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EXHAUST TREATMENT APPARATUS

Abstract

An exhaust treatment apparatus for reducing nitrogen oxides contained in exhaust gas discharged from an internal combustion engine, the exhaust treatment apparatus including: a chamber that includes a cylindrical wall and includes one-side end and another-side end in a cylinder-axis direction, the one-side end including an inlet port for introducing the exhaust gas, the another-side end being closed; a pipe that includes: a pipe peripheral wall; an inlet provided in one-side portion of a pipe axis; and an outlet provided in another-side portion of the pipe axis and positioned outside the chamber, the pipe being disposed so that a circumferential space is formed between the cylindrical wall and the pipe peripheral wall; an injector that injects a reducing agent toward the circumferential space; and a guide plate that guides the exhaust gas and the injected reducing agent from a side of the circumferential space toward the inlet.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority of Japanese Patent Application No. 2024-022169, filed on Feb. 16, 2024, the disclosure of which including the specification, drawings and abstract is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure relates to an exhaust treatment apparatus.

BACKGROUND ART

[0003] An exhaust treatment apparatus for treating particulate matter (PM) and nitrogen oxides (NOx) contained in exhaust gas discharged from an internal combustion engine is known. For example, an exhaust treatment apparatus in which nitrogen oxides contained in exhaust gas are reduced by mixing the exhaust gas with a urea solution as a reducing agent is called a urea selective catalytic reduction apparatus (Selective Catalytic Reduction (SCR)).

[0004] Patent Literature (hereinafter, referred to as PTL) 1 discloses an exhaust gas purifying apparatus including: an exhaust passage extending from a combustion chamber of an engine; a reducing agent injector that injects a reducing agent into the exhaust gas in the exhaust passage; a reduction catalyst main body that purifies nitrogen oxides in the exhaust gas by the reducing agent or a substance generated from the reducing agent; an impactor that divides an inside of the exhaust passage into a first space on an inner side and a second space on an outer side with a cylindrical partition wall; and a mixer disposed between the impactor and the reduction catalyst main body and having a protruding piece protruding inward from an inner surface of the exhaust passage, in which an injection direction of the reducing agent by the reducing agent injector is directed to an injection target portion set on a surface of the partition wall on a side of the first space.

[0005] Further, PTL 2 discloses a reducing agent pyrolysis system for a selective catalytic reduction apparatus, the reducing agent pyrolysis system comprising: an elbow duct that is provided in an exhaust duct at a front end of a reactor, allows exhaust gas to flow thereinto, and discharges the flowing exhaust gas toward the reactor; an inner pipe unit that is disposed in the elbow duct, and allows a part of the exhaust gas to flow into and be discharged from the inner pipe unit; a heating device that is provided in the inner pipe unit, and heats the exhaust gas flowing into the inner pipe unit; and a nozzle that is provided in the inner pipe unit, is disposed at a rear end of the heating device based on a flow of the exhaust gas, and injects a reducing agent into the inner pipe unit.

[0006] Further, PTL 3 discloses a nitrogen oxide removing apparatus including: an exhaust pipe that derives exhaust gas of an engine to a supercharger turbine; a dynamic pressure generator that extracts a part of the exhaust gas flowing through the exhaust pipe; a reducing agent supplier that mixes the extracted gas with a reducing agent and supplies the mixed gas to the exhaust pipe; and an SCR reactor that is connected to a rear end of the supercharger turbine and removes nitrogen oxides contained in the exhaust gas through a catalytic reduction reaction using the reducing agent, in which the extracted gas and the reducing agent provided to the exhaust pipe are sequentially guided to the supercharger turbine and the SCR reactor through the exhaust pipe.

CITATION LIST

Patent Literature

PTL 1

[0007] Japanese Patent Application Laid-Open No. 2018-123788

PTL 2

[0008] Japanese Unexamined Patent Application Publication (Translation of PCT Application) No. 2016-528424
PTL 3
[0009] Japanese Patent Application Laid-Open No. 2014-55594
SUMMARY OF INVENTION
Technical Problem
[0010] Incidentally, in the invention described in PTL 1, the impactor is continuously heated by the heat of the exhaust gas passing through the second space on the outer side, thereby promoting the evaporative decomposition of the reducing agent injected into the first space. However, there is room for improvement in efficiently promoting the evaporative decomposition of the reducing agent.
[0011] Furthermore, in the invention described in PTL 2, the inner pipe is continuously heated by the heat of the exhaust gas passing through the outside of the inner pipe, thereby promoting the evaporative decomposition of the reducing agent injected into the inner pipe. However, there is room for improvement in efficiently promoting the evaporative decomposition of the reducing agent.
[0012] In addition, in the invention described in PLT 3, the porous inner cylinder is continuously heated by the heat of the exhaust gas passing through the outside of the porous inner cylinder, thereby promoting the evaporative decomposition of the reducing agent injected into the porous cylinder. However, there is room for improvement in efficiently promoting the evaporative decomposition of the reducing agent.
[0013] An object of the present disclosure is to provide an exhaust treatment apparatus capable of efficiently promoting evaporative decomposition of a reducing agent.
Solution to Problem
[0014] To achieve the above object, an exhaust treatment apparatus according to the present disclosure is for reducing nitrogen oxides contained in exhaust gas by mixing, with a reducing agent, the exhaust gas discharged from an internal combustion engine, the exhaust treatment apparatus including: a chamber that includes a cylindrical wall extending in a cylinder-axis direction and includes one-side end and another-side end in the cylinder-axis direction, the one-side end including an inlet port for introducing the exhaust gas, the another-side end being closed; a pipe that includes: a pipe peripheral wall extending in a pipe-axis direction; an inlet provided in one-side portion of a pipe axis; and an outlet provided in another-side portion of the pipe axis and positioned outside the chamber, the pipe being disposed so that a circumferential space is formed between the cylindrical wall and the pipe peripheral wall by being surrounded by the cylindrical wall from an outside; an injector that injects the reducing agent toward the circumferential space; and a guide plate that guides the exhaust gas and the injected reducing agent from a side of the circumferential space toward the inlet.
Advantageous Effects of Invention
[0015] According to the present disclosure, it is possible to efficiently promote the evaporative decomposition of the reducing agent.

