



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.06.2003 Bulletin 2003/23

(51) Int Cl.7: **F01N 3/022**

(21) Application number: **02079020.0**

(22) Date of filing: **30.09.2002**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
IE IT LI LU MC NL PT SE SK TR**
Designated Extension States:
AL LT LV MK RO SI

(72) Inventor: **Jacque, Etienne**
3271 Bettembourg (LU)

(74) Representative: **Denton, Michael John**
Delphi Automotive Systems,
Centre Technique Paris,
117, avenue des Nations,
B.P. 60059
95972 Roissy Charles de Gaulle Cédex (FR)

(30) Priority: **03.12.2001 GB 0128772**

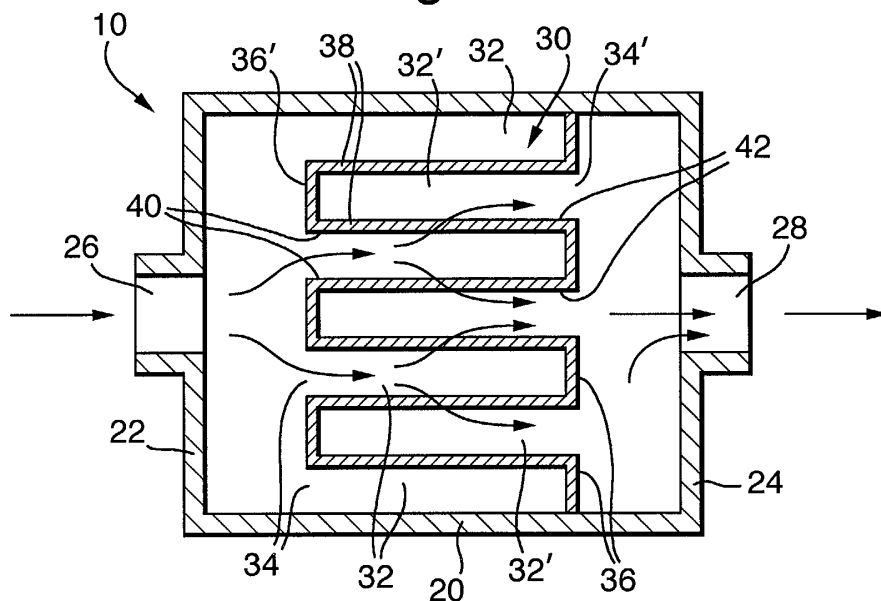
(71) Applicant: **Delphi Technologies, Inc.**
Troy, MI 48007 (US)

(54) **Particulate filter for diesel engines**

(57) A particulate filter (10) for positioning in an exhaust system (12) from a diesel engine (14) comprising a housing (20); the housing having a first end (22) with a opening (26) for the flow of exhaust gases, and a second end (24) with an opening (28) for the flow of exhaust gases; and a filter substrate (30) positioned inside the housing between the opening in the first end and the opening in the second end, the filter substrate having a first surface (40) open to the opening in the first end but substantially closed from the opening in the second end, and a second surface (42) open to the opening in the second end but substantially closed from the opening in

the first end; wherein the first surface and the second surface are capable of trapping ash material; and wherein the opening in the first end is substantially identical to the opening in the second end such that the housing can be positioned in the exhaust system either with the opening in the first end allowing flow of exhaust gases into the housing from the diesel engine, or with the opening in the second end allowing flow of exhaust gases into the housing from the diesel engine. Ash removal from the filter substrate can be easily achieved by reversing the position of the particulate filter relative to the exhaust system.

Fig.3.



DescriptionTechnical Field

[0001] The present invention relates to a particulate filter for the exhaust system of a diesel engine.

Background of the Invention

[0002] It is known to provide particulate filters in the exhaust system of a diesel engine. The filter material (usually a honeycomb structure) in a particulate filter collects particles in the exhaust gases, and burns the particles off continuously or at regular intervals. Not all the particulate matter is fully combusted, and there is a risk that some residual ashes will remain which plug up and partially block the filter over the life of the diesel engine. The only known methods for removing these ashes are mechanical operations. For motor vehicles with diesel engines, the known methods require a service at around 80000 km (for the vehicle), when the filter material of the particulate filter is cleaned with a high pressure cleaner. An alternative system includes exhaust valves which invert the direction of exhaust gas flow through the filter material, thereby blowing the ashes off the filter surface.

