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(54) **Mixing device**

(57) The invention relates to a mixing device providing an even distribution of a gas stream, which has a perforated pipe with a number of external deflectors attached to the pipe.

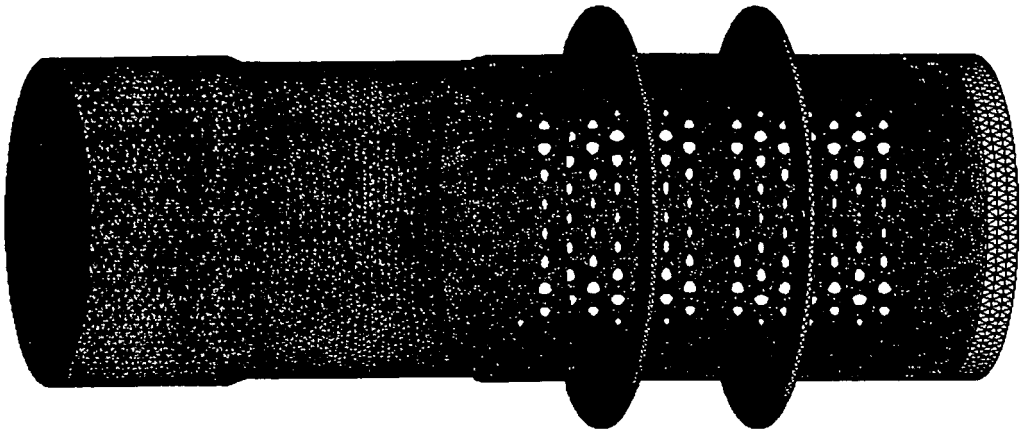

Fig. 1

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## Description

**[0001]** To clean up emissions from diesel engines, (e.g. for vehicles such as trucks and cars, and stationary engines) it is known to use diesel particulate filters (DPFs) and Selective Catalytic Reduction (SCR). For either system to work reliably and effectively it is necessary that the gases are highly dispersed and are evenly distributed onto the catalyst or filter. Mixers can be used to aid dispersion of gases and liquids. However these mixers create pressure losses with consequent reduction in engine performance and fuel economy.

**[0002]** The objective of this disclosure is to create good gas flow diffusion and mixing with minimum pressure loss in within a minimum package space.

**[0003]** In a typical engine exhaust the flow diffusion and mixing device is placed within the exhaust pipe. For a typical heavy duty engine of 12 litres capacity the exhaust pipe diameter is 5 inches.

**[0004]** It could be shown by the applicant that improved flow diffusion and mixing and reduced pressure loss is achieved by having a perforated pipe with a number of external deflectors attached to the pipe to direct the flow towards the substrate front face. The defectors size and number is then optimized depending on the flow conditions and design of the after treatment assembly. The deflectors may be full rings or partial rings attached at different angle to the external of the perforated pipe.

**[0005]** This results in improved mixing and gas flow diffusion and the back pressure is reduced simultaneously. Thus the adverse impact on engine performance and fuel economy is reduced.

Figure 1: shows an example of the combined diffusion and mixer unit with guiding deflectors. Case 01.

Figure 2: shows an example of the diffuser and mixer unit without the deflectors as disclosed in XC7000159-D. Case 02.

Figure 3: shows an example of the diffuser and mixer unit with partial deflectors as disclosed in XC7000159-F. Case 03.

Figure 4: shows the CFD analysis performed on a suitable combined flow diffuser and mixer unit with full deflectors within a vehicle after treatment assembly. Case 01.

Figure 5: show the CFD analysis performed on a suitable combined flow diffuser and mixer unit with out deflectors within a vehicle after treatment assembly. Case 02.

Figure 6: shows the CFD analysis performed on a suitable combined flow diffuser and mixer unit with partial deflectors within a vehicle after treatment assembly. The deflectors in this case are semi-circular. Case 03.

