

US Patent & Trademark Office

Patent Public Search | Text View

United States Patent	12392271
Kind Code	B2
Date of Patent	August 19, 2025
Inventor(s)	Velyaev; Oleksandr et al.

Modularly constructed exhaust gas treatment arrangement

Abstract

In a modularly configured exhaust gas treatment arrangement, a first module includes an entry interface and a first mixing section, a second module includes a first deflection housing and a first catalytic converter arrangement of a first exhaust gas treatment section. The second module is detachably connected to the first module and a third module includes a particle filter arrangement of the first exhaust gas treatment section. The third module is detachably connected to the second module and a fourth module includes a second deflection housing. The fourth module is detachably connected to the third module. A fifth module includes a second mixing section, a third deflection housing, and a second exhaust gas treatment section and the fifth module is detachably connected to the fourth module.

Inventors: Velyaev; Oleksandr (Stuttgart, DE), Lin; Shengxiao (Esslingen, DE), Kast; Peter (Esslingen, DE)

Applicant: Purem GmbH (Neunkirchen, DE)

Family ID: 1000008765553

Assignee: Purem GmbH (Neunkirchen, DE)

Appl. No.: 18/640983

Filed: April 19, 2024

Prior Publication Data

Document Identifier	Publication Date
US 20240352883 A1	Oct. 24, 2024

Foreign Application Priority Data

DE	10 2023 110 142.0	Apr. 21, 2023
----	-------------------	---------------

Publication Classification

Int. Cl.: **F01N13/00** (20100101); **F01N3/021** (20060101); **F01N3/10** (20060101); **F01N3/20** (20060101); **F01N3/28** (20060101)

U.S. Cl.:

CPC **F01N13/0097** (20140603); **F01N3/021** (20130101); **F01N3/106** (20130101); **F01N3/2066** (20130101); **F01N3/2882** (20130101); **F01N3/2892** (20130101); **F01N2610/1453** (20130101)

Field of Classification Search

CPC: F01N (13/0097); F01N (3/021); F01N (3/106); F01N (3/2066); F01N (3/2882); F01N (3/2892); F01N (2610/1453)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
8695330	12/2013	Davidson	60/303	B01D 53/9495
10907522	12/2020	Poinsot	N/A	F01N 3/208
10914218	12/2020	Chapman	N/A	F01N 3/2066
2009/0158721	12/2008	Wieland et al.	N/A	N/A
2010/0242450	12/2009	Werni	60/299	F01N 13/0097
2015/0071822	12/2014	Stanavich	422/128	B01F 25/3131
2016/0115847	12/2015	Chapman	60/324	F01N 3/2892
2016/0160727	12/2015	Isada et al.	N/A	N/A
2017/0241322	12/2016	Isada et al.	N/A	N/A
2019/0323397	12/2018	Pill	N/A	F01N 3/2892
2020/0032695	12/2019	Bean	N/A	F16B 2/08
2022/0251994	12/2021	Lin	N/A	F01N 3/2892
2022/0341355	12/2021	Webb	N/A	F01N 3/208
2022/0356832	12/2021	Brenner	N/A	B01D 53/9431

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
10 2015 015 505	12/2015	DE	N/A
102020007553	12/2020	DE	F01N 13/009
10 2021 111 759	12/2021	DE	N/A

Primary Examiner: Largi; Matthew T

Attorney, Agent or Firm: Walter Ottesen, P.A.

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

(1) This application claims priority of German patent application no. 10 2023 110 142.0, filed Apr. 21, 2023, the entire content of which is incorporated herein by reference.

TECHNICAL FIELD

(2) The present disclosure relates to modularly constructed exhaust gas treatment arrangements, which, in particular in exhaust gas systems of internal combustion engines used in vehicles, contribute to reducing the pollutant emissions.

BACKGROUND

(3) Such exhaust gas treatment arrangements, which are used, for example, in association with diesel internal combustion engines, generally include, following one another in the direction of flow, a diesel oxidation catalytic converter, a diesel particle filter, and an SCR catalytic converter. A mixing section is provided upstream of the SCR catalytic converter, in which exhaust gas and reaction agent dispensed by a reaction agent dispensing arrangement, generally designated as an injector, for example a urea-water solution, are mixed and reacted to subsequently carry out a selective catalytic reduction in the SCR catalytic converter. To comply with the exhaust gas norms, which are becoming stricter, it can be necessary to connect a further SCR catalytic converter upstream of these system areas provided for exhaust gas treatment. A further mixing section is required in association with this further SCR catalytic converter, generally designated as a pre-SCR catalytic converter, in order to mix exhaust gas with reaction agent upstream of this pre-SCR catalytic converter and supply it to the pre-SCR catalytic converter.

