

(19)



(11)

EP 3 032 061 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

15.06.2016 Bulletin 2016/24

(51) Int Cl.:

F01N 3/28 (2006.01)**F01N 3/20** (2006.01)**F01N 3/10** (2006.01)**F01N 3/021** (2006.01)**B01F 5/06** (2006.01)(21) Application number: **14197160.6**(22) Date of filing: **10.12.2014**

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

Designated Extension States:

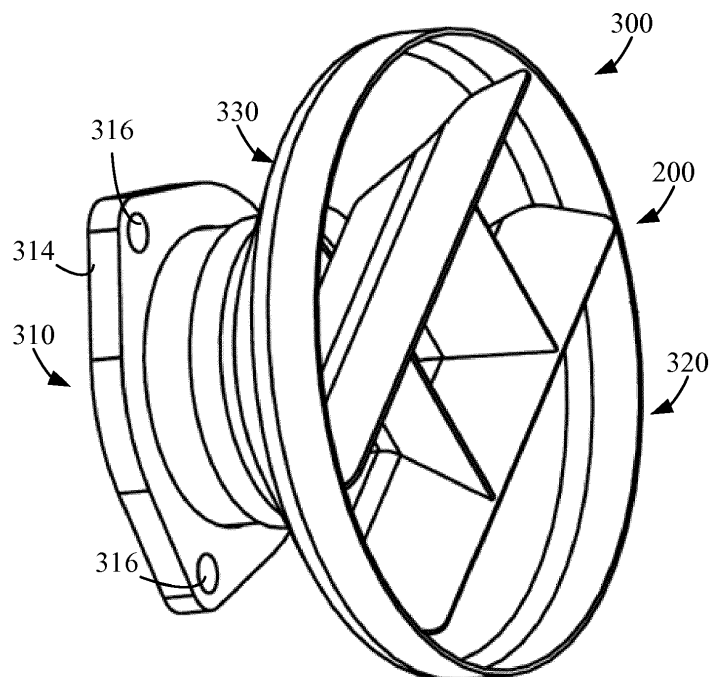
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Columbus, IN 47201 (US)(74) Representative: **Roberts, Peter David****Marks & Clerk LLP****1 New York Street****Manchester M1 4HD (GB)**(54) **Inlet deflector assembly for an aftertreatment system**

(57) An inlet flange for an aftertreatment system component comprises a flange body (300) and an inlet deflector assembly (200) to deflect and expand exhaust gas from the inlet (312) outwardly as the exhaust gas flows towards an aftertreatment component (410), such as an selective catalytic reduction catalyst, a diesel particulate filter, and/or a diesel oxidation catalyst. The inlet deflector

assembly (200) may include a first deflection member (210), a second deflection member (220), and a third deflection member (230). The first deflection member (210), the second deflection member (220), and the third deflection member (230) are configured to deflect fluid flow outwardly away from a longitudinal axis (350) defined by a flange inlet opening (312).

**FIG. 5**

Description

TECHNICAL FIELD

[0001] The present application relates generally to the field of aftertreatment systems for internal combustion engines.

BACKGROUND

[0002] For internal combustion engines, such as diesel engines, nitrogen oxide (NO_x) compounds may be emitted in the exhaust. To reduce NO_x emissions, a selective catalytic reduction (SCR) process may be implemented to convert the NO_x compounds into more neutral compounds, such as diatomic nitrogen, water, or carbon dioxide, with the aid of a catalyst and a reductant. The catalyst may be included in a catalyst chamber of an exhaust system, such as that of a vehicle or power generation unit. A reductant, such as anhydrous ammonia, aqueous ammonia, or urea is typically introduced into the exhaust gas flow prior to the catalyst chamber. To introduce the reductant into the exhaust gas flow for the SCR process, an SCR system may dose or otherwise introduce the reductant through a dosing module that vaporizes or sprays the reductant into an exhaust pipe of the exhaust system upstream of the catalyst chamber. The SCR system may include one or more sensors to monitor conditions within the exhaust system.

SUMMARY

[0003] One implementation relates to an inlet flange for an aftertreatment system component that includes a flange body having a first end and a second end. The first end includes a flange inlet opening having a first diameter and defining a longitudinal axis. The second end includes a flange outlet opening having a second diameter that is greater than the first diameter. The second end is configured to be coupled to a body of an aftertreatment system component, and the flange body defines an expansion chamber of the inlet flange. The inlet flange also includes a first deflection member coupled to the flange body at a first end and a second end. The first deflection member deflects fluid flow outwardly away from the longitudinal axis in a first direction relative to the longitudinal axis. The inlet flange further includes a second deflection member coupled to the flange body at a first end and a second end. The second deflection member deflects fluid flow outwardly away from the longitudinal axis in a second direction relative to the longitudinal axis. The second direction is a mirrored direction of the first direction along the longitudinal axis. The inlet flange still further includes a third deflection member coupled to the first deflection member at a first end and the second deflection member at a second end. The third deflection member deflects fluid flow outwardly away from the longitudinal axis in a third direction relative to the longitudinal

axis. The third direction is substantially perpendicular to a plane containing the first direction and the second direction.

[0004] Some implementations further include a fourth deflection member coupled to the first deflection member at a first end and the second deflection member at a second end. The fourth deflection member is configured to deflect fluid flow outwardly away from the longitudinal axis in a fourth direction relative to the longitudinal axis. The fourth direction is a mirrored direction of the third direction along the longitudinal axis. In some implementations, the first deflection member spans across a chord of the flange outlet opening, and a length of the chord is less than the second diameter. In some implementations, the first deflection member includes a first portion and a second portion. The first portion is substantially parallel to the longitudinal axis, and the second portion is angularly offset from the first portion. In some implementations, the first portion and the second portion of the first deflection member are flat plates. In some implementations, the first deflection member is coupled to the flange body at the first end and the second end by a weld.

[0005] In some implementations, the third deflection member includes a first portion and a second portion. The first portion is substantially parallel to the longitudinal axis, and the second portion is angularly offset from the first portion. In some implementations, the first portion and the second portion of the third deflection member are flat plates. In some implementations, the flange body includes a conical portion defining the expansion chamber of the inlet flange. In other implementations, the flange body includes a cylindrical portion defining the expansion chamber of the inlet flange. In some implementations, the first end is configured to be coupled to an upstream exhaust system component. In some implementations, the first deflection member, the second deflection member, and the third deflection member are positioned upstream of a selective catalytic reduction catalyst, a diesel oxidation catalyst, or a particulate filter.

[0006] Another implementation relates to an aftertreatment system component that includes a body, an inlet deflector assembly, and at least one of a selective catalytic reduction catalyst, a diesel oxidation catalyst, or a particulate filter. The body has a first end, a second end, and an expansion chamber between the first end and the second end. The first end includes an inlet opening having a first diameter, and the body defines a longitudinal axis and has a second diameter that is greater than the first diameter. The inlet deflector assembly includes a first deflection member, a second deflection member, a third deflection member, and a fourth deflection member. The first deflection member is coupled to the body at a first end and a second end and extends across a first portion of the expansion chamber. The first deflection member is configured to deflect fluid flow outwardly away from the longitudinal axis in a first direction. The second deflection member is coupled to the body at a first end and a second end and extends across a second portion

of the expansion chamber. The second deflection member is configured to deflect fluid flow outwardly away from the longitudinal axis in a second direction. The second direction is a mirrored direction of the first direction along the longitudinal axis. The third deflection member is coupled to the first deflection member at a first end and the second deflection member at a second end. The third deflection member is configured to deflect fluid flow outwardly away from the longitudinal axis in a third direction. The third direction is substantially perpendicular to a plane containing the first direction and the second direction. The fourth deflection member is coupled to the first deflection member at a first end and the second deflection member at a second end. The fourth deflection member is configured to deflect fluid flow outwardly away from the longitudinal axis in a fourth direction. The fourth direction is a mirrored direction of the third direction along the longitudinal axis.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The details of one or more implementations are set forth in the accompanying drawings and the description below. Other features, aspects, and advantages of the disclosure will become apparent from the description, the drawings, and the claims, in which:

Figure 1 is a block schematic diagram of an example selective catalytic reduction system having an example reductant delivery system for an exhaust system;

Figure 2 is a front elevation view of an example inlet deflector assembly for an aftertreatment system;

Figure 3 is a side elevation view of the example inlet deflector assembly of Figure 2;

Figure 4 is a perspective view of the example inlet deflector assembly of Figure 2;

Figure 5 is a perspective view of the example inlet deflector assembly of Figure 2 shown in a conical flange body for an aftertreatment system;

Figure 6 is a bottom cross-sectional view of the example inlet deflector assembly in the conical flange of Figure 5;

Figure 7 is a front elevation view of the example inlet deflector assembly in the conical flange body of Figure 5;

Figure 8 is a side cross-sectional view of an example aftertreatment component having the example inlet deflector assembly;

Figure 9 is an axial velocity contour graph showing the downstream axial velocity of exhaust gas flowing through an aftertreatment component with the example inlet deflector assembly; and

Figure 10 is a bottom cross-sectional view of another example inlet deflector assembly shown in a cylindrical flange body for an aftertreatment system.