## Claims

1. A mixing device having a member with a plurality of openings.

2. A mixing device having at least one feature as disclosed in the specification and/or the drawings.

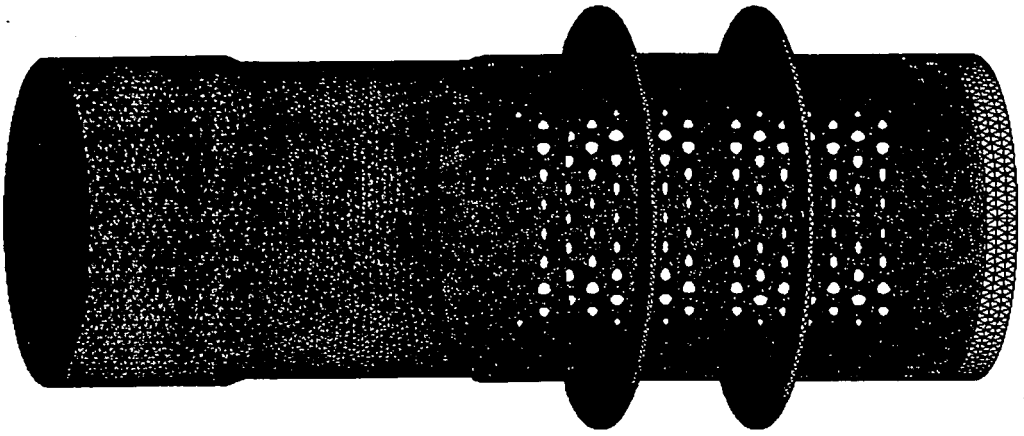


Fig. 1