Summary of the Invention

[0003] The present invention aims to provide a simplified arrangement for removing ashes from a particulate filter.

[0004] A particulate filter in accordance with the present invention, for positioning in an exhaust system from a diesel engine, comprises a housing; the housing having a first end with an opening for the flow of exhaust gases, and a second end with an opening for the flow of exhaust gases; and a filter substrate positioned inside the housing between the opening in the first end and the opening in the second end, the filter substrate having a first surface open to the opening in the first end but substantially closed from the opening in the second end, and a second surface open to the opening in the second end but substantially closed from the opening in the first end; wherein the first surface and the second surface are capable of trapping ash material; and wherein the opening in the first end is substantially identical to the opening in the second end such that the housing can be positioned in the exhaust system either with the opening in the first end allowing flow of exhaust gases into the housing from the diesel engine, or with the opening in the second end allowing flow of exhaust gases into the housing from the diesel engine.

[0005] In the present invention, the position of the particulate filter can be reversed relative to the exhaust system to provide easy removal of trapped ash material.

Brief Description of the Drawings

[0006] The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic view of a particulate filter in accordance with the present invention positioned in the exhaust system of a diesel engine;

Figure 2 is a perspective view of the particulate filter of Figure 1;

Figure 3 is a cross-sectional view of the particulate filter of Figures 1 and 2 in a first position relative to the exhaust system;

Figure 4 is a cross-sectional view of the particulate filter of Figures 1 and 2 in a second position relative to the exhaust system; and

Figure 5 is a cross-sectional view of an alternative embodiment of particulate filter in accordance with the present invention.

Description of the Preferred Embodiment

[0007] Referring to Figure 1, a particulate filter 10 in accordance with the present invention is for positioning in the exhaust system 12 from a diesel engine 14. The particulate filter 10 traps particles in the exhaust gases from the diesel engine and combusts the particles. Ash material may be formed as a result of the combustion process.

[0008] Referring to Figures 2 and 3, the particulate filter 10 comprises a housing 20 having a first end 22 and a second end 24. The first end 22 has an opening 26 formed therein. The second end 24 has an opening 28 formed therein. The openings 26, 28 are substantially identical in shape, size and configuration. The housing 20 is preferably substantially symmetrical, with the first and second ends 22, 24 being substantially identical and at axially opposed ends of the housing.

[0009] Positioned and secured inside the housing 20 is a filter substrate 30 (shown in enlarged form in Figure 3). The filter substrate 30 has a substantially symmetrical configuration, with a honeycomb structure defining a number of axially extending first bores 32 and a number of axially extending second bores 32'. The first and second bores 32,32' are positioned adjacent one another. Each first bore 32 has an open end 34, and a closed or plugged end 36. Each second bore 32' has an open end 34', and a closed or plugged end 36'. The walls 38 separating the first and second bores 32,32' are formed from the filter material. The open ends 34 of the first bores 32 are positioned adjacent the closed ends 36' of the second bores 32', and the open ends 34' of the second bores are positioned adjacent the closed ends 36 of the first bores. The open ends 34 of the first bores 32 open to the opening 26 in the first end 22, and the closed ends 36 are closed to the opening 28 in the second end 24. The open ends 34' of the second bores

32' open to the opening 28 in the second end 24, and the closed ends 36' are closed to the opening 26 in the first end 22. With this arrangement, exhaust gases (passing through the particulate filter 10) enter and pass along the first bores 32, pass through the filter material defining the walls 38 between the bores, and then pass through (and out of) the second bores 32'. Each filter substrate 30 therefore has a first surface 40 (defined by the walls of the first bores 32) open to the first end 22, but substantially closed to the second end 24; and a second surface 42 (defined by the walls of the second bores 32') open to the second end, but substantially closed to the first end. Ash material formed during the combustion process is trapped on one of the first or second surfaces 40, 42.