(4) Since the installation space available for receiving exhaust gas treatment arrangements is limited in vehicles, for example, also utility vehicles or trucks, and it is also thus predetermined where in such vehicles the upstream or downstream connection areas are provided for the integration of an exhaust gas treatment arrangement in an exhaust gas system, the requirement also exists in principle of housing exhaust gas treatment arrangements containing further system areas while maintaining or achieving an optimum flow behavior with the least possible counter pressure in the installation space which is available in already existing or conceived vehicles. This requires that when further system areas are integrated in such exhaust gas treatment arrangements, their external dimensions also cannot or cannot significantly deviate from the external dimensions of already existing exhaust gas treatment arrangements. At the same time, the possibility has to exist or be retained of having access to system areas of such exhaust gas treatment arrangements which degrade in exhaust gas treatment operation and therefore require maintenance or replacement.

SUMMARY

(5) It is an object of the present disclosure to provide an exhaust gas treatment arrangement, in particular for an exhaust gas system of an internal combustion engine in a vehicle, which, with improved exhaust gas treatment capacity, offers the possibility of maintenance or replacement of system areas thereof.

(6) This object is achieved according to the disclosure by a modularly constructed exhaust gas treatment arrangement, including: an entry interface for receiving exhaust gas in the exhaust gas treatment arrangement, a first mixing section, a first exhaust gas treatment section having a first catalytic converter arrangement and a particle filter arrangement, a second mixing section, a second exhaust gas treatment section having a second catalytic converter arrangement, a first deflection housing, which connects an exit area of the first mixing section to an entry area of the first exhaust gas treatment section, a second deflection housing, which connects an exit area of the first exhaust gas treatment section to an entry area of the second mixing section, a third deflection housing, which connects an exit area of the second mixing section to an entry area of the second exhaust gas treatment section.

(7) In this exhaust gas treatment arrangement, it is furthermore provided according to the disclosure that: a first module includes the entry interface and the first mixing section, a second module

includes the first deflection housing and the first catalytic converter arrangement of the first exhaust gas treatment section, wherein the second module is detachably connected to the first module, a third module includes the particle filter arrangement of the first exhaust gas treatment section, wherein the third module is detachably connected to the second module, a fourth module includes the second deflection housing, wherein the fourth module is detachably connected to the third module, a fifth module includes the second mixing section, the third deflection housing, and the second exhaust gas treatment section, wherein the fifth module is detachably connected to the fourth module.

(8) Due to the breakdown of the exhaust gas treatment arrangement into a plurality of modules detachably connected to one another, there is the possibility of constructing each such module alone and detached from other modules and integrating it as such in the exhaust gas treatment arrangement or removing it therefrom to carry out maintenance or replacement work. At the same time, the use of a plurality of modules in the exhaust gas treatment arrangement assists spatial positioning of the individual modules or system areas of the individual modules in relation to one another such that a compact construction is obtained, which permits an exhaust gas treatment arrangement, in particular also containing a further mixing section, to be integrated into the installation space available in already constructed or conceived vehicles.

(9) For a connection of the modules to one another which is simple to implement and also reliable and gas-tight, it is proposed that at least one module of the first module, second module, third module, fourth module, and fifth module be detachably connected to at least one further module of the first module, second module, third module, fourth module, and fifth module by a screw connection and/or a clamp connection.

(10) It is to be noted in this context that when two modules adjoin one another and are to be detachably connected to one another in the area of tubular elements, the tubular elements can be positioned adjoining one another with flange-type ends thereof, possibly with a seal element interposed, and can be connected to one another by a pipe clamp externally enclosing the flange-type ends or by threaded bolts or the like which are led through the flange-type ends or couple them to one another. For the detachable attachment of a tubular element of one module to a deflection housing of another module, a flange-type end of the tubular element can be attached to the deflection housing by a threaded bolt or the like extending through this end and a wall of the deflection housing or provided thereon. Alternatively, to attach a tubular element of a module, constructed having a flange-type end, to a deflection housing, the deflection housing can have a tubular or nozzle-type area having a flange-type end protruding from a wall thereof, which is positioned opposite to the flange-type end of the tubularly constructed element, possibly with a seal element interposed, and is connected via a pipe clamp externally enclosing these flange-type ends or a plurality of threaded bolts or the like extending through the flange-type ends or coupling them to one another.

(11) For the detachable connection of the first module to the second module, the exit area of the first mixing section can be detachably connected to an entry area of the first deflection housing.

(12) The second module can be detachably coupled with the third module in a simple manner in that an exit area of the first catalytic converter arrangement is detachably connected to an entry area of the particle filter arrangement.