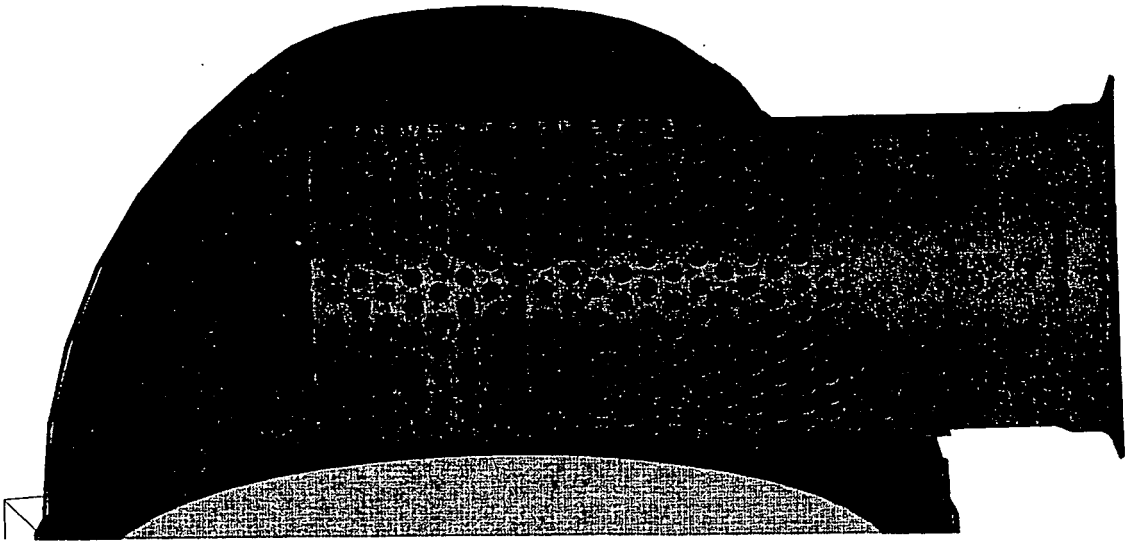


Fig. 2

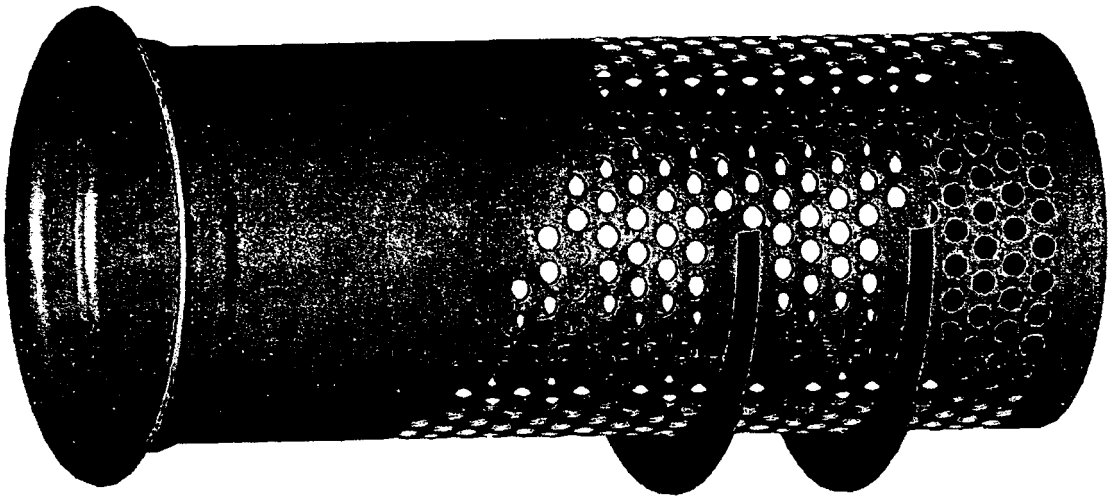


Fig 3a

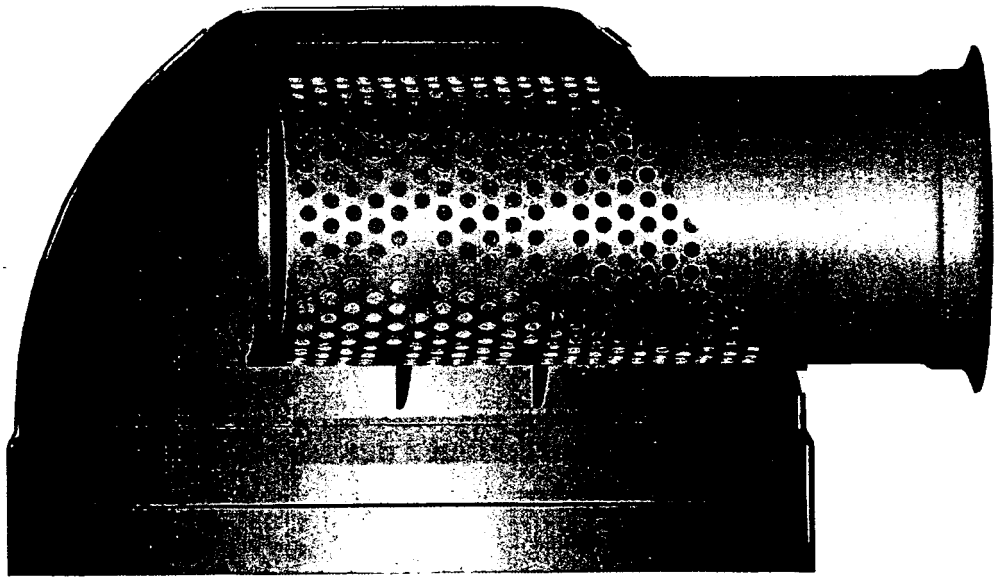
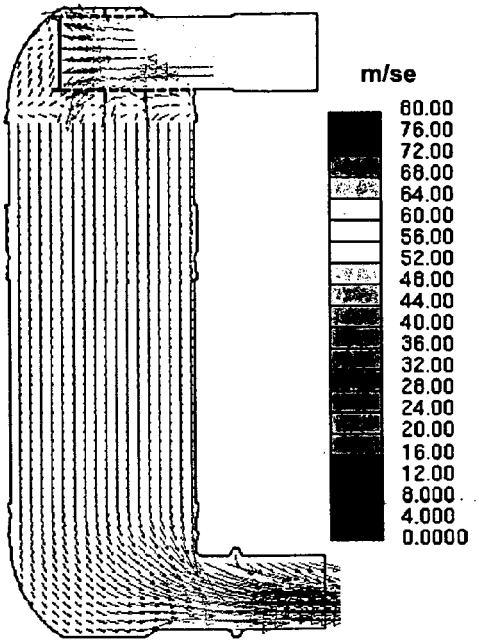
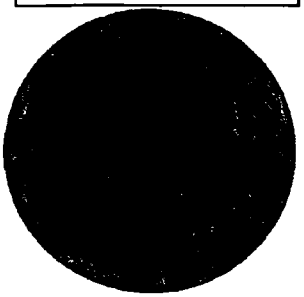