[0008] It will be recognized that some or all of the fig-

ures are schematic representations for purposes of illustration. The figures are provided for the purpose of illustrating one or more implementations with the explicit understanding that they will not be used to limit the scope or the meaning of the claims.

DETAILED DESCRIPTION

[0009] Following below are more detailed descriptions of various concepts related to, and implementations of, methods, apparatuses, and systems for inlet deflector assembly for an aftertreatment system. The various concepts introduced above and discussed in greater detail below may be implemented in any of numerous ways, as the described concepts are not limited to any particular manner of implementation. Examples of specific implementations and applications are provided primarily for illustrative purposes.

I. Overview

[0010] In exhaust systems with SCR aftertreatment systems, the aftertreatment system components, such as a diesel particulate filter (DPF), a SCR catalyst, a diesel oxidation catalyst (DOC), etc. may be within housings having a larger diameter than an exhaust inlet leading to the housing. For such aftertreatment system components to maximize their utilization for the exhaust gas, such as filtering particulate matter, converting NO_x , oxidizing hydrocarbons and carbon monoxide, etc., the flow distribution of the exhaust gas leading to these components should be as uniform as possible. That is, the distribution of exhaust gas across a cross-sectional area of the housing or body upstream of the aftertreatment system components should be as uniform as possible. Thus, the aftertreatment system component may filter particulate matter, convert NO_x , oxidize hydrocarbons and carbon monoxide, etc. across the entire face of the component, thereby increasing the efficiency of the aftertreatment system component.

[0011] When fluid flow transitions from a smaller diameter pipe to a larger diameter pipe, the fluid will naturally expand to the larger diameter and, over a length of the downstream pipe, approach a uniform flow distribution. Moreover, when the flow velocity of the fluid increases or the greater the ratio of the larger diameter pipe to the smaller diameter pipe, achieving uniform flow distribution requires a greater length of the downstream pipe. Thus, it may be useful to assist the fluid flow in approaching a uniform flow distribution over a shorter distance. For example, an exhaust system may be constrained by dimensions of the entity having the exhaust system (e.g., a vehicle, a power generation unit, etc.). In addition, with the reduced length, the potential costs for the exhaust system may be reduced based on the reduced material utilized. It may also be useful to maintain low backpressure while still achieving a substantially uniform flow distribution. For instance, an internal combustion engine

may operate more inefficiently when an exhaust system has a higher backpressure.

[0012] Conversion efficiency of an aftertreatment system component may depend upon the flow distribution uniformity of the exhaust gas flowing into the aftertreatment system component. That is, the exhaust gas distribution at the upstream face of the aftertreatment system component may be proportional to the conversion efficiency of the aftertreatment system component. A Flow Distribution Index (FDI) may be calculated based on discretizing the area of the upstream face of the aftertreatment system component and using the axial velocity of the exhaust gas and the area of discretized cell faces. That is, FDI, γ , may be determined based on:

$$\gamma = 1 - \frac{1}{2} \left[\sum_i^{i=n} \frac{A_i}{A_{tot}} \cdot \frac{|(v_i - v_{avg})|}{v_{avg}} \right]$$

where v is the axial velocity, A is the cell face area, i is the cell index, v_{avg} is the area-weighted average of axial velocity, and A_{tot} is the total area of the cells on the face of interest. An FDI, γ , of 1 is indicative of uniform flow distribution, while a value of 0 is indicative of non-uniform flow distribution. Accordingly, it may be useful to achieve a substantially uniform flow distribution, e.g., having an FDI, γ , of 0.9 or greater, while also maintaining a low backpressure.

[0013] Implementations described herein relate to inlet deflector assemblies and/or components incorporating the inlet deflector assemblies that improve the flow distribution over the face of an aftertreatment system component with minimal increase in backpressure attributable to the inlet deflector assembly. Such inlet deflector assemblies may be of a simplified design, easy to manufacture, reliable, and/or modifiable for varying exhaust system configurations, while reducing manufacturing costs and achieving increase flow distribution with minimal backpressure increase. The inlet deflector assemblies described herein also permit the length of the aftertreatment system to be reduced based on the increased flow distribution over a shorter distance resulting from utilization of the inlet deflector assemblies. Furthermore, the inlet deflector assemblies may be utilized for a variety of ratios of housing diameters for aftertreatment system components and inlet diameters.

[0014] Such inlet deflector assemblies include one or more deflection members disposed within a flange for an aftertreatment system component and/or within a body housing the aftertreatment system component. The one or more deflection members may be coupled to the flange and/or body at a first end and a second end of the one or more deflection members. The one or more deflection members deflect fluid flow outwardly away from a longitudinal axis of the flange and/or body. That is, the one or

more deflection members include an angled and/or curved portion that assists the expansion of the exhaust gas to fill the larger diameter body housing the aftertreatment system component by diverting a portion of the exhaust gas flow outwardly.

[0015] In some implementations two deflection members may deflect fluid flow outwardly away from the longitudinal axis of the flange and/or body in opposing, mirrored directions (e.g., at an upwardly angle and at a downwardly angle). In still further implementations, a third deflection member may be included that is coupled to the first deflection member and the second deflection member to deflect fluid flow outwardly away from the longitudinal axis in yet a third direction (e.g., at a lateral angle). In yet further implementations, a fourth deflection member may be included that is also coupled to the first deflection member and the second deflection member to deflect fluid flow outwardly away from the longitudinal axis in yet a fourth direction that is an opposing, mirrored direction to the third direction (e.g., at a lateral angle that is a mirrored angle to the lateral angle of the third direction relative to the longitudinal axis). In some instances, the first, second, third, and fourth deflection members may define a central opening through the inlet deflector assembly that allows exhaust gas to continue flowing longitudinally while portions of the exhaust gas are directed in several directions away from the longitudinal axis.

[0016] In some implementations, the one or more deflection members may be flat plates having a first section that is parallel to the longitudinal axis and a second section that is angled relative to the longitudinal axis to deflect the exhaust gas. In other implementations, the one or more deflection members may be curved plates and/or airfoils (e.g., National Advisory Committee for Aeronautics (NACA) airfoils). The one or more deflection members may be welded to the flange and/or body.

II. Overview of Aftertreatment System

[0017] Figure 1 depicts an aftertreatment system 100 having an example reductant delivery system 110 for an exhaust system 190. The aftertreatment system 100 includes a DPF 102, the reductant delivery system 110, a decomposition chamber or reactor 104, and a SCR catalyst 106.

[0018] The DPF 102 is configured to remove particulate matter, such as soot, from exhaust gas flowing in the exhaust system 190. The DPF 102 includes an inlet, where the exhaust gas is received, and an outlet, where the exhaust gas exits after having particulate matter substantially filtered from the exhaust gas and/or converting the particulate matter into carbon dioxide.

[0019] The decomposition chamber 104 is configured to convert a reductant, such as urea, aqueous ammonia, or diesel exhaust fluid (DEF), into ammonia. The decomposition chamber 104 includes a reductant delivery system 110 having a dosing module 112 configured to dose the reductant into the decomposition chamber 104. In

some implementations, the reductant is injected upstream of the SCR catalyst 106. The reductant droplets then undergo the processes of evaporation, thermolysis, and hydrolysis to form gaseous ammonia within the exhaust system 190. The decomposition chamber 104 includes an inlet in fluid communication with the DPF 102 to receive the exhaust gas containing NO_x emissions and an outlet for the exhaust gas, NO_x emissions, ammonia, and/or remaining reductant to flow to the SCR catalyst 106.

[0020] The decomposition chamber 104 includes the dosing module 112 mounted to the decomposition chamber 104 such that the dosing module 112 may dose the reductant into the exhaust gases flowing in the exhaust system 190. The dosing module 112 may include an insulator 114 interposed between a portion of the dosing module 112 and the portion of the decomposition chamber 104 to which the dosing module 112 is mounted. The dosing module 112 is fluidly coupled to one or more reductant sources 116. In some implementations, a pump 118 may be used to pressurize the reductant from the reductant source 116 for delivery to the dosing module 112.

[0021] The dosing module 112 and the pump 118 are also electrically or communicatively coupled to a controller 120. The controller 120 is configured to control the dosing module 112 to dose reductant into the decomposition chamber 104. The controller 120 may also be configured to control the pump 118. The controller 120 may include a microprocessor, an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA), etc., or combinations thereof. The controller 120 may include memory which may include, but is not limited to, electronic, optical, magnetic, or any other storage or transmission device capable of providing a processor, ASIC, FPGA, etc. with program instructions. The memory may include a memory chip, Electrically Erasable Programmable Read-Only Memory (EEPROM), erasable programmable read only memory (EPROM), flash memory, or any other suitable memory from which the controller 120 can read instructions. The instructions may include code from any suitable programming language.