(13) The third module can be detachably connected to the fourth module in that an exit area of the particle filter arrangement is detachably connected to an entry area of the second deflection housing.

(14) For the detachable connection of the fourth module to the fifth module, it is proposed that an exit area of the second deflection housing be detachably connected to the entry area of the second mixing section.

(15) To efficiently reduce the nitrogen oxide proportion in the exhaust gas emitted by an internal combustion engine, in particular a diesel internal combustion engine, it is proposed that the first

catalytic converter arrangement include a pre-SCR catalytic converter unit, and that the first module have a first reaction agent interface for receiving a first reaction agent dispensing arrangement.

(16) For example, the first reaction agent interface can be provided in the area of an entry area of the first mixing section.

(17) The first catalytic converter arrangement can furthermore include an oxidation catalytic converter unit.

(18) To reduce the nitrogen oxide proportion in the exhaust gas emitted by an internal combustion engine as much as possible, the second catalytic converter arrangement can include at least one main SCR catalytic converter unit, and the fourth module can have a second reaction agent interface for receiving a second reaction agent dispensing arrangement.

(19) In order to make the capacity of the second catalytic converter arrangement for reducing the nitrogen oxide proportion as large as possible, it can include two main SCR catalytic converter units connected in parallel to one another.

(20) To achieve a compact configuration, it is proposed that, in the circumferential direction around a longitudinal center access of the exhaust gas treatment arrangement, one of the main SCR catalytic converter units follows the first exhaust gas treatment section, the second mixing section follows the one main SCR catalytic converter unit of the two main SCR catalytic converter units, the other main SCR catalytic converter unit of the two main SCR catalytic converter units follows the second mixing section, and the first exhaust gas treatment section follows the other main SCR catalytic converter unit of the two main SCR catalytic converter units.

(21) A compact construction of the exhaust gas treatment arrangement according to the disclosure can furthermore be assisted in that the first mixing section is elongated in the direction of a first mixing section longitudinal axis, which is essentially parallel to an exhaust gas treatment arrangement longitudinal axis, the second mixing section is elongated in the direction of a second mixing section longitudinal axis, which is essentially parallel to the exhaust gas treatment arrangement longitudinal axis, the first exhaust gas treatment section is elongated in the direction of a first exhaust gas treatment section longitudinal axis, which is essentially parallel to the exhaust gas treatment arrangement longitudinal axis, the second exhaust gas treatment section is elongated in the direction of a second exhaust gas treatment section longitudinal axis, which is essentially parallel to the exhaust gas treatment arrangement longitudinal axis, and the first mixing section, the second mixing section, the first exhaust gas treatment section, and the second exhaust gas treatment section are arranged overlapping one another in the direction of the exhaust gas treatment arrangement longitudinal axis.

(22) If the first deflection housing and the third deflection housing are arranged here in a first axial end area of the exhaust gas treatment arrangement with respect to an exhaust gas treatment arrangement longitudinal axis and the second deflection housing is arranged in a second axial end area with respect to the exhaust gas treatment arrangement longitudinal axis, essentially all system areas extending in the direction of the exhaust gas treatment arrangement longitudinal axis are located in the same axial area or essentially completely overlapping one another, so that a construction which is compact in the direction of the exhaust gas treatment arrangement longitudinal axis is achieved.

(23) An exit housing can be provided for the emission of treated exhaust gas from the exhaust gas treatment arrangement, wherein an exit area of the second exhaust gas treatment section is open to the exit housing, and an exit interface for emitting exhaust gas from the exhaust gas treatment arrangement can be provided on the exit housing. For example, the exit housing can form a component of the fifth module.

(24) To assist the mixing of exhaust gas and reaction agent in the second mixing section, at least a part of the second mixing section can extend in the interior of the exit housing.

(25) The disclosure furthermore relates to an exhaust gas system for an internal combustion engine, including an exhaust gas treatment arrangement constructed according to the disclosure.

Description

BRIEF DESCRIPTION OF DRAWINGS

- (1) The invention will now be described with reference to the drawings wherein:
- (2) FIG. 1 shows a schematic top view of an exhaust gas treatment arrangement in viewing direction I in FIG. 2;
- (3) FIG. 2 shows the exhaust gas treatment arrangement of FIG. 1 in the viewing direction II in FIG. 1;
- (4) FIG. 3 shows the exhaust gas treatment arrangement of FIG. 1 in the viewing direction III in FIG. 1;
- (5) FIG. 4 shows a schematic representation of the detachable connection of two modules of the exhaust gas treatment arrangement of FIG. 1; and,
- (6) FIG. 5 shows a schematic representation of the area of the exhaust gas treatment arrangement of FIG. 1, in which the exhaust gas treated in the exhaust gas treatment arrangement leaves the exhaust gas treatment arrangement at an exit interface.

