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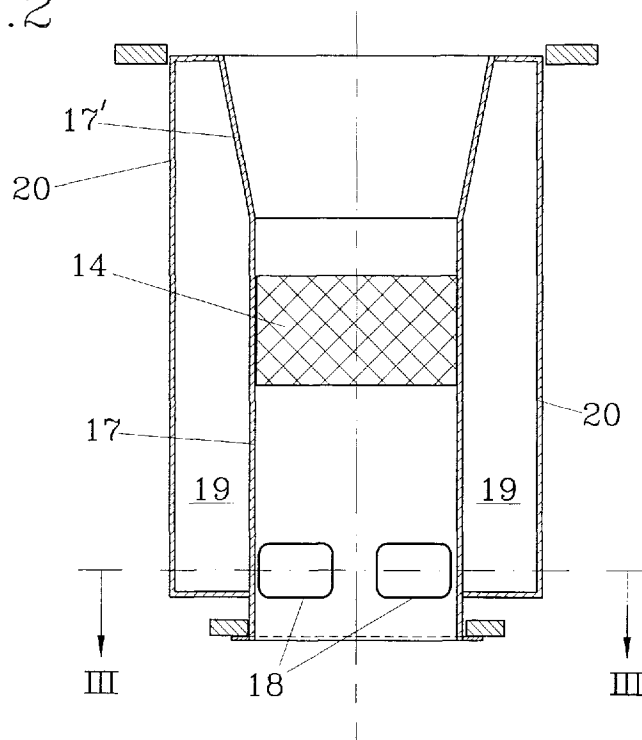
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(54) Reactor chamber for catalytic cleaning of combustion exhausts

(57) An apparatus for damping noise at an exhaust conduit belonging to a Diesel engine (10), which conduit (11) comprises a system (12) for injection of a reagent into the combustion exhausts of the engine. The conduit also comprises at least one reactor chamber (15) for catalytic cleaning of said exhausts, and at least one reactive silencer (18-20; 21, 22) in communication with said

exhaust conduit, the length of said silencer being acoustically adapted to the wave length of the sound waves which are going to be damped within a specific frequency range. The silencer (18-20; 21, 22) comprises at least one resonance chamber (19; 21) which is arranged concentric to a straight segment (17) of the exhaust conduit (11) and which is connected to said channel via at least one opening (18; 22).

FIG.2



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Description

FIELD OF THE INVENTION

The present invention refers to an apparatus for damping noise at an exhaust conduit belonging to a Diesel engine, which conduit comprises a system for injection of a reagent into the combustion exhausts of the engine, at least one reactor chamber for catalytic cleaning of said exhausts, and at least one reactive silencer in communication with said exhaust conduit, the length of said silencer being acoustically adapted to the wave length of the sound waves which are going to be damped within a specific frequency range.

BACKGROUND OF THE INVENTION

When installing a reactor chamber according to above in a vessel, usually accommodations must be made in order to clear the limited amount of available installation space. It is known that a catalytic reactor having a number of layers of ceramic honeycomb monolith blocks, display good sound absorbing properties, especially with regard to high frequency sound. Thus, it is sometimes to possible to dismount the conventional silencer from the funnel shaft and replace it with a reactor chamber. However, you risk the creation of interference within the exhaust system, for certain installation applications and for certain operational conditions, so that certain sound frequencies are increased instead of dampened. Thus, sound damping requirements result in that an additional damper perhaps nevertheless has to installed.

It is known to use a reactive silencer in the form of a quatre wave resonator, a so called Helmholtz resonator, in exhaust systems in order to dampen a certain low frequency noise, e.g. within the range of 35-150 Hz. A conventionally designed quatre wave resonator is however comparatively space consuming and involve a clear risk for collection of soot particles which may cause fire in the exhaust system and a gradual deterioration of the function of the resonator.

THE TECHNICAL PROBLEM

One object of the present invention is therefore to provide an apparatus for sound damping which does not exhibit the above mentioned drawbacks, and which is simple to integrate into an exhaust system comprising a catalytic reactor.