[0022] The SCR catalyst 106 is configured to assist in the reduction of NO_x emissions by accelerating a NO_x reduction process between the ammonia and the NO_x of the exhaust gas into diatomic nitrogen, water, and/or carbon dioxide. The SCR catalyst 106 includes inlet in fluid communication with the decomposition chamber 104 from which exhaust gas and reductant is received and an outlet in fluid communication with an end of the exhaust system 190.

[0023] The exhaust system 190 may further include a diesel oxidation catalyst (DOC) in fluid communication with the exhaust system 190 (e.g., downstream of the SCR catalyst 106 or upstream of the DPF 102) to oxidize hydrocarbons and carbon monoxide in the exhaust gas.

[0024] In some implementations, the DPF 102 may be positioned downstream of the decomposition chamber

or reactor pipe 104. For instance, the DPF 102 and the SCR catalyst 106 may be combined into a single unit, such as an SDPF. In some implementations, the dosing module 112 may instead be positioned downstream of a turbocharger or upstream of a turbocharger.

III. Example Inlet Deflector Assemblies

[0025] Figures 2-7 depict an example inlet deflector assembly 200, shown best in Figures 2-4, that may be included within a flange body 300 of an aftertreatment system component, such as a DPF, SCR, DOC, SDPF, etc., shown best in Figure 5-7. The inlet deflector assembly 200 includes a first deflection member 210, a second deflection member 220, a third deflection member 230, and a fourth deflection member 240. In some implementations, one of the third deflection member 230 or the fourth deflection member 240 may be omitted.

[0026] The first deflection member 210 is configured to deflect fluid flow outwardly away from a center portion 202 of the inlet deflector assembly 200. In the implementation shown, the first deflection member 210 includes a first portion 212 and a second portion 214. The first portion 212 is substantially parallel to fluid flowing past the inlet deflection assembly 200, and the second portion 214 is angularly offset from the first portion 212. That is, the second portion 214 is angled to deflect fluid flowing over the first deflection member 210. In the example shown, the first portion 212 and the second portion 214 are flat plates. In other implementations, the first deflection member 210 may instead be a curved member, such as a curved plate and/or an airfoil. In the example shown, the first deflection member 210 may be an upper deflection member configured to deflect exhaust gas flow upwardly away from the center portion 202 of the inlet deflector assembly 200.

[0027] The second deflection member 220 is also configured to deflect fluid flow outwardly away from the center portion 202 of the inlet deflector assembly 200. The second deflection member 220 of the inlet deflector assembly 200 may be a mirrored version of the first deflection member 210. In the implementation shown, the second deflection member 220 includes a first portion 222 and a second portion 224. The first portion 222 is substantially parallel to fluid flowing past the inlet deflection assembly 200, and the second portion 224 is angularly offset from the first portion 222. That is, the second portion 224 is angled to deflect fluid flowing over the second deflection member 220. In the example shown, the first portion 222 and the second portion 224 are flat plates. In other implementations, the second deflection member 220 may instead be a curved member, such as a curved plate and/or an airfoil. In the example shown, the second deflection member 220 may be a lower deflection member configured to deflect exhaust gas flow downwardly away from the center portion 202 of the inlet deflector assembly 200.

[0028] The third deflection member 230 is also config-

ured to deflect fluid flow outwardly away from the center portion 202 of the inlet deflector assembly 200. In the implementation shown, the third deflection member 230 is positioned between and coupled to the first deflection member 210 and the second deflection member 220. In some implementations, the third deflection member 230 may integrally formed with the first deflection member 210 and the second deflection member 220 and/or may be attached, such as via a weld. The third deflection member 230 includes a first portion 232 and a second portion 234. The first portion 232 is substantially parallel to fluid flowing past the inlet deflection assembly 200, and the second portion 234 is angularly offset from the first portion 232. That is, the second portion 234 is angled to deflect fluid flowing over the third deflection member 230. In the example shown, the first portion 232 and the second portion 234 are flat plates. In other implementations, the third deflection member 230 may instead be a curved member, such as a curved plate and/or an airfoil. In the example shown, the third deflection member 230 may be a side deflection member, such as a right or left side deflection member, configured to deflect exhaust gas flow laterally away from the center portion 202 of the inlet deflector assembly 200.

[0029] The fourth deflection member 240 is also configured to deflect fluid flow outwardly away from the center portion 202 of the inlet deflector assembly 200. The fourth deflection member 240 of the inlet deflector assembly 200 may be a mirrored version of the first deflection member 210. In the implementation shown, the third deflection member 230 is positioned between and coupled to the first deflection member 210 and the second deflection member 220. In some implementations, the third deflection member 230 may integrally formed with the first deflection member 210 and the second deflection member 220 and/or may be attached, such as via a weld. The third deflection member 230 includes a first portion 232 and a second portion 234. The first portion 232 is substantially parallel to fluid flowing past the inlet deflection assembly 200, and the second portion 234 is angularly offset from the first portion 232. That is, the second portion 234 is angled to deflect fluid flowing over the third deflection member 230. In the example shown, the first portion 232 and the second portion 234 are flat plates. In other implementations, the third deflection member 230 may instead be a curved member, such as a curved plate and/or an airfoil. In the example shown, the third deflection member 230 may be a side deflection member, such as a right or left side deflection member, configured to deflect exhaust gas flow laterally away from the center portion 202 of the inlet deflector assembly 200.

[0030] The inlet deflector assembly 200 thus utilizes deflection members 210, 220, 230, 240 to divert portions of the exhaust gas flowing through the inlet deflector assembly 200 to expand the exhaust gas over a short longitudinal distance while maintaining a low increase in backpressure due to the inlet deflector assembly 200.

[0031] Figures 5-7 depict the inlet deflector assembly

200 of Figures 2-4 within a flange body 300 of an after-treatment system component, such as a DPF, SCR, DOC, SDPF, etc. The flange body 300 includes an inlet portion at a first end 310, an outlet portion at a second end 320, and an expansion portion 330. The inlet portion of the first end 310 includes a flange inlet opening 312 that receives exhaust gas from an upstream portion of the exhaust system and has an inlet diameter, d_1 . The flange inlet opening 312 also defines a longitudinal axis 350 of the flange body 300. The inlet portion may also include an attachment flange 314 having one or more attachment openings 316 to couple the inlet portion to the upstream portion of the exhaust system, such as another component of the aftertreatment system, an exhaust manifold, and/or another upstream exhaust system component. Exhaust gas flowing into the inlet portion flows into the expansion portion 330 of the flange body 300. In some implementations, an intermediary tube 318 may be positioned between the inlet portion and the expansion portion 330. In other implementations, the intermediary tube 318 may be omitted and the exhaust gas may flow directly from the inlet portion to the expansion portion 330.

[0032] The outlet portion of the second end 320 includes a flange outlet opening 322 that receives exhaust gas from the expansion portion 330 of the flange body 300 and has an outlet diameter, d_2 . The outlet diameter, d_2 , may be greater than the inlet diameter, d_1 . The outlet portion may also include an attachment flange and/or may be configured to couple to a body or other downstream portion of an aftertreatment system component, such as a DPF, SCR, DOC, SDPF, etc., and/or to another component of the exhaust system. In some implementations, the outlet portion may be welded to a body of an aftertreatment system component such that the flange body 300 and the body of the aftertreatment system component form a single component.

[0033] The flange body 300 from the first end 310 of the inlet portion to the second end 320 of the outlet portion may define an expansion chamber 332 of the expansion portion 330. The expansion portion 330 of the present flange body 300 is a conical expansion portion 330 that receives exhaust gas from the flange inlet opening 312 of the inlet portion, which has an inlet diameter of d_1 , and expands outwardly from the longitudinal axis 350 to a second outlet diameter, d_2 , of a flange outlet opening 322 of the outlet portion of the second end 320.

[0034] Exhaust gas entering the flange body 300 via the flange inlet opening 312 of the first end 310 flows through the flange body 300 to the expansion chamber 332 of the expansion portion 330 where the exhaust gas expands outwardly away from the longitudinal axis 350. As noted above, when the flow velocity of the exhaust gas increases or the greater the ratio of the outlet diameter, d_2 , to the inlet diameter of d_1 , the exhaust gas may not expand rapidly enough to achieve a substantially uniform flow distribution. Accordingly, the inlet deflector assembly 200 may be provided within the expansion cham-

ber 332 of the expansion portion 330 to assist in achieving a substantially uniform flow distribution.