Fig. 3b

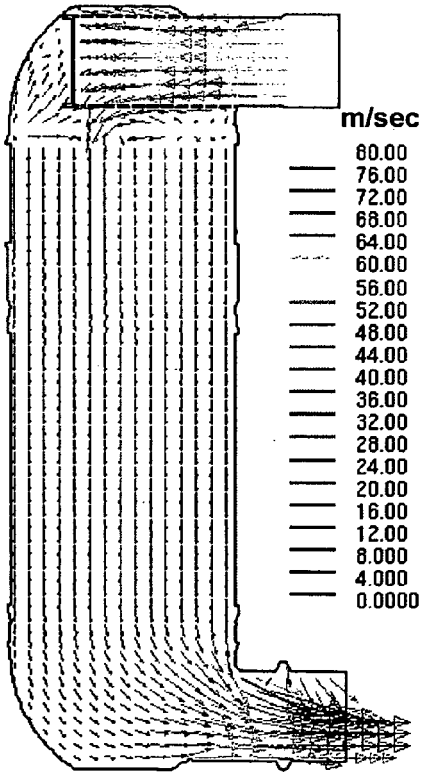



Section through the DOC substrate

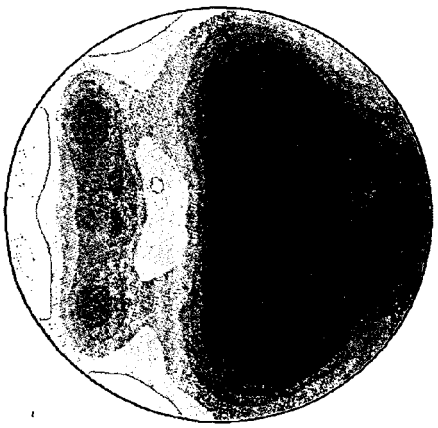



| CFD RUN ID | | DOC RUN029 |
|---|---|---|
| Gamma | ... | 0.980 |
| Vmax | m/sec | 11.7 |
| Vmin | m/sec | 9.2 |
| Vavg | m/sec | 10.5 |
| Backpressure | kPa | 1.3 |

Fig. 4




Section through the DOC substrate




| CFD RUN ID | | DOC RUN019 |
|---|---|---|
| Gamma | ... | 0.953 |
| Vmax | m/sec | 13.0 |
| Vmin | m/sec | 8.2 |
| Vavg | m/sec | 10.8 |
| Backpressure | kPa | 1.5 |

Fig. 5

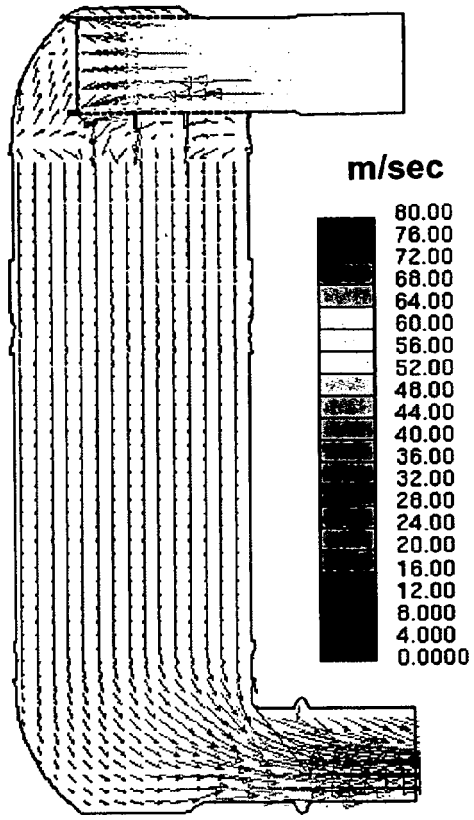
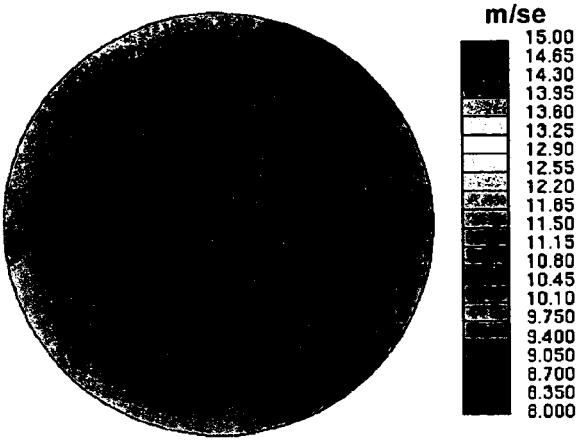