THE SOLUTION

For this object, the invention is characterized in that the silencer comprises at least one resonance chamber which is arranged concentric to a straight segment of the exhaust conduit and which is connected to said channel via at least one opening.

Preferably, the opening is located so that it continually drains occurring soot particles into the exhaust conduit. Alternatively, the opening may be provided with an acoustically permeable filter which prevents soot particles from entering the resonance chamber.

According to a preferable embodiment of the invention, the resonance chamber is located upstream the reactor chamber. This makes it possible to integrate the resonance chamber, e.g. by means of a gasification unit for injection of the reagent, or a reagent mixer unit.

Suitably, the radially inner wall of the resonance chamber is formed by the outer wall of the exhaust conduit. This wall may be provided with a channel segment which diverges conically downstream, said segment opening out into the reactor chamber and causing a reduction in the pressure drop through the reactor.

Two or more resonance chambers may be coaxially located around the exhaust chamber with different lengths that are acoustically adapted to the wave length of the sound waves which are going to be damped within different specific frequency ranges.

DESCRIPTION OF THE DRAWINGS

The invention will be described hereinafter with reference to embodiments that are shown in the enclosed drawings, wherein

- Fig. 1 schematically shows a Diesel motor with an exhaust system equipped with a silencer apparatus according to the invention,
- Fig. 2 shows in a larger scale a section through a silencer apparatus according to the invention, along the line II-II in Fig. 3,
- Fig. 3 shows a section along the line III-III in Fig. 2
- Fig. 4 shows in a corresponding way as Fig. 2 a second embodiment of the silencer apparatus according to the invention,
- Fig. 5 schematically shows a gasification unit with a silencer apparatus according to a third embodiment of the invention, and
- Fig. 6 schematically shows a reactor chamber with a silencer apparatus according to a fourth embodiment of the invention.

DESCRIPTION OF EMBODIMENTS

In the description, the expression "concentrically arranged" is used in order to illustrate the location of the silencer apparatus with reference to the exhaust channel and the components included in the exhaust channel: gasification unit, mixer unit and reactor chamber. The expression "concentric" also include other sections than circular, e.g. quadratic and triangular.

The installation diagrammatically shown in Fig. 1 comprises a Diesel engine 10 with an exhaust conduit 11 which is connected to a gasification unit 12 for injection and gasification of urea or some other reagent into

the exhausts of the engine. The exhausts are conducted from the gasification unit via a first mixer unit 13 and a second mixer unit 14 which mixer units are arranged for providing an even distribution of the reagent in the exhausts.

The mixer unit 14 is connected to a reactor chamber 15 which according to prior art is provided with internal support surfaces for not shown honeycomb monoliths of a ceramic material, which contribute to reduce for example contents of nitric oxide in the exhausts. An outlet 16 from the chamber 15 lead directly out into the atmosphere.

As is illustrated by Fig. 2 and 3, the mixer unit 14 is built into a pipe segment 17 which is provided with a number of openings 18 opening out into an otherwise closed resonance chamber 19 which is arranged concentrically to the pipe segment 17. The chamber 19 forms by means of its outer walls 20 a reactive silencer the length of which is acoustically adapted to the wave length of those sound waves which are going to be damped within a specific frequency range, e.g. 50-150 Hz. The relations between the section areas for the chamber 19 and the pipe segment 17 determines the capacity for damping sound.

The openings 18 are located at the same level as the bottom edge of the chamber 19, so that they are able to drain occurring soot particles being transported by the exhaust stream, back into the pipe segment 17. By adapting the height of the openings, the silencer frequency range may be broadened or concentrated.

Because the resonance chamber encloses the mixer unit 14, the chamber does not lead to any actual lengthening of the exhaust system of the engine 10.

Because the radially inner wall of the resonance chamber is the same as the outer wall 17 of the exhaust conduit, the gas in the resonance chamber will have substantially the same temperature as the gas stream in the exhaust channel, which is acoustically advantageous. Besides, the design leads to a low level of material stress resulting from thermal expansion.

