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(54) Catalyst arrangement for the exhaust system of an internal combustion engine

(57) In an exhaust system with a trap 18 for particulate emissions from an engine, a catalyst is incorporated in a solid material insert 22 which is fitted upstream of the particulate trap so that the exhaust gases pass over the insert on their way to the trap. In passing the hot exhaust gases cause catalyst to be vaporised from the insert and carried along to the trap where it promotes burning of the particulates.

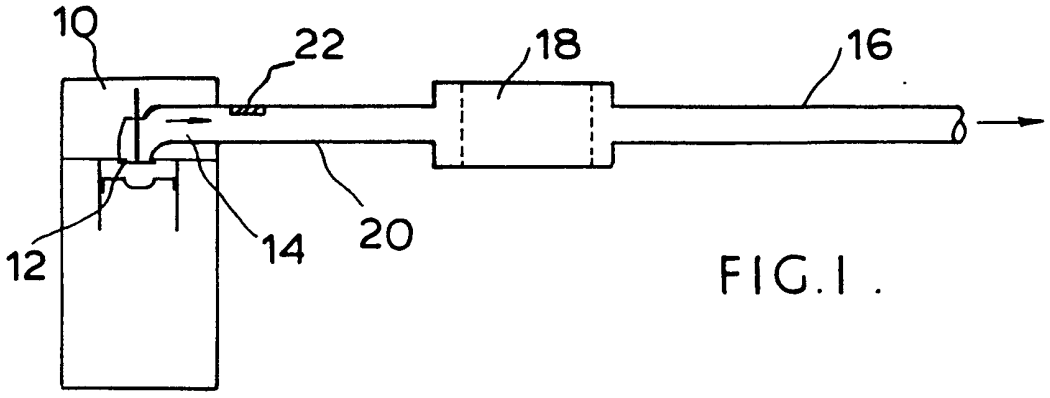


FIG.1.

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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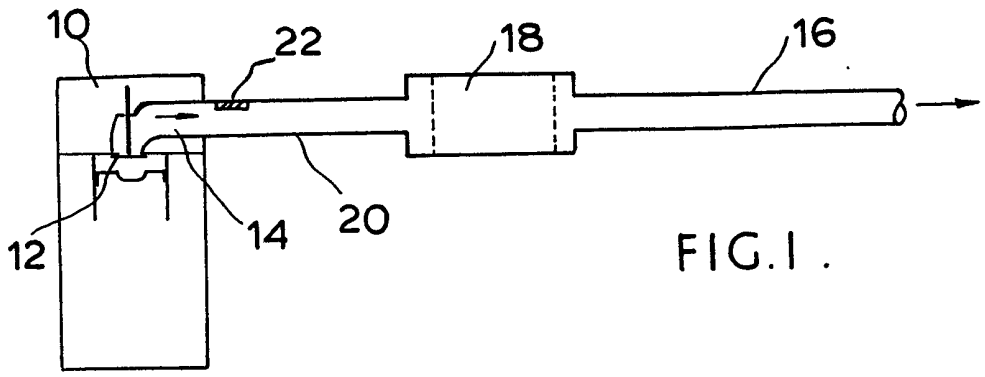


FIG.1.