Fig. 6

Section through the DOC substrate




| CFD RUN ID | | DOC RUN031 |
|---|---|---|
| Gamma | ... | 0.973 |
| Vmax | m/sec | 12.1 |
| Vmin | m/sec | 9.0 |
| Vavg | m/sec | 10.6 |
| Backpressure | kPa | 1.4 |

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# PARTIAL EUROPEAN SEARCH REPORT

Application Number EP 08 01 6764

which under Rule 63 of the European Patent Convention shall be considered, for the purposes of subsequent proceedings, as the European search report

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X | US 4 909 635 A (LECOFFRE YVES [FR] ET AL) 20 March 1990 (1990-03-20) * figure 2 * | 1 | INV. B01F5/06 ADD. F01N3/28 |
| X | DE 103 51 690 A1 (F & B GMBH FEUERSCHUTZ & BRAND [DE]) 10 February 2005 (2005-02-10) * figures 1,2 * | 1 | |
| X | US 3 190 618 A (RAPHAEL KATZEN) 22 June 1965 (1965-06-22) * figures 1,9,10 * | 1 | |
| X | US 4 043 539 A (GILMER WILLIAM N ET AL) 23 August 1977 (1977-08-23) * figures 3,4 * | 1 | |
| A | WO 01/04466 A (JOHNSON MATTHEY PLC [GB]; ALLANSSON RONNY [SE]; ANDREASSON ANDERS KLAS) 18 January 2001 (2001-01-18) * figure 3 * | 1 | TECHNICAL FIELDS SEARCHED (IPC) B01F F01N |
| A | WO 2007/110575 A (UK IND LTD [GB]; TELFORD CLIVE [GB]) 4 October 2007 (2007-10-04) * figures 1,2 * | 1 | |

## INCOMPLETE SEARCH

The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC to such an extent that a meaningful search into the state of the art cannot be carried out, or can only be carried out partially, for these claims.

Claims searched completely :

Claims searched incompletely :

Claims not searched :

Reason for the limitation of the search:

see sheet C

4

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 7 April 2009 | Krasenbrink, B |

CATEGORY OF CITED DOCUMENTS

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

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

EPO FORM 1503 03.82 (P04E07)

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**INCOMPLETE SEARCH**
**SHEET C**

Application Number
EP 08 01 6764

Claim(s) searched incompletely:
1

Claim(s) not searched:
2

Reason for the limitation of the search:

1. Independent Claim 1 is not supported by the description as required by Article 84 EPC, as its scope is broader than justified by the description and drawings.

The present claim 1 relates to an extremely large number of possible devices. Support and disclosure within the meaning of Articles 84 and 83 EPC are to be found, however, for only a very small proportion of the devices claimed, namely only to the embodiment disclosed on p.1, l.15-21 and in the figures 1-3b. Non-compliance with the substantive provisions is such that a meaningful search of the whole claimed subject-matter of the claim can not be carried out (Rule 63 EPC and Guidelines B-VIII, 3). The extent of the search has been consequently limited.

Furthermore, to solve the problem described by the invention, namely to "create good gas flow diffusion and mixing with minimum pressure loss in within a minimum package space" (cf. p.1, l.10-11), it is disclosed in the description on p. 1, l.15-21 that the features "perforated pipe" and "external deflectors" are essential to the definition of the invention. Therefore, the search has been performed taking into account the presence of such features.

2. Independent claim 2 contains only references to the description and the drawings. It claims "a mixing device having at least one feature as disclosed in the specification and/or the drawings". According to Rule 43(6) EPC, claims should not contain such references except where absolutely necessary, which is not the case here (see Guidelines C-III, 4.17).

Non-compliance with the substantive provisions is such that no meaningful search of claim 2 could be carried out at all (Rule 63 EPC and Guidelines B-VIII, 3).

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 01 6764

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
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07-04-2009

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EPO FORM P0459

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