Each honeycomb monolith is provided with a stocking 13 which extends along the vertical sides and forms a seal against the adjacent blocks and the side walls 10.

Tests have proven that a silencer designed according to Fig. 2 and 3 provide a dampening of about 10-20 dB(A) at a flow speed of 25-40 m/sec and a temperature range of 150-500 C°.

The exhaust conduit 17 displays a segment 17' which diverges in the direction of flow, which segment opens out into the reactor chamber and provides a reduction of the pressure fall through the reaction chamber.

Fig. 4 shows an embodiment of the invention where a further resonance chamber 21 is coaxially arranged around the exhaust conduit 17 inside the resonance chamber 19, and communicates acoustically with the exhaust conduit 17 via openings 22 being located downstream the openings 18. These openings 22 are also

located so that they drain soot particles back to the conduit 17. The resonance chamber 21 display a shorter length than the chamber 19 and is in that way acoustically adapted to wave lengths of sound waves which are to be damped within another specific frequency range than that which the chamber 19 is designed for.

Fig. 5 shows a gasification unit 12 with spray nozzle 23 which is equipped with two in series located resonance chambers 19, 21, essentially displaying the same sectional area and length. Because the height of the openings 18 of the reactor chamber 19, as seen in the direction of flow, are larger than the height of the openings 22 of the resonance chamber 21, the two resonance chambers 19, 21 may dampen sound within different ranges of frequency.

Fig. 6 shows a reactor chamber 15 having four outer walls together forming a rectangular chamber section. The chamber comprises three levels of honeycomb monolith blocks 24. Every one of the outer walls of the chamber is so designed that it forms a resonance chamber 19 which is connected via openings 18 to the exhaust channel 11, which openings are located upstream the actual reactor chamber. Because the individual resonance chambers 19 are identically designed, they may work together as a single large resonance chamber. This means that the resonance chambers may be made very small, so that they do not add to the dimensions of the reactor chamber appreciably. Also, the resonance chambers 19 have an insulating effect around the reactor chamber, so that the heat radiation to the environment may be reduced. Because of this effect, the dimensions of the normal thermal insulation 25 of the reactor chamber may be reduced, which also contributes to reducing the outer dimensions of the reactor. One of the four wall elements of the reactor chamber is preferably dismountable, so that the honeycomb monolith blocks 24 may be exchanged.

By means of the apparatus according to the invention, a silencer unit is provided which to a large extent facilitate installation of a plant catalytic reduction of the exhausts from a Diesel engine, in particular within the limited amounts of space which prevail within a vessel.

The invention is not limited to the above described embodiment, instead more variants are conceivable within the scope of the following claims. For example, the reactor chamber may be located at another segment of the exhaust system than shown, e.g. centrally around the gasification unit 12, or downstream the reactor chamber 15. It is possible to provide the apparatus according to the invention with more than two resonance chambers.

Claims

1. Apparatus for damping noise at an exhaust conduit belonging to a Diesel engine (10), which conduit (11) comprises a system (12) for injection of a re-

gent into the combustion exhausts of the engine, at least one reactor chamber (15) for catalytic cleaning of said exhausts, and at least one reactive silencer (18-20; 21, 22) in communication with said exhaust conduit, the length of said silencer being acoustically adapted to the wave length of the sound waves which are going to be damped within a specific frequency range, **characterized** in that the silencer (18-20; 21, 22) comprises at least one resonance chamber (19; 21) which is arranged concentric to a straight segment (17) of the exhaust conduit (11) and which is connected to said channel via at least one opening (18; 22).