[0035] The inlet deflector assembly 200 may be coupled to the flange body 300 via one or more welds or other modes of securing the inlet deflector assembly 200 to the flange body 300. For instance, the first deflection member 210 may be coupled to the flange body 300 at a first end 216 and a second end 218 of the first deflection member 210. The first deflection member 210 includes the first portion 212 and the second portion 214. The first portion 212 may be substantially parallel to the longitudinal axis 350, and the second portion 214 is angularly offset from the first portion 212. That is, the second portion 214 is angled to deflect fluid outwardly away from the longitudinal axis 350 in a first direction (e.g., at an upwardly angle) relative to the longitudinal axis 350.

[0036] The second deflection member 220 may also be coupled to the flange body 300 at a first end and a second end of the second deflection member 220. The second deflection member 220 includes the first portion 222 and the second portion 224. The first portion 222 may be substantially parallel to the longitudinal axis 350, and the second portion 224 is angularly offset from the first portion 222. That is, the second portion 224 is angled to deflect fluid outwardly away from the longitudinal axis 350 in a second direction (e.g., at a downwardly angle) relative to the longitudinal axis 350. The second deflection member 220 may be a mirrored deflection member to the first deflection member 210 such that the second direction is a mirrored direction of the first direction along the longitudinal axis 350. That is, the first deflection member 210 may deflect exhaust gas at, for instance, a first direction of 30 degrees upwardly relative to the longitudinal axis 350 and the second deflection member 220 may deflect exhaust gas at, for instance, a second direction of -30 degrees downwardly relative to the longitudinal axis 350.

[0037] The third deflection member 230 is coupled the first deflection member 210 at a first end and to the second deflection member 220 at a second end. The third deflection member 230 includes the first portion 232 and the second portion 234. The first portion 232 may be substantially parallel to the longitudinal axis 350, and the second portion 234 is angularly offset from the first portion 232. That is, the second portion 234 is angled to deflect fluid outwardly away from the longitudinal axis 350 in a third direction (e.g., at a lateral, leftward or rightward, angle) relative to the longitudinal axis 350. The third direction may be substantially perpendicular to a plane containing the first direction and the second direction.

[0038] The fourth deflection member 240 is coupled the first deflection member 210 at a first end and to the second deflection member 220 at a second end. The fourth deflection member 240 includes the first portion 242 and the second portion 244. The first portion 242 may be substantially parallel to the longitudinal axis 350, and the second portion 244 is angularly offset from the

first portion 242. That is, the second portion 244 is angled to deflect fluid outwardly away from the longitudinal axis 350 in a fourth direction (e.g., at a lateral, leftward or rightward, angle) relative to the longitudinal axis 350. The fourth deflection member 240 may be a mirrored deflection member to the third deflection member 230 such that the fourth direction is a mirrored direction of the third direction along the longitudinal axis 350. That is, the third deflection member 210 may deflect exhaust gas at, for instance, a third direction of 30 degrees laterally (e.g., to the right) relative to the longitudinal axis 350 and the fourth deflection member 240 may deflect exhaust gas at, for instance, a fourth direction of -30 degrees laterally (e.g., to the left) relative to the longitudinal axis 350.

[0039] Referring to Figure 7, the inlet deflector assembly 200 is shown within the expansion chamber 332 of the flange body 300. The first deflection member 210, the second deflection member 220, the third deflection member 230, and the fourth deflection member 240 are all offset from a centerline of the flange body 300 that corresponds to the longitudinal axis 350. Thus, the first deflection member 210 and the second deflection member 220 may span across a chord of the flange outlet opening 322 that is less than the second diameter, d_2 . The first deflection member 210 and the second deflection member 220 may span across different portions of the expansion chamber 332 as well. Thus, the inlet deflector assembly 200 allows a portion of the exhaust gas to flow through the center portion 202 of the inlet deflector assembly 200 while deflecting the remaining portions of the exhaust gas via the first deflection member 210, the second deflection member 220, the third deflection member 230, and the fourth deflection member 240, thereby assisting the expansion of the exhaust gas within the expansion chamber to achieve a substantially uniform flow distribution, such as a flow distribution of approximately 0.92.

[0040] Figure 8 depicts a side cross-sectional view of an example aftertreatment system component 400 having the inlet deflector assembly 200 within a flange body 300. The inlet deflector assembly 200 is secured within the flange body 300, such as via welding of one or more of the first deflection member 210 or the second deflection member 220 to an interior of the expansion chamber 332. The aftertreatment system component 400 includes a body 402 for containing one or more aftertreatment components 410, such as a selective catalytic reduction catalyst, a diesel particulate filter, and/or a diesel oxidation catalyst. The body 402 includes an inlet 404 and an outlet 406. In some implementations, the inlet 404 and the first end 310 of the flange body 300 may be the same inlet.

[0041] The inlet deflector assembly 200, including the first deflection member 210, the second deflection member 220, the third deflection member 230, and the fourth deflection member 240 are positioned upstream of the one or more aftertreatment components 410. For instance, the inlet deflector assembly 200 may be up-

stream of one or more of a selective catalytic reduction catalyst, a diesel particulate filter, and/or a diesel oxidation catalyst. By increasing the flow distribution uniformity over a short longitudinal length, the inlet deflector assembly 200 may allow a reduction in overall length of the aftertreatment system component 400 by reducing the longitudinal length of the flange body 300 and/or the portion of the body 402 of the aftertreatment system component 400 corresponding to the flange body 300.

[0042] Figure 9 depicts an axial velocity contour graph 500 showing the axial velocity of exhaust gas downstream of the inlet deflector assembly 200 and flowing through an aftertreatment system component, such as aftertreatment system component 400. The axial velocity contour graph 500 shows the variation in axial velocity prior to the upstream face of an aftertreatment component housed within a body 402 of the aftertreatment system component 400.

[0043] Figure 10 depicts another bottom cross-sectional view of another embodiment of an inlet deflector assembly 600 and flange body 700. The flange body 700 includes an inlet portion at a first end 710, an outlet portion at a second end 720, and an expansion portion 730. The inlet portion of the first end 710 includes a flange inlet opening 712 that receives exhaust gas from an upstream portion of the exhaust system and has an inlet diameter, d_1 . The flange inlet opening 712 also defines a longitudinal axis 750 of the flange body 700. The inlet portion may also include an attachment flange 714 having one or more attachment openings to couple the inlet portion to the upstream portion of the exhaust system, such as another component of the aftertreatment system, an exhaust manifold, and/or another upstream exhaust system component. Exhaust gas flowing into the inlet portion flows into the expansion portion 730 of the flange body 700. In some implementations, an intermediary tube 718 may be positioned between the inlet portion and the expansion portion 730. In other implementations, the intermediary tube 718 may be omitted and the exhaust gas may flow directly from the inlet portion to the expansion portion 730.

[0044] The outlet portion of the second end 720 includes a flange outlet opening 722 that receives exhaust gas from the expansion portion 730 of the flange body 700 and has an outlet diameter, d_2 . The outlet diameter, d_2 , may be greater than the inlet diameter, d_1 . The outlet portion may also include an attachment flange and/or may be configured to couple to a body or other downstream portion of an aftertreatment system component, such as a DPF, SCR, DOC, SDPF, etc., and/or to another component of the exhaust system. In some implementations, the outlet portion may be welded to a body of an aftertreatment system component such that the flange body 700 and the body of the aftertreatment system component form a single component.

[0045] The flange body 700 from the first end 710 of the inlet portion to the second end 720 of the outlet portion may define an expansion chamber 732 of the expansion

portion 730. The expansion portion 730 of the present flange body 700 is a cylindrical expansion portion 730 that receives exhaust gas from the flange inlet opening 712 of the inlet portion, which has an inlet diameter of d_1 , and expands outwardly from the longitudinal axis 750 to a second outlet diameter, d_2 , of a flange outlet opening 722 of the outlet portion of the second end 720.

[0046] Exhaust gas entering the flange body 700 via the flange inlet opening 712 of the first end 710 flows through the flange body 700 to the expansion chamber 732 of the expansion portion 730 where the exhaust gas expands outwardly away from the longitudinal axis 750. As noted above, when the flow velocity of the exhaust gas increases or the greater the ratio of the outlet diameter, d_2 , to the inlet diameter of d_1 , the exhaust gas may not expand rapidly enough to achieve a substantially uniform flow distribution. Accordingly, the inlet deflector assembly 600 may be provided within the expansion chamber 732 of the expansion portion 730 to assist in achieving a substantially uniform flow distribution.