[0010] In use, on initial installation of the particulate filter 10 in the exhaust system 12, the opening 26 in the first end 22 receives exhaust gases from the diesel engine 14, and the opening 28 in the second end 24 is connected to atmosphere. Exhaust gas flow through the particulate filter 10 is indicated by the arrows in Figure 3. Ash material formed during the combustion process is trapped on the first surface 40 of the filter substrate 30. After an appropriate period, the particulate filter 10 requires maintenance and removal of the ash. With the present invention, the particulate filter 10 is removed from the exhaust system 12 and then reinstalled in the reverse position. At this stage, the opening 28 in the second end 24 receives exhaust gases from the diesel engine 14, and the opening 26 in the first end 22 is connected to atmosphere. Exhaust gas flow through the particulate filter 10 is indicated by the arrows in Figure 4. Ash previously trapped on the first surface 40 is blown off the filter substrate 30 and into the atmosphere during a light-off phase of the exhaust emissions cycle. New ash material formed during the combustion process is trapped on the second surface 42 of the filter substrate 30.

[0011] By reversing the position of the particulate filter 10 at regular intervals relative to the exhaust system 12, the problem of ash accumulation is resolved in a simple and easy manner, without having to resort to mechanical cleaning, and without the need for special exhaust valves.

[0012] An alternative embodiment for the configuration of a particulate filter 100 in accordance with the present invention is shown in Figure 5. Like parts have been given the same reference numeral as in Figures 1 to 4. In this alternative embodiment, the honeycomb structure of the filter substrate 30 has been replaced by a ceramic mesh-type filter 44. The ceramic filter 44 has the configuration of an enlarged thick-walled tube 38 which is spaced from the housing 20 by an axially extending gap 32'. At one end 36', the gap 32' is closed, whilst the other end 34' of the gap is open. The adjacent ends 34,36 of bore 32 of the ceramic filter 44 are open and closed respectively. The operation of the particulate filter 100 is substantially the same as the particulate filter

of Figures 1 to 4, except that ashes may accumulate inside the filter material as well as on the surface thereof. As described above, at regular intervals the position of the particulate filter 100 is reversed relative to the exhaust system 12 for the removal of ash. In a further alternative, the ceramic filter may be replaced by a foam-type filter of similar configuration.

[0013] The present invention has particular application in motor vehicles having a diesel engine, but may be used with diesel engines having an alternative use.

[0014] The present invention also applies to catalytic converters whose position, relative to the exhaust system, is reversed at regular intervals. The poisoned inlet side of the catalytic converter is moved to the outlet, and the cleaner outlet becomes the inlet side, thereby improving emissions during the light-off phase of the emissions cycle.

20 Claims

1. A particulate filter for positioning in an exhaust system from a diesel engine comprising a housing; the housing having a first end with an opening for the flow of exhaust gases, and a second end with an opening for the flow of exhaust gases; and a filter substrate positioned inside the housing between the opening in the first end and the opening in the second end, the filter substrate having a first surface open to the opening in the first end but substantially closed from the opening in the second end, and a second surface open to the opening in the second end but substantially closed from the opening in the first end; wherein the first surface and the second surface are capable of trapping ash material; and wherein the opening in the first end is substantially identical to the opening in the second end such that the housing can be positioned in the exhaust system either with the opening in the first end allowing flow of exhaust gases into the housing from the diesel engine, or with the opening in the second end allowing flow of exhaust gases into the housing from the diesel engine.
2. A particulate filter as claimed in Claim 1, wherein the first and second ends of the housing are at axially opposite end of the housing.
3. A particulate filter as claimed in Claim 1 or Claim 2, wherein the first and second ends of the housing are substantially identical.
4. A particulate filter as claimed in any one of Claims 1 to 3, wherein the filter substrate comprises a number of axially extending first bores, a number of axially extending second bores, the first and second bores being positioned adjacent one another, filter material defining the walls between adjacent first

and second bores, each bore having an open end and a closed end, with the open ends of the first bores positioned adjacent the closed ends of the second bores, with the open ends of the second bores positioned adjacent the closed ends of the first bores, and with the walls of the first bores forming the first surface and the walls of the second bores forming the second surface.