2. Apparatus according to claim 1, 15
characterized in that the segment of the exhaust conduit (11) which is enclosed by the resonance chamber (19) houses a gasification unit (12) for injection of the reagent. 20
3. Apparatus according to claim 1, 25
characterized in that the opening (18; 22) is located so that it continually drains occurring soot particles into the exhaust conduit (11). 30
4. Apparatus according to claim 1, 35
characterized in that the segment of the exhaust conduit (11) which is enclosed by the resonance chamber (19) houses a reagent mixer unit (14). 40
5. Apparatus according to any one of the preceding claims, **characterized** in that the radially inner wall (17) of the resonance chamber (19) is provided with a channel segment (17') which diverges conically downstream, said segment opening out into the reactor chamber (15). 45
6. Apparatus according to claim 5, 50
characterized in that the radially inner wall of the resonance chamber (19) is formed by the outer wall (17) of the exhaust conduit. 55
7. Apparatus according to claim 1, 60
characterized in that two or more resonance chambers (19, 21) are coaxially located around the exhaust chamber (17) with different lengths and being acoustically adapted to the wave length of the sound waves which are going to be damped within different specific frequency ranges. 65
8. Apparatus according to claim 1, 70
characterized in that the resonance chamber (19) is located upstream the reactor chamber (15). 75
9. Apparatus according to claim 1, 80
characterized in that the opening (18, 22) is provided with an acoustically permeable filter. 85