DETAILED DESCRIPTION

- (7) In the figures, a schematically shown exhaust gas treatment arrangement for an exhaust gas system **10** of an internal combustion engine is generally designated by **12**. The exhaust gas treatment arrangement **12** is modularly constructed in principle and includes five modules **M1** to **M5**, described hereinafter in detail, which are detachably connected to one another.
- (8) A first module **M1** includes a first mixing section **14**, constructed, for example, using a tubular element **26**. At an entry area **16** of the first mixing section **14**, an entry interface **18** of the exhaust gas treatment arrangement **12**, which is constructed, for example, using a pipe section or a pipe connecting piece, is provided, using which it can be connected to an upstream area of the exhaust gas system **10**. Exhaust gas A emitted by an internal combustion engine enters the exhaust gas system **10** in the area of the entry interface **18**.
- (9) A first reaction agent interface **22** is provided in the area of the entry area **16** of the first mixing section **14** or at the tubular element **20**, which also provides the entry interface **18**. A first reaction agent dispensing arrangement **24**, also designated in general as an injector, can be connected in the area of the first reaction agent interface **22** to the module **M1** in an upstream area of the first mixing section **14**. A reaction agent, such as a urea/water solution, can be introduced by the first reaction agent dispensing arrangement **24** into the exhaust gas A flowing into the exhaust gas system **10** in the area of the entry interface **18**. For efficient mixing of reaction agent, generally dispensed as a spray mist, with the exhaust gas A, for example, a mixer constructed using a large number of blade-like deflection elements or the like can be arranged in the first mixing section **14**. As it flows along the tubular element **26**, which is essentially elongated in a first mixing section longitudinal direction **LM1**, of the first mixing section **14** the exhaust gas A mixes with the reaction agent.
- (10) A downstream exit area **28** of the first mixing section **14** is detachably connected, as illustrated by an area indicated by dashed lines, to a first deflection housing **30**. For this purpose, a flange-like end **100** of the tubular element **26** of the first mixing section **14**, which can be seen in the lower part of FIG. 4, can be detachably connected by a plurality of threaded bolts **102** or the like to a wall **104** of the first deflection housing **30**. Alternatively, as illustrated in the upper part of FIG. 4, a pipe connecting piece **108** formed having a flange-like end **106** can be provided on the wall **100** of the first deflection housing **30**, wherein the flange-like ends **100**, **106** on the tubular element **26**, on the one hand, and on the first deflection housing **30**, on the other hand, which then abut one another, can be connected to one another firmly and in a gas-tight manner by a plurality of threaded bolts or

by a pipe clamp **110** enclosing them.

(11) The exhaust gas or mixture of exhaust gas and reaction agent introduced in the exit area **28** of the first mixing section **14** into the first deflection housing **30** in an entry area **31** thereof is deflected in the first deflection housing **30** with respect to an exhaust gas treatment arrangement longitudinal direction $L_{sub.A}$ by approximately 180° and leaves the first deflection housing **30** in the direction of a first exhaust gas treatment section **32**. The first exhaust gas treatment section **32** includes, following one another in the direction of flow, a first catalytic converter arrangement **34** and a particle filter arrangement **36**. The first catalytic converter arrangement **34** includes a pre-SCR catalytic converter unit **38** and, for example, downstream thereof, an oxidation catalytic converter unit **40**.

(12) The first deflection housing **30** forms, with the first catalytic converter arrangement **34** of the first exhaust gas treatment section **32**, which is fundamentally elongated in a first exhaust gas treatment arrangement longitudinal direction $L_{sub.A1}$ and can also have flow through it in this direction, a second module **M2**. For this purpose, for example, a tubular jacket of the first catalytic converter arrangement **34**, which receives the pre-SCR catalytic converter unit **38** and the oxidation catalytic converter unit **40** with, for example, fibrous or matted bearing material interposed, can be firmly connected to a wall of the first deflection housing **30**, for example, by material bonding. Alternatively, a tubular housing of the first catalytic converter arrangement **34** can be firmly connected to the first deflection housing **30**. The pre-catalytic converter unit **38** or the oxidation catalytic converter unit **40** can then be received in this tubular housing. Each of these units can then in turn be constructed with a jacket and the catalytic converter block received therein, for example, with fibrous or matted material interposed.

(13) The particle filter arrangement **36** forms a third module **M3** of the exhaust gas treatment arrangement **12**. An entry area **42** of the particle filter arrangement **36** is detachably connected to an exit area **44** of the first catalytic converter arrangement **34**, as indicated by a dashed line. For this purpose, the first catalytic converter arrangement **34** and the particle filter arrangement **36**, which are constructed in principle using tubular housing elements or jackets, can be formed flange-like in their ends adjoining one another, thus in the entry area **42** and in the exit area **44**, and can be connected to one another detachably and in a gas-tight manner by a pipe clamp enclosing these areas or by a plurality of threaded bolts.