[0047] The inlet deflector assembly 600 may be coupled to the flange body 700 via one or more welds or other modes of securing the inlet deflector assembly 600 to the flange body 700. For instance, the first deflection member 610 may be coupled to the flange body 700 at a first end 616 and a second end 618 of the first deflection member 610. The first deflection member 610 includes the first portion 612 and the second portion 614. The first portion 612 may be substantially parallel to the longitudinal axis 750, and the second portion 614 is angularly offset from the first portion 612. That is, the second portion 614 is angled to deflect fluid outwardly away from the longitudinal axis 750 in a first direction (e.g., at an upwardly angle) relative to the longitudinal axis 750.

[0048] The second deflection member (not shown) may also be coupled to the flange body 700 at a first end and a second end of the second deflection member. The second deflection member includes the first portion and the second portion. The first portion may be substantially parallel to the longitudinal axis 750, and the second portion is angularly offset from the first portion. That is, the second portion is angled to deflect fluid outwardly away from the longitudinal axis 750 in a second direction (e.g., at a downwardly angle) relative to the longitudinal axis 750. The second deflection member may be a mirrored deflection member to the first deflection member 610 such that the second direction is a mirrored direction of the first direction along the longitudinal axis 750. That is, the first deflection member 610 may deflect exhaust gas at, for instance, a first direction of 30 degrees upwardly relative to the longitudinal axis 750 and the second deflection member may deflect exhaust gas at, for instance, a second direction of -30 degrees downwardly relative to the longitudinal axis 750.

[0049] A third deflection member 630 is coupled the first deflection member 610 at a first end and to the second deflection member at a second end. The third deflection member 630 includes the first portion 632 and

the second portion 634. The first portion 632 may be substantially parallel to the longitudinal axis 750, and the second portion 634 is angularly offset from the first portion 632. That is, the second portion 634 is angled to deflect fluid outwardly away from the longitudinal axis 750 in a third direction (e.g., at a lateral, leftward or rightward, angle) relative to the longitudinal axis 750. The third direction may be substantially perpendicular to a plane containing the first direction and the second direction.

[0050] The fourth deflection member 640 is coupled the first deflection member 610 at a first end and to the second deflection member at a second end. The fourth deflection member 640 includes the first portion 642 and the second portion 644. The first portion 642 may be substantially parallel to the longitudinal axis 750, and the second portion 644 is angularly offset from the first portion 642. That is, the second portion 644 is angled to deflect fluid outwardly away from the longitudinal axis 750 in a fourth direction (e.g., at a lateral, leftward or rightward, angle) relative to the longitudinal axis 750. The fourth deflection member 640 may be a mirrored deflection member to the third deflection member 630 such that the fourth direction is a mirrored direction of the third direction along the longitudinal axis 750. That is, the third deflection member 610 may deflect exhaust gas at, for instance, a third direction of 30 degrees laterally (e.g., to the right) relative to the longitudinal axis 750 and the fourth deflection member 640 may deflect exhaust gas at, for instance, a fourth direction of -30 degrees laterally (e.g., to the left) relative to the longitudinal axis 750.

[0051] While this specification contains many specific implementation details, these should not be construed as limitations on the scope of what may be claimed, but rather as descriptions of features specific to particular implementations. Certain features described in this specification in the context of separate implementations can also be implemented in combination in a single implementation. Conversely, various features described in the context of a single implementation can also be implemented in multiple implementations separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination.

[0052] Similarly, while operations are depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, the separation of various system components in the implementations described above should not be understood as requiring such separation in all implementations, and it should be understood that the described components and systems

can generally be integrated in a single product or packaged into multiple products embodied on tangible media.

[0053] As utilized herein, the terms "approximately," "about," "substantially", and similar terms are intended to have a broad meaning in harmony with the common and accepted usage by those of ordinary skill in the art to which the subject matter of this disclosure pertains. It should be understood by those of skill in the art who review this disclosure that these terms are intended to allow a description of certain features described and claimed without restricting the scope of these features to the precise numerical ranges provided. Accordingly, these terms should be interpreted as indicating that insubstantial or inconsequential modifications or alterations of the subject matter described and claimed are considered to be within the scope of the invention as recited in the appended claims. Additionally, it is noted that limitations in the claims should not be interpreted as constituting "means plus function" limitations under the United States patent laws in the event that the term "means" is not used therein.

[0054] The terms "coupled," "connected," and the like as used herein mean the joining of two components directly or indirectly to one another. Such joining may be stationary (e.g., permanent) or moveable (e.g., removable or releasable). Such joining may be achieved with the two components or the two components and any additional intermediate components being integrally formed as a single unitary body with one another or with the two components or the two components and any additional intermediate components being attached to one another.

[0055] The terms "fluidly coupled," "in fluid communication," and the like as used herein mean the two components or objects have a pathway formed between the two components or objects in which a fluid, such as water, air, gaseous reductant, gaseous ammonia, etc., may flow, either with or without intervening components or objects. Examples of fluid couplings or configurations for enabling fluid communication may include piping, channels, or any other suitable components for enabling the flow of a fluid from one component or object to another.

[0056] It is important to note that the construction and arrangement of the system shown in the various exemplary implementations is illustrative only and not restrictive in character. All changes and modifications that come within the spirit and/or scope of the described implementations are desired to be protected. It should be understood that some features may not be necessary and implementations lacking the various features may be contemplated as within the scope of the application, the scope being defined by the claims that follow. In reading the claims, it is intended that when words such as "a," "an," "at least one," or "at least one portion" are used there is no intention to limit the claim to only one item unless specifically stated to the contrary in the claim. When the language "at least a portion" and/or "a portion" is used the item can include a portion and/or the entire item unless specifically stated to the contrary.

Claims

1. An inlet flange for an aftertreatment system component comprising:

a flange body having a first end and a second end, the first end comprising a flange inlet opening having a first diameter and defining a longitudinal axis, the second end comprising a flange outlet opening having a second diameter, the second diameter being greater than the first diameter, wherein the second end is configured to be coupled to a body of an aftertreatment system component, and wherein the flange body defines an expansion chamber of the inlet flange;

a first deflection member coupled to the flange body at a first end and a second end, wherein the first deflection member deflects fluid flow outwardly away from the longitudinal axis in a first direction relative to the longitudinal axis;

a second deflection member coupled to the flange body at a first end and a second end, wherein the second deflection member deflects fluid flow outwardly away from the longitudinal axis in a second direction relative to the longitudinal axis, and wherein the second direction is a mirrored direction of the first direction along the longitudinal axis; and

a third deflection member coupled to the first deflection member at a first end and the second deflection member at a second end, wherein the third deflection member deflects fluid flow outwardly away from the longitudinal axis in a third direction relative to the longitudinal axis, and wherein the third direction is substantially perpendicular to a plane containing the first direction and the second direction.

2. The inlet flange of claim 1 further comprising:

a fourth deflection member coupled to the first deflection member at a first end and the second deflection member at a second end, wherein the fourth deflection member is configured to deflect fluid flow outwardly away from the longitudinal axis in a fourth direction relative to the longitudinal axis, and wherein the fourth direction is a mirrored direction of the third direction along the longitudinal axis.

3. The inlet flange of any of claims 1 or 2, wherein the first deflection member spans across a chord of the flange outlet opening, and wherein a length of the chord is less than the second diameter.

4. The inlet flange of any of claims 1-3, wherein the first deflection member comprises a first portion and a

second portion, wherein the first portion is substantially parallel to the longitudinal axis, and wherein the second portion is angularly offset from the first portion.

5. The inlet flange of claim 4, wherein the first portion and the second portion of the first deflection member are flat plates.

6. The inlet flange of any of claims 1-5, wherein the first deflection member is coupled to the flange body at the first end and the second end by a weld.

7. The inlet flange of any of claims 1-6, wherein the third deflection member comprises a first portion and a second portion, wherein the first portion is substantially parallel to the longitudinal axis, and wherein the second portion is angularly offset from the first portion.

8. The inlet flange of claim 7, wherein the first portion and the second portion of the third deflection member are flat plates.

9. The inlet flange of any of claim 1-8, wherein the flange body comprises a conical portion defining the expansion chamber of the inlet flange.

10. The inlet flange of any of claims 1-8, wherein the flange body comprises a cylindrical portion defining the expansion chamber of the inlet flange.

11. The inlet flange of any of claims 1-10, wherein the first end is configured to be coupled to an upstream exhaust system component.

12. The inlet flange of any of claims 1-11, wherein the first deflection member, the second deflection member, and the third deflection member are positioned upstream of a selective catalytic reduction catalyst.

13. The inlet flange of any of claims 1-11, wherein the first deflection member, the second deflection member, and the third deflection member are positioned upstream of a diesel oxidation catalyst.

14. The inlet flange of any of claims 1-11, wherein the first deflection member, the second deflection member, and the third deflection member are positioned upstream of a particulate filter.