5

5. A particulate filter as claimed in any one of Claims 1 to 3, wherein the filter substrate comprises an axially extending bore; and wherein the filter substrate is spaced from the housing by an axially extending gap; the axially extending bore being open at one end and closed at the other end, with the radially adjacent ends of the gap being closed and open respectively.

10

15

20

25

30

35

40

45

50

55

Fig.1.

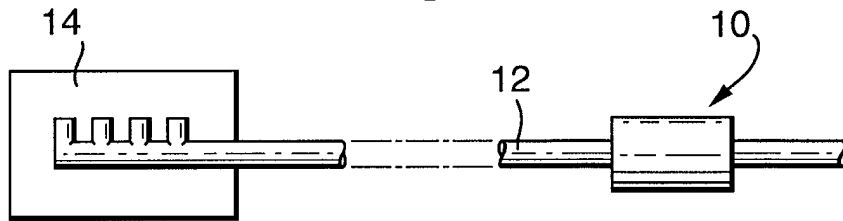


Fig.2.

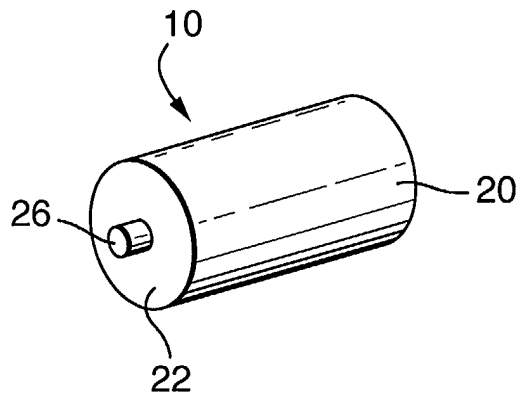


Fig.3.