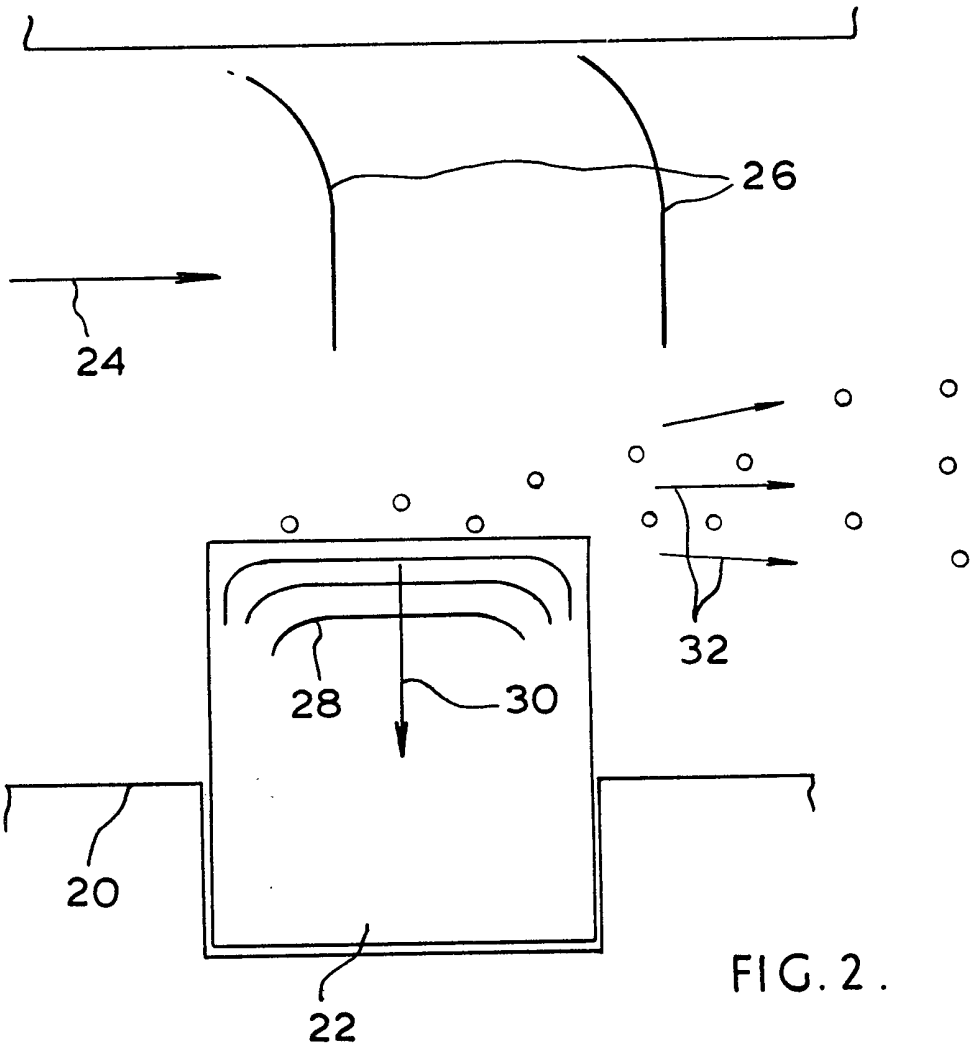


FIG.2.

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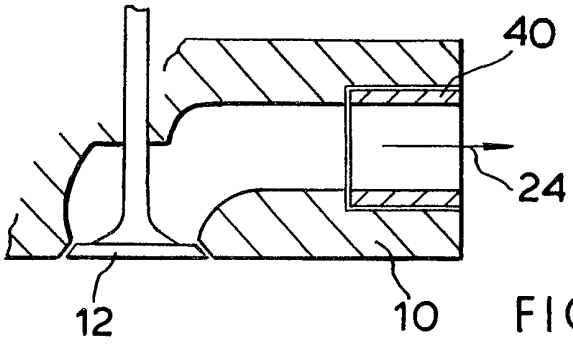


FIG. 3.

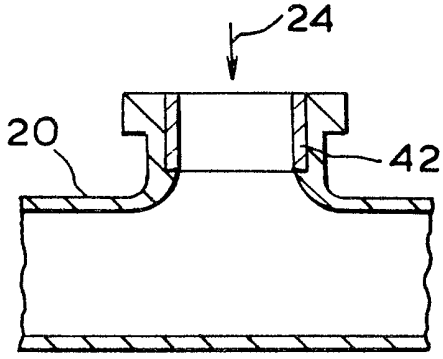


FIG. 4.

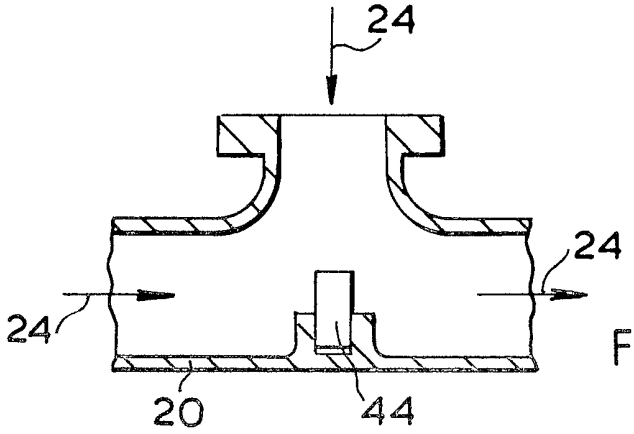


FIG. 5.

SPECIFICATION

Catalyst arrangement for the exhaust system of an internal combustion engine

This invention relates to a catalyst arrangement for the exhaust system of an internal combustion engine. The invention is particularly, but not exclusively, intended for use in the exhaust system of diesel engines.

In order to reduce the exhaust emission levels, it is known to place a particulate filter trap in the exhaust system which retains a high proportion of the particulate material in the exhaust gas. The particulates are collected in a layer on the filter medium and consist predominantly of carbon and hydrocarbon material. The exhaust gas passes through the filter, through the exhaust system and to atmosphere with a reduced quantity of noxious emissions.

The particulate material builds up in the trap and restricts the flow of exhaust gas and generates a back pressure on the engine. A condition is reached where regeneration of the particulate trap is required, which involves burning off of the deposit in a controlled way. This is achieved by increasing the temperature of the exhaust gas until combustion of the deposit is initiated. Burning continues until all, or most, of the particulate deposit is removed. The increase in exhaust temperature is achieved by operating the engine in a manner that causes a temperature increase or by an additional external device.