(14) An exit area **46** of the particle filter arrangement **36** detachably abuts a second deflection housing **48**. The second deflection housing **48** forms a fourth module **M4** in the exhaust gas treatment arrangement **12**. An entry area **50** of the second deflection housing **48** is connected detachably and in a gas-tight manner to the exit area **46** of the particle filter arrangement for example in a manner as was described above with reference to the connection of the first deflection housing **30** to the first mixing section **14**, by a pipe clamp or by a plurality of threaded bolts or the like.

(15) In the second deflection housing **48**, the exhaust gas or mixture of exhaust gas and reaction agent flowing out of the first exhaust gas treatment section **32** in the direction of the first exhaust gas treatment section longitudinal axis $L_{sub.A1}$ or in the direction of the exhaust gas treatment arrangement longitudinal axis $L_{sub.A}$ is deflected and in the area of an exit area **52** of the second deflection housing **48**, the exhaust gas leaves the fourth module **M4** provided essentially by the second deflection housing **48** in the direction toward a second mixing section **56** essentially including a tubular element **54**. An entry area **58** of the second mixing section **56** is detachably connected to the exit area **52** of the second deflection housing **48**. The detachable connection can also be connected here in the manner described above with reference to the detachable connection between the exit area **28** of the first mixing section **14** and the entry area **31** of the first deflection housing **30**.

(16) A second reaction agent interface **60** is provided in association with the second mixing section **56** on the fourth module **M4** or on the second deflection housing **48**. In the area of the second

reaction agent interface **60**, which is essentially opposite to the entry area **58** of the second mixing section **56**, a second reaction agent dispensing arrangement **62** is fixed on the second deflection housing **48**, so that reaction agent emitted by the second reaction agent dispensing arrangement **62**, for example, a urea/water solution, is introduced together with the exhaust gas flowing through the second deflection housing **48** into the entry area **58** of the second mixing section **56**. The mixture of exhaust gas and reaction agent flows into the tubular element **54**, which is elongated in a second mixing section longitudinal direction L.sub.M2, of the second mixing section **56**, wherein a mixer including a large number of deflection blades or the like can be arranged to assist the mixing in the tubular element **54**.

(17) At an exit area **64** of the second mixing section **56**, the latter adjoins a third deflection housing **66**. The tubular element **54** of the second mixing section **56** can be firmly connected here to a wall of the third deflection housing **66**, for example, by welding or the like.

(18) It is to be noted that the deflection housings **30**, **48**, **66** provided in the exhaust gas treatment arrangement **12**, where the mixing sections **14**, **56** or the exhaust gas treatment sections **32**, **68** adjoin respective entry areas or exit areas thereof, have openings in order to enable the entry or the exit of exhaust gas and possibly reaction agent into or out of deflection chambers formed in the deflection housings **30**, **48**, **66**.

(19) In the third deflection housing **66**, the mixture of exhaust gas and reaction agent leaving the second mixing section **56** is deflected by approximately 180° in the direction of a second exhaust gas treatment section designated in general by **68**. The second exhaust gas treatment section **68** includes a second catalytic converter arrangement **70** having two main SCR catalytic converter units **72**, **74** arranged adjacent to one another transversely to the exhaust gas treatment longitudinal direction L.sub.A and elongated in a second exhaust gas treatment section longitudinal direction L.sub.A2. Each of the main SCR catalytic converter units **72**, **74** can have a tubular jacket, which can be connected firmly and in a gas-tight manner to a wall of the third deflection housing **66** by welding or the like and in each of which at least one catalytic converter block can be held with fibrous or matted material interposed. Alternatively, each of the main SCR catalytic converter units **72**, **74** can have a tubular housing firmly connected to the third deflection housing **66**, for example, by welding or the like, in each of which at least one catalytic converter unit can be received each having a tubular jacket and a catalytic converter block held therein, for example, by fibrous material or mat material.