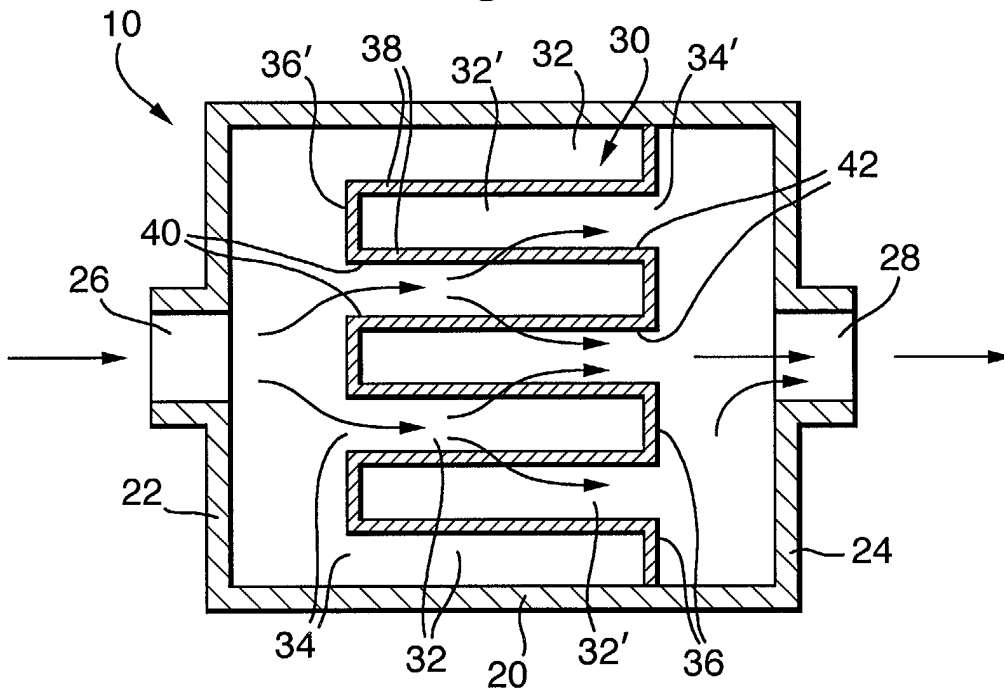
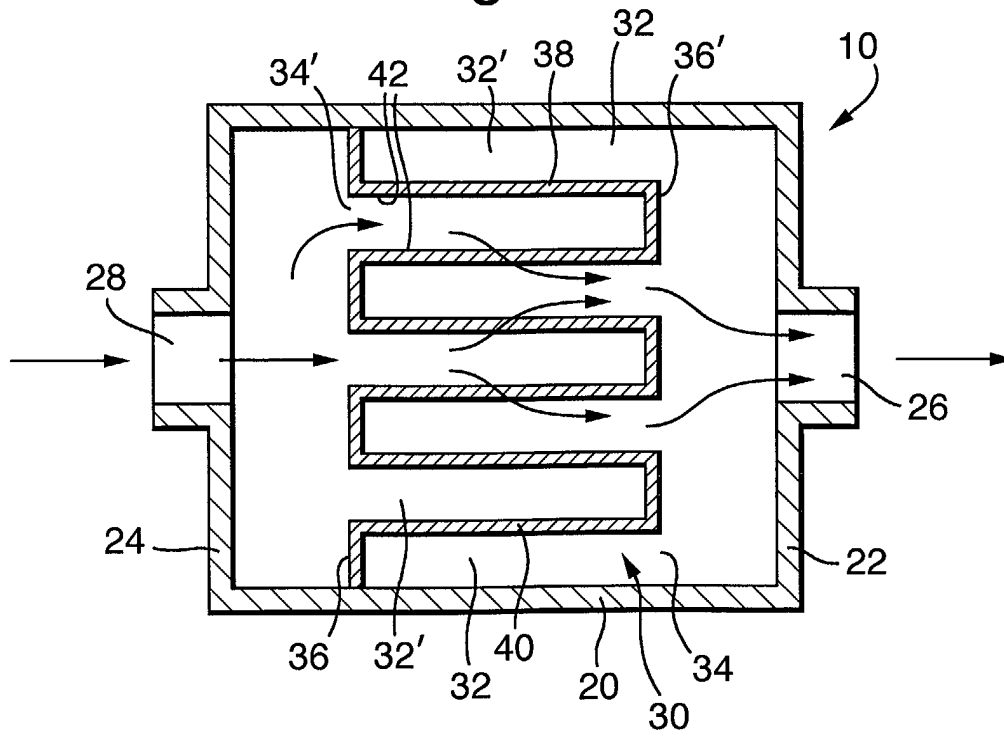


Fig.4.





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 2001/017026 A1 (PETERS BRUCE ET AL) 30 August 2001 (2001-08-30) * abstract * * figure 1 *	1-4	F01N3/022
A	DE 197 08 549 A (GIFHORN ANDREAS ;RABL HANS PETER (DE); DOBIASCH ALEXANDER (DE); ME) 10 September 1998 (1998-09-10) * column 2, line 68 - column 3, line 6 * * column 3, line 44 - column 3, line 53 * * claims 3,11 * * figure 1 *	1-4	
A	EP 0 603 392 A (SUMITOMO ELECTRIC INDUSTRIES) 29 June 1994 (1994-06-29) * abstract * * figures 4A,4B *	1-3,5	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F01N B01D
Place of search	Date of completion of the search	Examiner	
MUNICH	10 March 2003	Ikas, G	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 02 07 9020

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-03-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2001017026 A1	30-08-2001	DE 10003816 A1	02-08-2001
DE 19708549 A	10-09-1998	DE 19708549 A1	10-09-1998
EP 0603392 A	29-06-1994	WO 9323144 A1	25-11-1993
		DE 69216101 D1	30-01-1997
		DE 69216101 T2	17-07-1997
		EP 0603392 A1	29-06-1994
		US 5458664 A	17-10-1995

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82