The temperature at which the particulate deposit begins to burn can be influenced by introducing a catalyst into the exhaust gas stream or by incorporating a catalyst with the filter element.

According to the present invention, there is provided a catalyst arrangement for the exhaust system of an internal combustion engine, the arrangement comprising a body of solid material incorporating a substance having catalytic properties and means for removably mounting the body in the exhaust system upstream of a particulate trap with a surface of the body exposed to exhaust gas flow, the composition and position of the body being such that, in use, hot exhaust gases flow over the surface of the body and release the catalytic substance from the body.

The body of solid material will be consumable and will need to be replaced from time to time.

The catalytic substance is preferably vaporised from the surface of the body of solid material by the exhaust gas heat. In order to obtain the correct temperature at the surface of the body for the desired vaporisation, it is important to control the thermal conductivity of the body itself, because the thermal conductivity will have an important effect on determining the surface temperature.

The substance having catalytic properties may be any suitable known catalyst. Suitable active components are metals with catalytic properties such as copper, nickel etc. and these can be combined with other materials to produce the body of solid material, with the other materials being adapted to determine the thermal conductivity of the body.

The invention will now the further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is schematic view of an engine and an associated exhaust system;

Figure 2 illustrates the mechanism by which the arrangement of the invention operates; and

Figures 3, 4 and 5 show various alternative positions for a catalyst body in accordance with the invention.

Fig. 1 shows the cylinder head 10 of an engine, with a valve 12 at the top of a cylinder, an exhaust gas outlet port 14 and an exhaust pipe 16. A particulate trap 18 is positioned in the exhaust pipe 16 to trap the particulates in the exhaust gas.

Upstream of the particulate trap 18, in the exhaust manifold 20, a solid material insert 22 is fitted. The material of this insert has catalytic properties.

Fig. 2 shows a section through the exhaust manifold 20, with the direction of exhaust gas flow being indicated by an arrow 24. The temperature gradient along the exhaust pipe is indicated by the lines 26, and the temperature gradients in the insert 22 are indicated by lines 28, and the direction of heat flow by an arrow 30.

As the hot exhaust gas flows over the surface of the insert 22, it vaporises the catalytic material which is then carried along the exhaust gas stream as indicated by a particulate flow 32. The vaporised material is swept off the insert and mixes into the gas stream to distribute the active catalysts and to promote burning of the particulates collected in the trap 18.

Fig. 3 shows an insert 40 in the form of an annular ring inserted in a recess at the point where the exhaust gas port 14 leaves the cylinder head 10.

Fig. 4 shows a similar arrangement but with an annular inserted 42 positioned in the mouth of an exhaust manifold 20.

Fig. 5 shows another arrangement incorporated in the exhaust manifold 20, with an insert 44 inside the manifold 20, in a position where it will be exposed to exhaust gas flows from the various cylinders.

The actual position of the insert in the exhaust system will be determined by the temperature conditions that exist in the system upstream of the particulate trap, and will be chosen to give a steady release of catalyst material. The temperature at which this steady release will occur will also depend on the composition of the insert.

The thermal conductivity of the catalyst insert must be controlled so that sufficient heat is retained at the surface to promote vaporisation of the active elements. The surface temperature is the critical parameter. Gas flows past the insert and heats the surface. Heat flows away from the surface through the insert at a rate which controls the surface temperature. The vaporised material is swept off the insert and mixes into the gas stream to distribute the active catalysts. If the element gets too hot it may melt. If it is too cold it may not release sufficient catalyst.

As material is removed from the insert it becomes expended and is required to be replaced at regular service intervals. The insert may be retained in the engine by several means, depending on the specific engine design requirements, in a manner that allows routine replacement.

CLAIMS

1. A catalyst arrangement for the exhaust system of an internal combustion engine, the arrangement comprising a body of solid material incorporating a substance having catalytic properties and means for removably mounting the body in the exhaust system upstream of a particulate trap with a surface of the body exposed to exhaust gas flow, the composition and position of the body being such that, in use, hot exhaust gases flow over the surface of the body and release the catalytic substance from the body.

2. An arrangement as claimed in Claim 1, wherein the catalytic substance is vaporised from the surface of the body of solid material by the exhaust gas heat.

3. An arrangement as claimed in Claim 1 or Claim 2, wherein the substance having catalytic properties comprises a metal with catalytic properties combined with other materials to produce the body of solid material, with the other materials being adapted to determine the thermal conductivity of the body.

4. An arrangement as claimed in any preceding claim, wherein the body of solid material is located in a recess which opens into the face of the cylinder head which mates with the exhaust manifold of the engine.

5. An arrangement as claimed in any one of Claims 1 to 3, wherein the body of solid material is located in a recess which opens into the face of the exhaust manifold which mates with the cylinder head of the engine.

6. An arrangement as claimed in any one of Claims 1 to 3, wherein body of solid material is located in a recess in the exhaust manifold of the engine.

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