15. An aftertreatment system component comprising:

a body having a first end, a second end, and an expansion chamber between the first end and the second end, the first end comprising an inlet opening having a first diameter, the body defining a longitudinal axis and has a second diam-

eter, the second diameter being greater than the first diameter;
 an inlet deflector assembly comprising:

a first deflection member coupled to the body at a first end and a second end and extending across a first portion of the expansion chamber, wherein the first deflection member is configured to deflect fluid flow outwardly away from the longitudinal axis in a first direction, 5
 a second deflection member coupled to the body at a first end and a second end and extending across a second portion of the expansion chamber, wherein the second deflection member is configured to deflect fluid flow outwardly away from the longitudinal axis in a second direction, and wherein the second direction is a mirrored direction of the first direction along the longitudinal axis, 10
 a third deflection member coupled to the first deflection member at a first end and the second deflection member at a second end, wherein the third deflection member is configured to deflect fluid flow outwardly away from the longitudinal axis in a third direction, and wherein the third direction is substantially perpendicular to a plane containing the first direction and the second direction, and 15
 a fourth deflection member coupled to the first deflection member at a first end and the second deflection member at a second end, wherein the fourth deflection member is configured to deflect fluid flow outwardly away from the longitudinal axis in a fourth direction, and wherein the fourth direction is a mirrored direction of the third direction along the longitudinal axis; and 20
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at least one of a selective catalytic reduction catalyst, a diesel oxidation catalyst, or a particulate filter.

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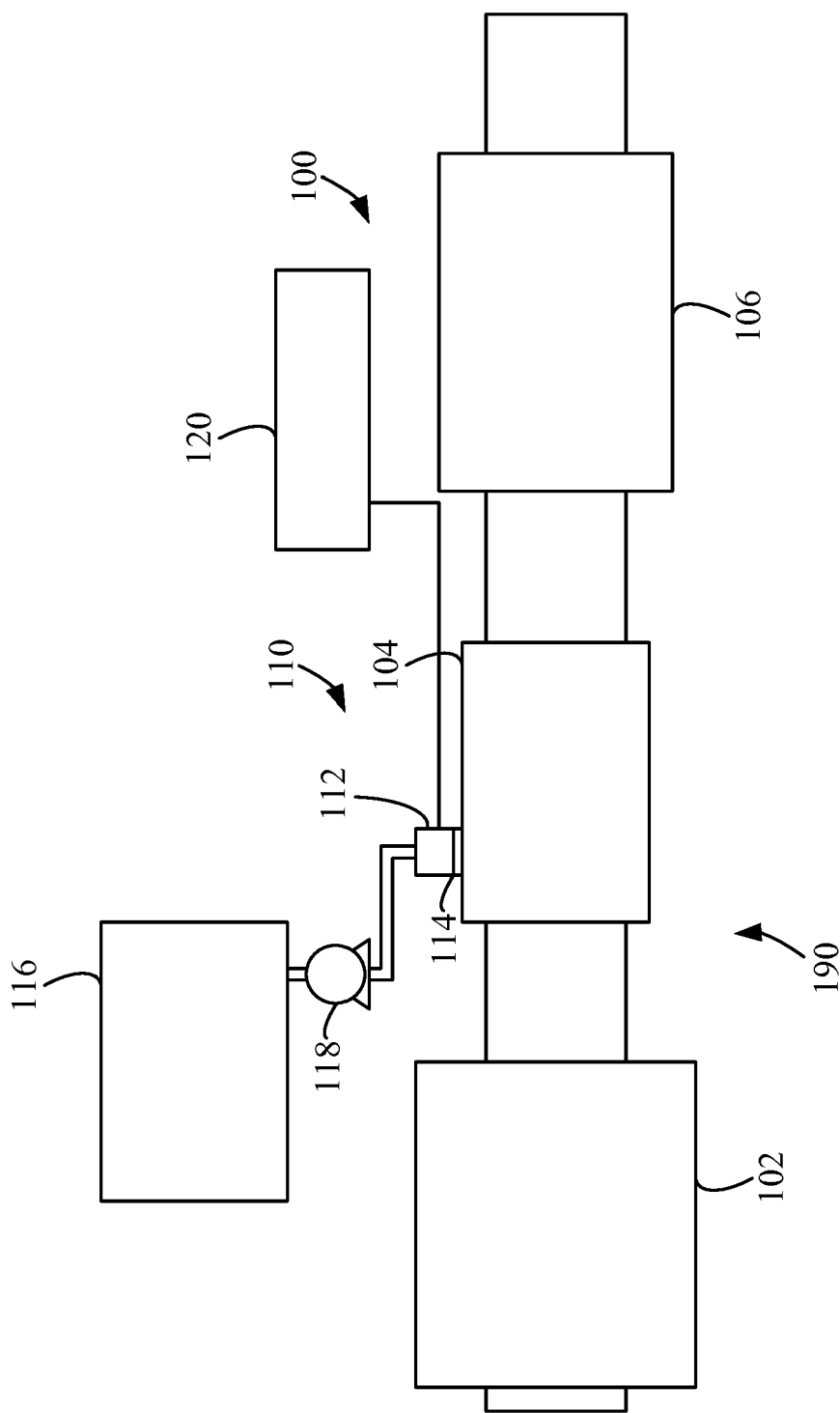
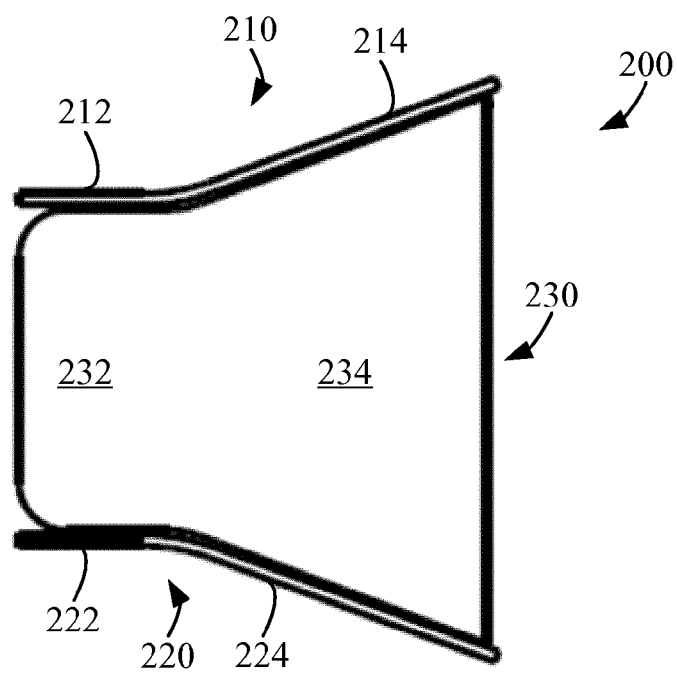
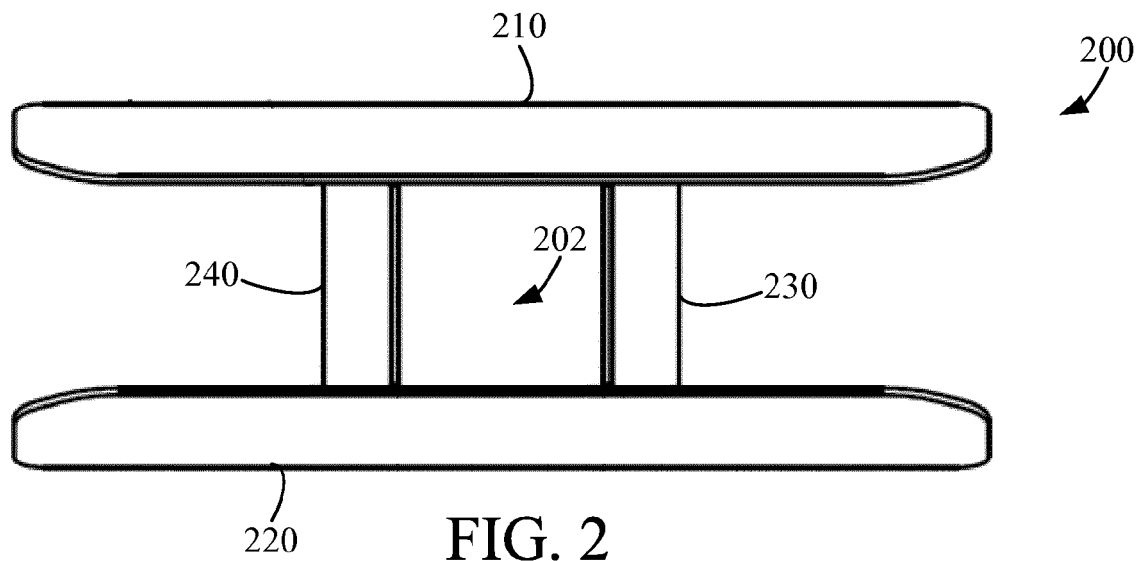