FIG. 1

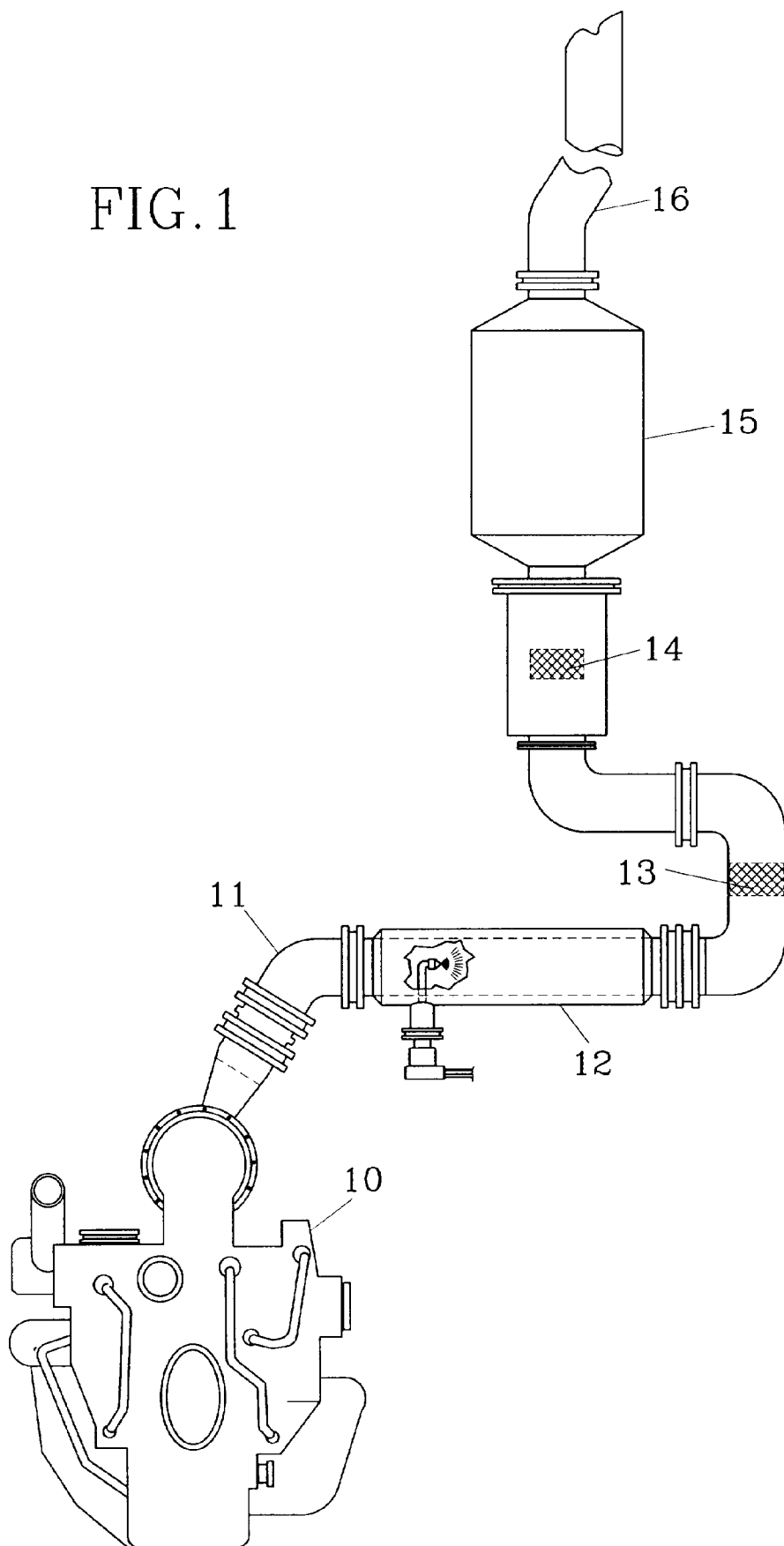


FIG.2

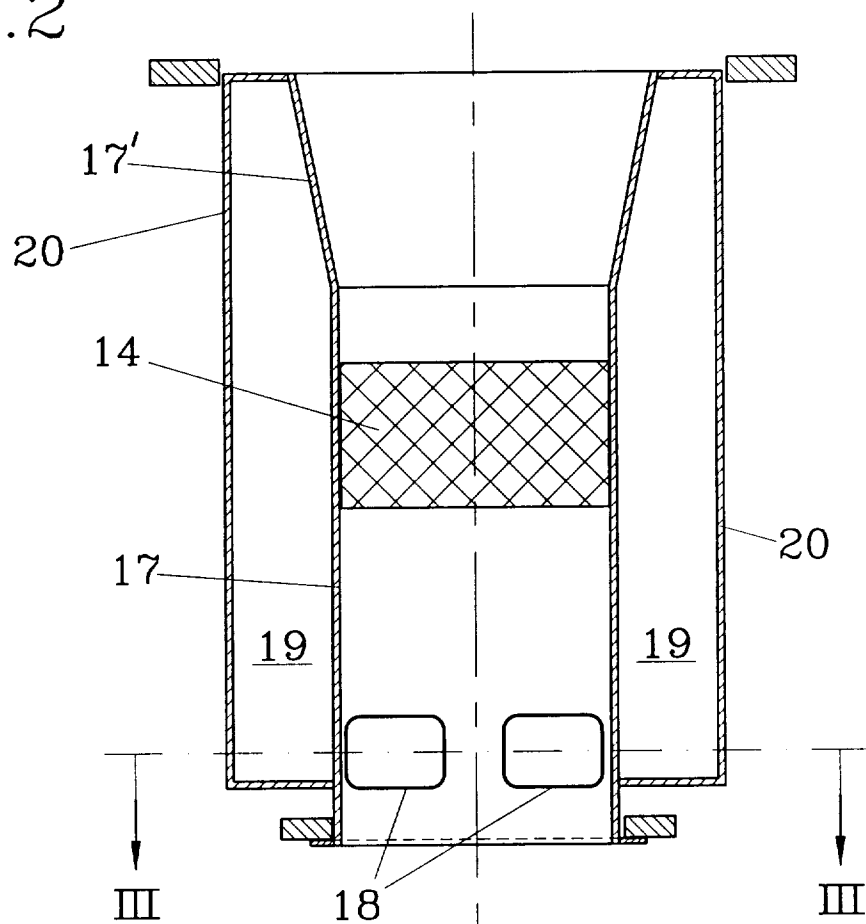