(20) At their downstream ends **86**, **88**, the two main SCR catalytic converter units **72**, **74** of the second catalytic converter arrangement **70** are open to an exit housing, which is designated in general by **76** and is indicated in FIG. 5 by dashed lines. The arrangement can be such that the tubular element **54** of the second mixing section **56** penetrates the exit housing **76** at least in some areas, so that exhaust gas flowing out of the main SCR catalytic converter units **72**, **74** can flow around the tubular element **54** at least in some areas and transfers heat thereto in this case. The evaporation of reaction agent in the second mixing section **56** and thus also the mixing of the reaction agent with the exhaust gas can be assisted in this way. An exit interface **80** of the exhaust gas treatment arrangement **12**, which is provided, for example, by a tubular element **78** or an opening in the exit housing **76**, is provided on the exit housing **76**. Using this exit interface **80**, the exhaust gas treatment arrangement **12** can be connected to a tubular system area of the exhaust gas system **10**, for example, which follows downstream, so that the pollutant-reduced exhaust gas treated in the exhaust gas treatment arrangement **12** can be discharged from the exhaust gas treatment arrangement **12**.

(21) To get access to the fourth module M4 essentially provided by the second deflection housing **48** and the particle filter arrangement **36** essentially providing the third module M3, the exit housing **76** can be formed in multiple parts and can have, for example, a detachable housing bottom also providing the exit interface **80**. Alternatively or additionally, the exit housing **76** can be configured to open in a lateral area, in order to get access laterally to the system areas of the

exhaust gas treatment arrangement **12** located in the interior of the exit housing **76**.

(22) In the exhaust gas treatment arrangement **12** shown in FIGS. **1** to **3**, the second mixing section **56**, the third deflection housing **66**, the second exhaust gas treatment section **68**, the exit housing **76**, and the exit interface **80** provided thereon thus form a fifth module **M5**, which is detachably connected in the above-described manner in the area of the entry area **58** of the second mixing section **56** to the fourth module **M4** essentially provided by the second deflection housing **48**.

(23) Due to the modular structure of the exhaust gas treatment arrangement **12**, a compact structure is achieved in which each of the modules **M1** to **M5** can be constructed separately as such in order to detachably connect the modules, which are provided as such with high structural strength and preferably system areas firmly and permanently connected to one another, such as deflection housings and tubular elements, to one another in the above-described manner. The various system areas of the exhaust gas treatment arrangement **12** which are elongated in the exhaust gas treatment arrangement longitudinal direction $L_{sub.A}$, thus essentially the two mixing sections **14**, **56** and the two exhaust gas treatment sections **32**, **68**, are located adjacent to one another transversely to the exhaust gas treatment arrangement longitudinal direction $L_{sub.A}$ and essentially completely overlapping one another axially, so that a structure results in which the first deflection housing **30** and the third deflection housing **66** are positioned essentially in the same axial area or in a first axial end area **82** of the exhaust gas treatment arrangement **12** and the second deflection housing **48** is positioned essentially in a second axial end area **84** of the exhaust gas treatment arrangement **12**. The entry interface **18** and the exit interface **80** are also positioned in this second axial end area **84**. A fundamentally cuboid outer circumference contour of the entire exhaust gas treatment arrangement **12**, which is indicated by dashed lines in FIGS. **1** to **3**, thus results, which can be integrated in the installation space provided for this purpose in vehicles, in particular in utility vehicles or trucks.

(24) Due to the above-described arrangement of the various system areas of the exhaust gas treatment arrangement **12** in various modules positioned in relation to one another in a defined manner, it is also possible here to integrate the first mixing section **14** and the pre-SCR catalytic converter unit **38** in the installation space provided for such an exhaust gas treatment arrangement **12**. With this compact positioning of the various modules in relation to one another, the second deflection housing **48** essentially providing the fourth module **M4** crosses the ends of the two main SCR catalytic converter units **72**, **74**, which are fundamentally open for the outflow of exhaust gas, transversely to the exhaust gas treatment arrangement longitudinal axis $L_{sub.A}$. This results in a structure in which the first exhaust gas treatment section **32** and the second mixing section **56** or their longitudinal directions $L_{sub.A1}$, $L_{sub.M2}$ defining respective longitudinal axes, on the one hand, and longitudinal center axes of the two main SCR catalytic converter units **72**, **74**, essentially extending in the second exhaust gas treatment section longitudinal direction $L_{sub.A2}$, on the other hand, are opposite to one another in pairs with respect to the exhaust gas treatment arrangement longitudinal direction $L_{sub.A}$, which essentially defines a longitudinal center axis of the exhaust gas treatment arrangement **12**, so that a line, which connects the first exhaust gas treatment section longitudinal direction $L_{sub.A1}$ and the second mixing section longitudinal direction $L_{sub.M2}$ and is orthogonal to each of these directions, and a line, which connects the longitudinal center axes of the two main SCR catalytic converter units **72**, **74** and is orthogonal to each of these, intersect one another. In the circumferential direction around the exhaust gas treatment arrangement longitudinal direction $L_{sub.A}$, which essentially defines a longitudinal center axis of the exhaust gas treatment arrangement **12**, one of the main SCR catalytic converter units **72**, **74** therefore follows the first exhaust gas treatment section **32**, the second mixing section **56** follows this main SCR catalytic converter unit of the two main SCR catalytic converter units **72**, **74**, the other of the two main SCR catalytic converter units **72**, **74** follows the second mixing section **56**, and then the first exhaust gas treatment section **32** follows the other of the two main SCR catalytic converter units **72**, **74**.