FIG. 1



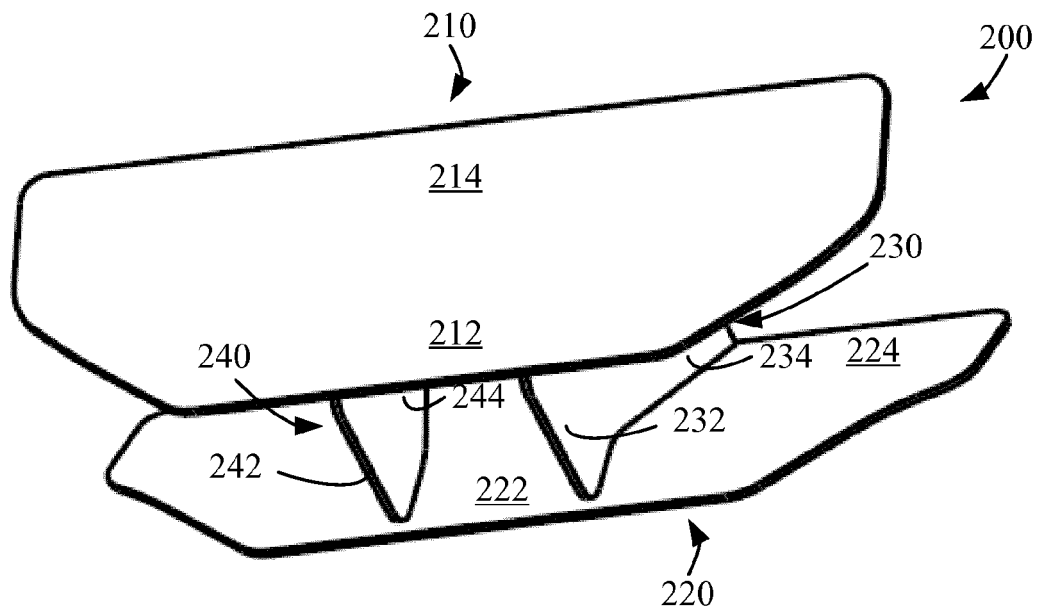


FIG. 4

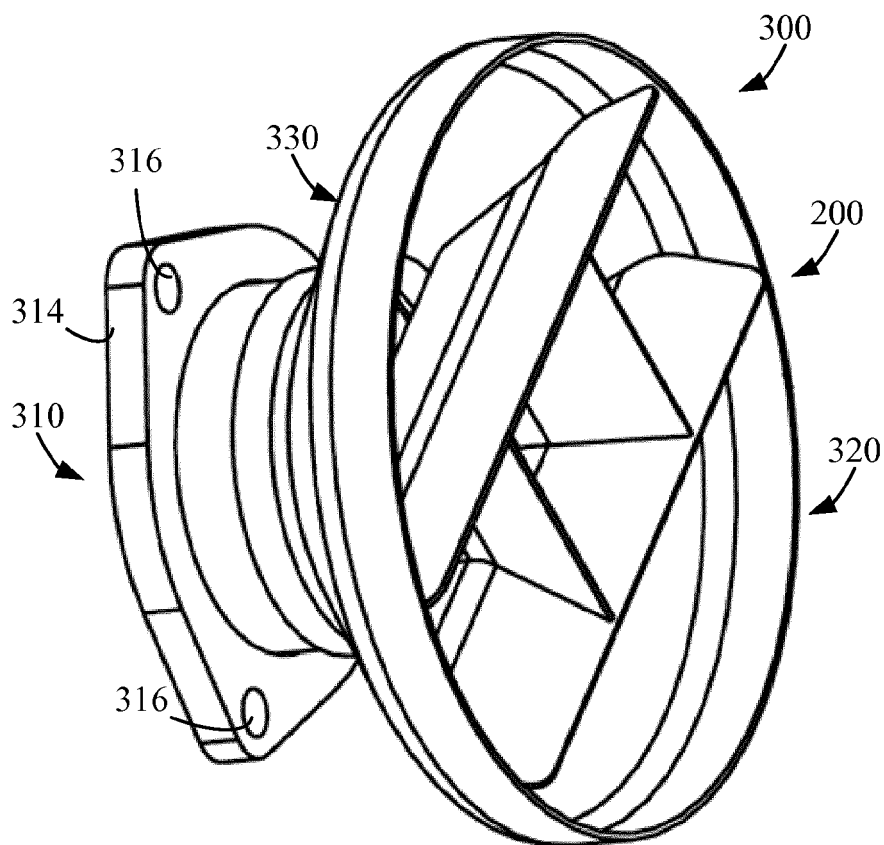


FIG. 5

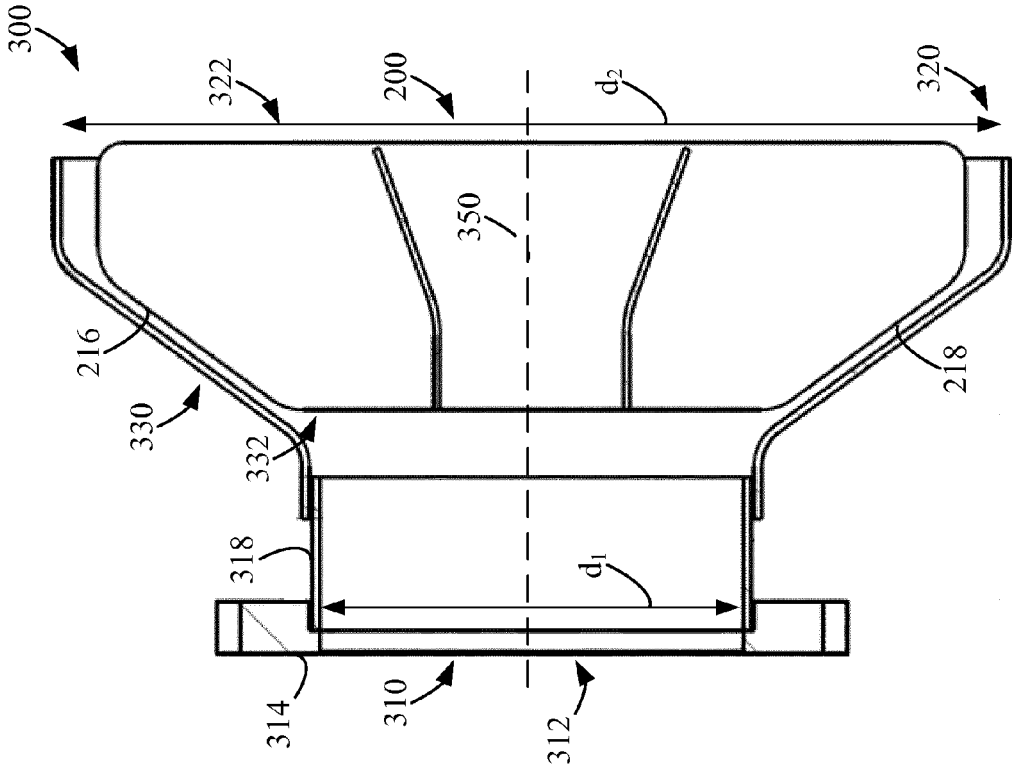


FIG. 6

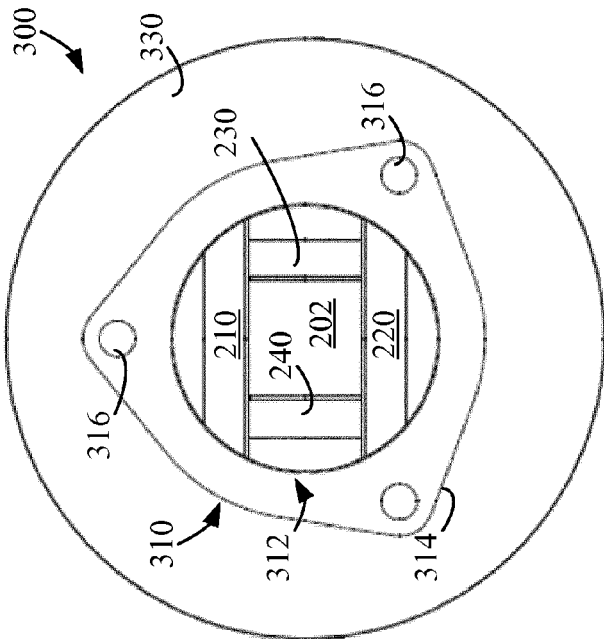


FIG. 7

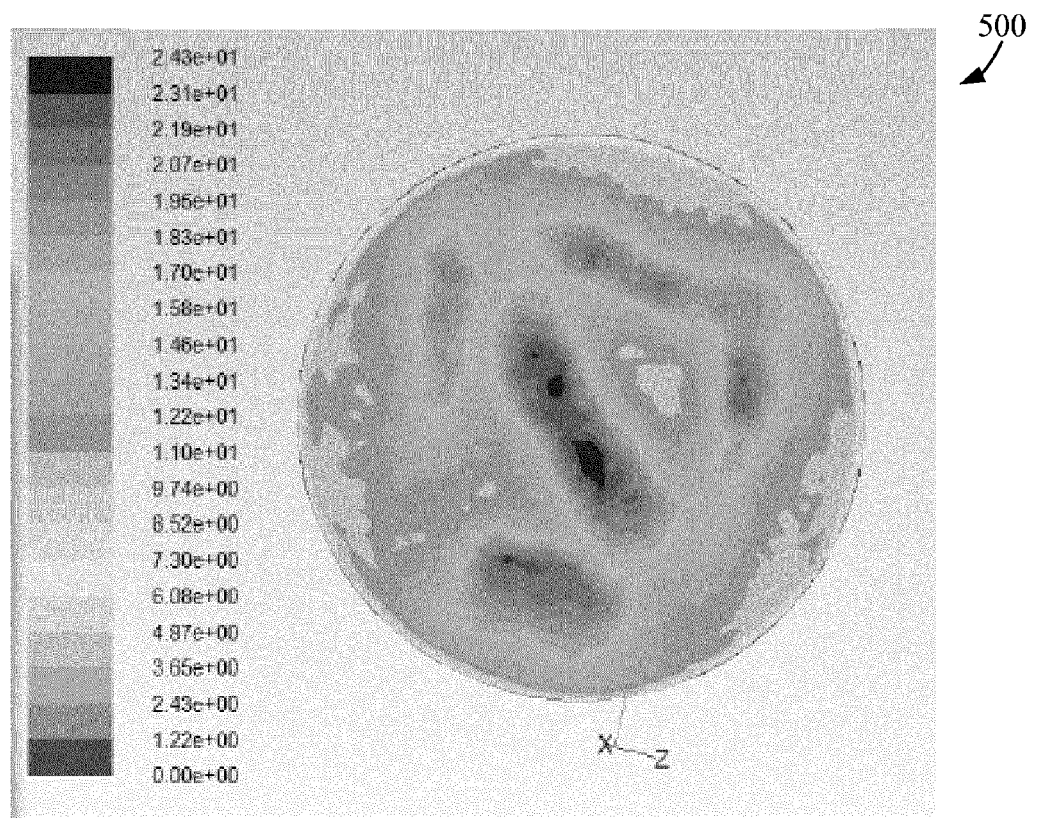
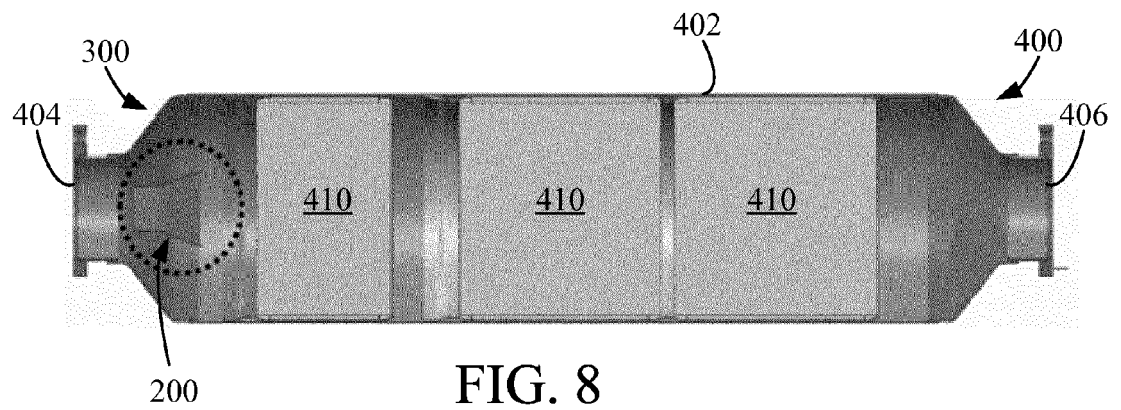


FIG. 9

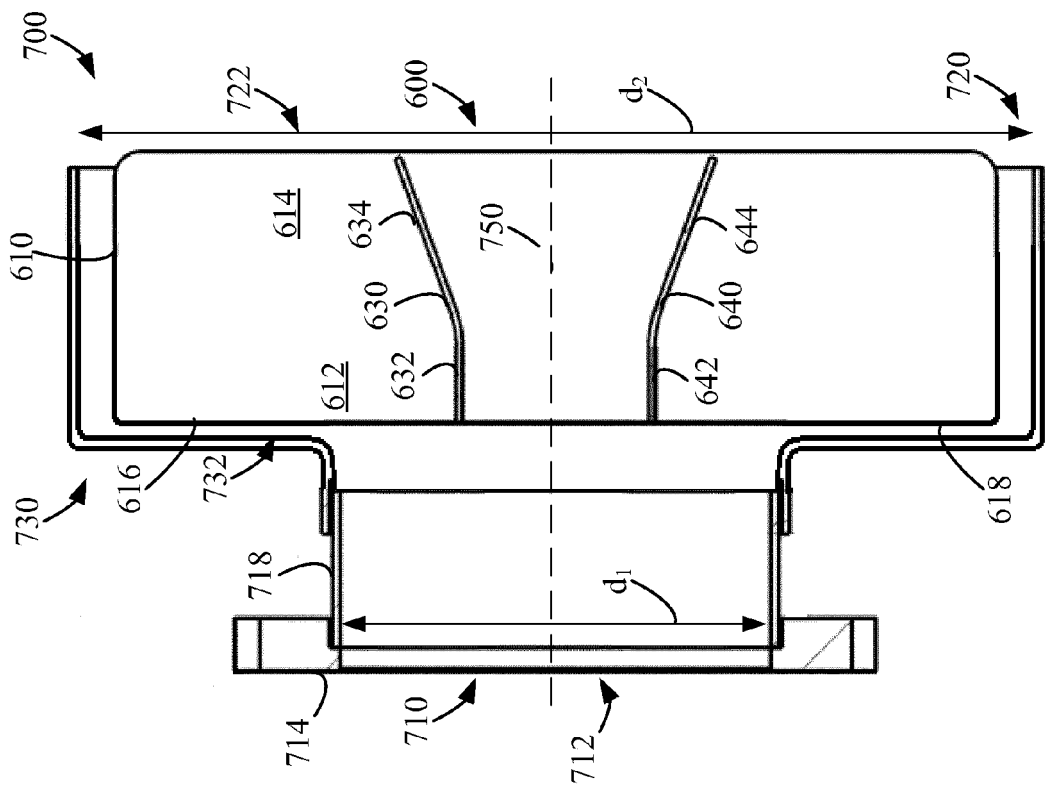


FIG. 10

**PARTIAL EUROPEAN SEARCH REPORT**

Application Number

under Rule 62a and/or 63 of the European Patent Convention.
This report shall be considered, for the purposes of
subsequent proceedings, as the European search report

EP 14 19 7160

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	DE 36 27 637 A1 (FUJITSUBO GIKEN CO [JP]) 1 October 1987 (1987-10-01) * column 2, line 18 - column 3, line 5 * * figures 1-4 *	1-14	INV. F01N3/28 F01N3/20 F01N3/10 F01N3/021 B01F5/06
Y	JP S51 148510 U (.) 29 November 1976 (1976-11-29) * page 3 - page 5 * * figures 1-4 *	1-14	
A	JP S50 28110 U (.) 1 April 1975 (1975-04-01) * page 4 - page 5 * * figures 1-4 *	1-14	
A	DE 10 2006 038204 A1 (FAURECIA ABGASTECHNIK GMBH [DE]) 21 February 2008 (2008-02-21) * paragraph [0014] - paragraph [0019] * * figures 1-5 *	1-14	
			TECHNICAL FIELDS SEARCHED (IPC)
			B01F F01N

INCOMPLETE SEARCH

The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC so that only a partial search (R.62a, 63) has been carried out.

Claims searched completely :

Claims searched incompletely :

Claims not searched :

Reason for the limitation of the search:

see sheet C

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EPO FORM 1503 03.02 (P04E07)

Place of search	Date of completion of the search	Examiner
Munich	3 July 2015	Ikas, Gerhard
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		

**INCOMPLETE SEARCH
SHEET C**

Application Number

EP 14 19 7160

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Claim(s) completely searchable:
1-14

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Claim(s) not searched:
15

Reason for the limitation of the search:

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The applicant has responded to an invitation pursuant to Rule 62a(1) EPC of 19.05.2015 by indicating to limit the scope of the search to the subject-matter of claims 1 to 14.

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

EP 14 19 7160

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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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03-07-2015

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EPO FORM P0459

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