FIG.3

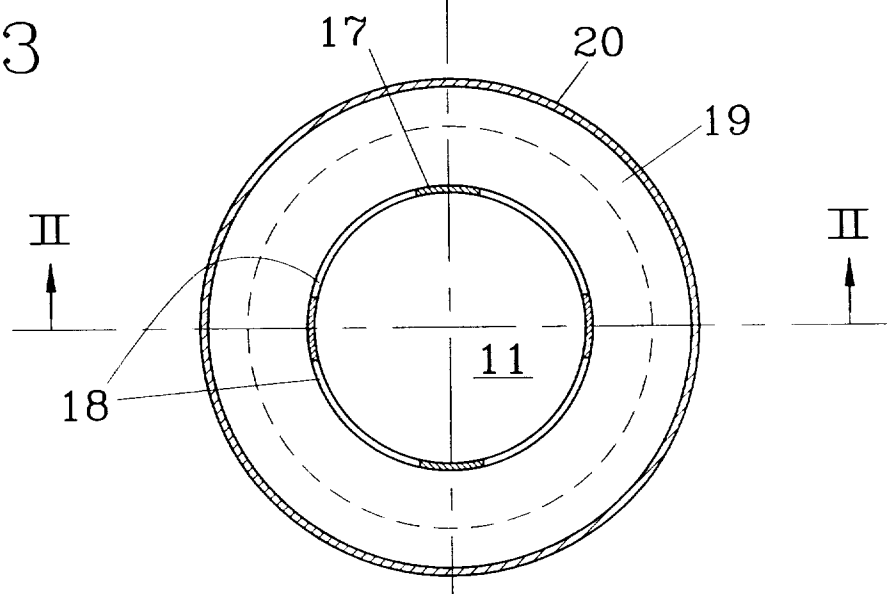
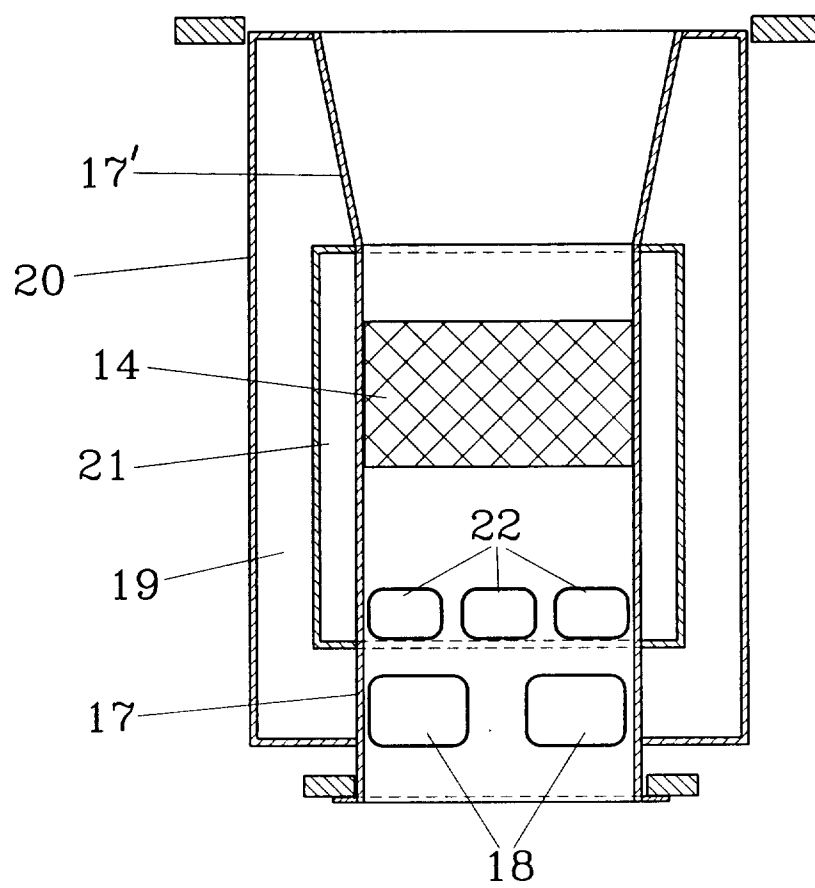