(25) Due to the detachable connection of the modules **M1** to **M5** to one another, it is possible to

perform maintenance work or repair work in a simple manner. For example, the particle filter arrangement **36**, which is strongly subjected to contamination, can easily be taken out of the exhaust gas treatment arrangement **12** and cleaned or replaced with a new or clean particle filter arrangement by opening the detachable connections thereof to the second module **M2**, on the one hand, and the fourth module **M4**, on the other hand. Since the modules **M2** and **M5** containing the respective catalytic converter units or catalytic converter blocks can also be detached as such from the exhaust gas treatment arrangement **12**, there is also the possibility of cleaning the catalytic converter units or catalytic converter blocks present in these modules or inserting new modules **M2**, **M5** in the exhaust gas treatment arrangement **12** if necessary.

(26) In spite of the compact construction, only a comparatively low counter pressure is generated in the exhaust gas treatment arrangement **12** as exhaust gas flows through it, to which in particular the fact also contributes that the second exhaust gas treatment section **68**, which assumes the significant proportion of the nitrogen oxide reduction, includes two main SCR catalytic converter units **72**, **74**, through which flow can occur in parallel.

(27) Since the areas in which the various modules **M1** to **M5** adjoin one another and are detachably connected to one another in the above-described manner are freely accessible from the outside in principle, there is the possibility in the simple manner of visually inspecting these areas of the detachable connection of the various modules to one another and checking them for leak-tightness. Furthermore, this free accessibility also enables the use of conventional tools for opening or establishing the detachable connection of the various modules to one another.

(28) It is understood that the foregoing description is that of the preferred embodiments of the invention and that various changes and modifications may be made thereto without departing from the spirit and scope of the invention as defined in the appended claims.

Claims

1. A modularly constructed exhaust gas treatment arrangement comprising: an entry interface for receiving exhaust gas into said exhaust gas treatment arrangement; a first mixing section having an exit area; a first exhaust gas treatment section having a first catalytic converter arrangement and a particle filter arrangement and defining an entry area and an exit area; a second mixing section having an entry area and an exit area; a second exhaust gas treatment section having a second catalytic converter arrangement and defining an entry area; a first deflection housing connecting said exit area of said first mixing section to said entry area of said first exhaust gas treatment section; a second deflection housing connecting said exit area of said first exhaust gas treatment section to said entry area of said second mixing section; a third deflection housing connecting said exit area of said second mixing section to said entry area of said second exhaust gas treatment section; a first module including said entry interface and said first mixing section; a second module including said first deflection housing and said first catalytic converter arrangement of said first exhaust gas treatment section; said second module being detachably connected to said first module; a third module including said particle filter arrangement of said first exhaust gas treatment section; said third module being detachably connected to said second module; a fourth module including said second deflection housing; said fourth module being detachably connected to said third module; a fifth module including said second mixing section, said third deflection housing and said second exhaust gas treatment section; and, said fifth module being detachably connected to said fourth module; wherein said first mixing section is elongated in the direction of a first mixing section longitudinal axis parallel to an exhaust gas treatment arrangement longitudinal axis, said second mixing section is elongated in the direction of a second mixing section longitudinal axis parallel to said longitudinal axis of said exhaust gas treatment arrangement, said first exhaust gas treatment section is elongated in the direction of a first exhaust gas treatment section longitudinal axis parallel to the exhaust gas treatment arrangement longitudinal axis, the second exhaust gas

treatment section is elongated in the direction of a second exhaust gas treatment section longitudinal axis parallel to said longitudinal axis of said exhaust gas treatment arrangement, and said first mixing section, said second mixing section, said first exhaust gas treatment section, and said second exhaust gas treatment section are arranged overlapping one another in the direction of said longitudinal axis of said exhaust gas treatment arrangement.

