into the device; A and B denote the longitudinal axis of the pipe and of the device, respectively; 2 denotes a cover fitted to the front end of the device, i.e. the inlet end; 3 denotes a spiral duct of which the walls 4 are created by the single coils of an element fashioned from metal coated with a material of low thermal conductivity and receding spirally from the axis B of the device.

4' denotes the same spirally coiled walls of an element fashioned in ceramic material such as cordierite.

5 denotes a void between the front cover 2 and the spirally coiled walls 4, which may be filled with sound-absorbent or sound-reflecting material.

6 denotes the outermost coil of the spiral element, which provides the external casing of the device in the event that the walls 4 are fashioned in metal with a coating of low thermal conductivity (fig 1); 7 denotes the outer casing of a device in which the walls 4' of the spiral element are ceramic (fig 3).

8 denotes a ring enclosing the innermost turns of the spiral duct at the inlet end and affording a central hole 9 by which these same innermost turns are caused to communicate with the exhaust pipe 1.

10 denotes a central baffle partly enclosing the rear end of the spiral duct 3, which consists in a circular dish pressed from the rear cover 11 of the device; 12 denotes a void between the rear cover 11 and the turns of the duct 3 not enclosed by the baffle 10, which may be filled with sound-absorbent or sound-reflecting material.

13 denotes a tail pipe associated with the device by insertion through the periphery of the rear cover 11 in such a way as to communicate with the outermost turns of the spiral duct 3; C denotes the axis of the pipe 13. The embodiment of fig 3 further comprises a layer of insulating material 14 sandwiched between the outermost coil 6 of the spiral element and the casing 7; also, the surface of each coil or wall 4' affords a plurality of projections 15 exhibiting a sawtooth profile, which serve to trap particulate matter.

Operation of the device will now be described.

Hot combustion gases generated by fuel combustion in an engine, or a burner generally, characterized by a high content of pollutant emissions and sound pressure waves of high intensity, are directed from the exhaust pipe 1 into the spiral duct 3 by way of the hole 9 in the inlet ring 8. The temperature of the walls 4 or 4', whether of metal with a coating of low thermal conductivity or of ceramic material, is raised to a level such as will promote further combustion of the pollutants present in the gases (CO, HC); further combustion in turn pushes the temperature of the walls 4 or 4' still higher, thereby enhancing the destruction process. This further combustion of carbon monoxide and hydrocarbons can be rendered more advantageous yet by coating the walls 4 or 4' with a platinum or palladium based catalytic material. Such a material might also be formulated with rhodium, to the end of catalyzing the reduction of nitrogen oxides.

The sawtooth projections 15 increase the ability of the device to trap any particulate matter on the surface of the walls 4 or 4', whereupon such matter will burn by reason of the high temperature of the coils.

In addition to the emission control thus obtained, sound pressure waves carried in the gases are also damped, principally by collision with the surfaces of the spiral duct and of the outlet to the tail pipe 13.

Claims

1. An anti-pollution device for the treatment of

exhaust gases from internal combustion engines and burners in general, functioning also as a silencer, consisting in a spiral duct connected with at least one inlet pipe and at least one outlet pipe, characterized in that the walls of the duct are fashioned in material possessing a low coefficient of thermal conductivity.

2. A device as in claim 1, wherein the walls of the spiral duct are fashioned in a ceramic material.

3. A device as in claim 1, wherein the walls of the spiral duct are fashioned in metal coated with a material possessing low thermal conductivity.

4. A device as in claim 1, wherein the inward facing surfaces of the walls of the spiral duct are coated with a catalytic material incorporating noble metals such as platinum, palladium and rhodium.

5. A device as in claim 1, wherein the inward facing surfaces of the walls of the spiral duct exhibit projections of sawtooth profile.

6. A device as in claim 1, wherein the inward facing surfaces and the outward facing surfaces of the walls of the spiral duct exhibit projections of sawtooth profile.

7. A device as in claim 4, wherein the inward facing surfaces of the walls of the spiral duct exhibit projections of sawtooth profile.

8. A device as in claim 4, wherein the inward facing surfaces and the outward facing surfaces of the walls of the spiral duct exhibit projections of sawtooth profile.

9. A device as in claim 1, wherein the inward facing surfaces of the walls of the spiral duct are undulated.

10. A device as in claim 1, wherein the inward facing surfaces and the outward facing surfaces of the walls of the spiral duct are undulated.

11. A device as in claim 4, wherein the inward facing surfaces of the walls of the spiral duct are undulated.

12. A device as in claim 4, wherein the inward facing surfaces and the outward facing surfaces of the walls of the spiral duct are undulated.