FIG. 4



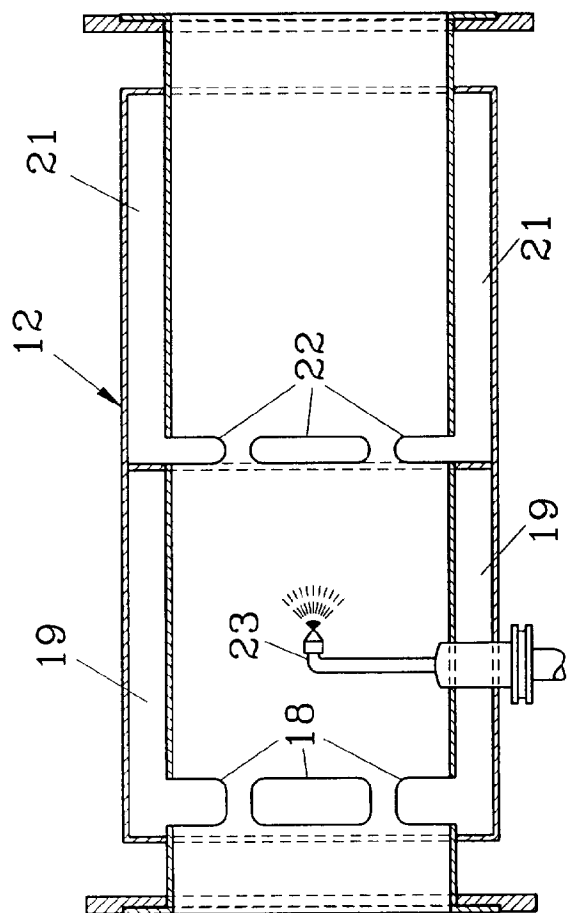


FIG. 5

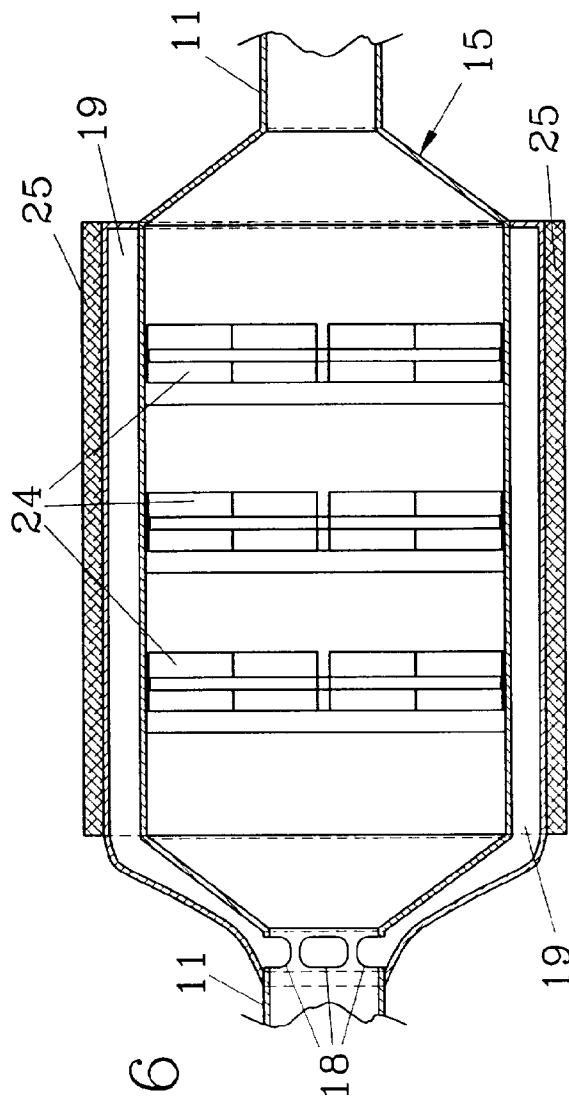


FIG. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 96 85 0186

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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A	* column 3, line 31 - line 56; figure 2 * ---	2,4	
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 26 February 1997	Examiner Friden, C
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			

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EUROPEAN SEARCH REPORT

Application Number
EP 96 85 0186

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.6)
A	US 3 780 826 A (HUBBELL F) 25 December 1973 -----		
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 26 February 1997	Examiner Friden, C
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			

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