2. The exhaust gas treatment arrangement of claim 1, wherein at least one module of said first module, said second module, said third module, said fourth module, and said fifth module is detachably connected to at least one other module of said first module, said second module, said third module, said fourth module, and said fifth module by a threaded fastener connection and/or a clamp connection.
3. The exhaust gas treatment arrangement of claim 1, wherein said exit area of said first mixing section is detachably connected to an entry area of said first deflection housing.
4. The exhaust gas treatment arrangement of claim 1, wherein an exit area of said first catalytic converter arrangement is detachably connected to an entry area of said particle filter arrangement.
5. The exhaust gas treatment arrangement of claim 1, wherein an exit area of the particle filter arrangement is detachably connected to an entry area of said second deflection housing.
6. The exhaust gas treatment arrangement of claim 1, wherein an exit area of said second deflection housing is detachably connected to said entry area of said second mixing section.
7. The exhaust gas treatment arrangement of claim 1, wherein said first catalytic converter arrangement includes a pre-SCR catalytic converter unit, and said first module has a first reaction agent interface for receiving a first reaction agent dispenser.
8. The exhaust gas treatment arrangement of claim 7, wherein said first reaction agent interface is provided in the region of an entry area of said first mixing section.
9. The exhaust gas treatment arrangement of claim 1, wherein said first catalytic converter arrangement includes an oxidation catalytic converter unit.
10. The exhaust gas treatment arrangement of claim 1, wherein said second catalytic converter arrangement includes at least one main SCR catalytic converter unit, and said fourth module has a second reaction agent interface for receiving a second reaction agent dispenser.
11. The exhaust gas treatment arrangement of claim 10, wherein said second catalytic converter arrangement includes two main SCR catalytic converter units connected in parallel to one another.
12. The exhaust gas treatment arrangement of claim 11, wherein said exhaust gas treatment arrangement defines a longitudinal center axis and, in a circumferential direction around said longitudinal center axis, one of said main SCR catalytic converter units follows said first exhaust gas treatment section, said second mixing section follows said one main SCR catalytic converter unit of said two main SCR catalytic converter units, the other main SCR catalytic converter unit of the two main SCR catalytic converter units follows the second mixing section, and said first exhaust gas treatment section follows the other main SCR catalytic converter unit of said two main SCR catalytic converter units.
13. The exhaust gas treatment arrangement of claim 1, wherein said first deflection housing and said third deflection housing are arranged in a first axial end area of said exhaust gas treatment arrangement with respect to a longitudinal axis of said exhaust gas treatment arrangement, and said second deflection housing is arranged in a second axial end area with respect to said longitudinal axis of said exhaust gas treatment arrangement.
14. The exhaust gas treatment arrangement of claim 1, wherein said exhaust gas treatment arrangement further comprises: an exit housing, and, wherein an exit area of said second exhaust gas treatment section is open to said exit housing, and an exit interface for emitting exhaust gas from said exhaust gas treatment arrangement is provided on said exit housing.
15. The exhaust gas treatment arrangement of claim 14, wherein said exit housing defines an interior; and, at least a part of said second mixing section extends in said interior of said exit housing.

16. An exhaust gas system for an internal combustion engine comprising: an exhaust gas treatment arrangement; said exhaust gas treatment arrangement including: an entry interface for receiving exhaust gas into said exhaust gas treatment arrangement; a first mixing section having an exit area; a first exhaust gas treatment section having a first catalytic converter arrangement and a particle filter arrangement and defining an entry area and an exit area; a second mixing section having an entry area and an exit area; a second exhaust gas treatment section having a second catalytic converter arrangement and defining an entry area; a first deflection housing connecting said exit area of said first mixing section to said entry area of said first exhaust gas treatment section; a second deflection housing connecting said exit area of said first exhaust gas treatment section to said entry area of said second mixing section; a third deflection housing connecting said exit area of said second mixing section to said entry area of said second exhaust gas treatment section; a first module including said entry interface and said first mixing section; a second module including said first deflection housing and said first catalytic converter arrangement of said first exhaust gas treatment section; said second module being detachably connected to said first module; a third module including said particle filter arrangement of said first exhaust gas treatment section; said third module being detachably connected to said second module; a fourth module including said second deflection housing; said fourth module being detachably connected to said third module; a fifth module including said second mixing section, said third deflection housing and said second exhaust gas treatment section; and, said fifth module being detachably connected to said fourth module; wherein said first mixing section is elongated in the direction of a first mixing section longitudinal axis parallel to an exhaust gas treatment arrangement longitudinal axis, said second mixing section is elongated in the direction of a second mixing section longitudinal axis parallel to said longitudinal axis of said exhaust gas treatment arrangement, said first exhaust gas treatment section is elongated in the direction of a first exhaust gas treatment section longitudinal axis parallel to the exhaust gas treatment arrangement longitudinal axis, the second exhaust gas treatment section is elongated in the direction of a second exhaust gas treatment section longitudinal axis parallel to said longitudinal axis of said exhaust gas treatment arrangement, and said first mixing section, said second mixing section, said first exhaust gas treatment section, and said second exhaust gas treatment section are arranged overlapping one another in the direction of said longitudinal axis of said exhaust gas treatment arrangement.