Description

BRIEF DESCRIPTION OF DRAWINGS
[0016] FIG. **1** is a diagram illustrating an exemplary layout of an aftertreatement system according to an embodiment of the present disclosure;
[0017] FIG. **2** is a view on arrow A of FIG. **1**;
[0018] FIG. **3** is a perspective view of an exhaust treatment apparatus assembled to a diesel particulate filter according to the embodiment of the present disclosure;

[0019] FIG. **4** is a front view of the exhaust treatment apparatus assembled to a diesel particulate filter according to the embodiment of the state disclosure;
[0020] FIG. **5** is a plan view of the exhaust treatment apparatus according to the embodiment of the present disclosure;
[0021] FIG. **6** is a front view of the exhaust treatment apparatus according to the embodiment of the present disclosure as viewed from an exhaust downstream side;
[0022] FIG. **7** is a rear view of the exhaust treatment apparatus according to the embodiment of the present disclosure as viewed from an exhaust upstream side;
[0023] FIG. **8** is a right-side view of the exhaust treatment apparatus according to the embodiment of the present disclosure;
[0024] FIG. **9** is a left-side view of the exhaust treatment apparatus according to the embodiment of the present disclosure;
[0025] FIG. **10** is a bottom view of the exhaust treatment apparatus according to the embodiment of the present disclosure;
[0026] FIG. **11** is a plan view of an exhaust treatment apparatus according to a variation of the present embodiment;
[0027] FIG. **12** is a front view of the exhaust treatment apparatus according to the variation of the present embodiment as viewed from the exhaust downstream side;
[0028] FIG. **13** is a right-side view of the exhaust treatment apparatus according to the variation of the present embodiment;
[0029] FIG. **14** is a left-side view of the exhaust treatment apparatus according to the variation of the present embodiment;
[0030] FIG. **15** is a bottom view of the exhaust treatment apparatus according to the variation of the present embodiment; and
[0031] FIG. **16** is a rear view of the exhaust treatment apparatus according to the variation of the present embodiment as viewed from the exhaust upstream side.

DESCRIPTION OF EMBODIMENTS

[0032] Hereinafter, an embodiment of the present disclosure will be described with reference to the drawings. FIG. **1** is a diagram illustrating an exemplary layout of an aftertreatement system according to the embodiment of the present disclosure. FIG. **2** is a view on arrow A of FIG. **1**. Aftertreatement system **100**A illustrated in FIGS. **1** and **2** includes a diesel particulate filter (DPF) and a selective catalytic reduction apparatus (SCR). The respective layouts of DPF and SCR are determined depending on the vehicle type. DPF collects and removes particulate matter (PM) in the exhaust gas discharged from an internal combustion engine. Note that aftertreatement system **100**A may include a diesel oxidation catalyst (DOC) that is disposed on the upstream side of the exhaust of DPF, raises the temperature of the exhaust gas by oxidizing the fuel (HC) injected after the combustion process to promote combustion in DPF.
[0033] DPF includes a cylindrical wall extending in the cylinder-axis direction. The cylinder-axis direction is a direction extending along straight line SL**1**.
[0034] SCR is disposed on the downstream side of the exhaust of DPF, and reduces nitrogen oxides (NOX) contained in the exhaust gas by mixing, with a reducing agent, the exhaust gas in which PM has been collected and removed by DPF. A urea solution ((NH.sub.2).sub.2CO)) is used as the reducing agent mixed with the exhaust gas. The urea solution is decomposed into ammonia (NH.sub.3) by the heat of the exhaust gas. The ammonia produced by the decomposition of the urea solution reacts with nitrogen oxides (NO.sub.x). Through the above process, nitrogen oxides are reduced to nitrogen (N.sub.2) and water (H.sub.2O).
[0035] Exhaust treatment apparatus **100** (SCR) in the present embodiment includes a urea-solution evaporation chamber, a diffusion chamber, and an SCR catalyst. The respective layouts of the urea-solution evaporation chamber, the diffusion chamber, and the SCR catalyst are determined depending on the vehicle type. The urea-solution evaporation chamber, the diffusion chamber, and

the SCR catalyst each have a cylindrical wall and a cylinder axis.
[0036] The urea-solution evaporation chamber is placed so that cylinder axis CS**1** is along straight line SL**1**. The diffusion chamber and the SCR catalysts are each placed so that cylinder axis CS**2** aligns with straight line SL**2** orthogonal to straight line SL**1**. A first pipe located on the urea-solution evaporation chamber side and a second pipe located on the diffusion chamber side are connected to each other through a connection pipe. The urea-solution evaporation chamber promotes the decomposition of the urea solution. The diffusion chamber diffuses ammonia and nitrogen oxides contained in the exhaust gas. The SCR catalyst uses a hydrocarbon (HC) as a reducing agent. Thus, ammonia selectively reacts with nitrogen oxides in the exhaust gas to generate nitrogen and water.
[0037] In the present embodiment, a urea-solution evaporation chamber is exemplified as exhaust treatment apparatus **100**. FIG. **3** is a perspective view of the exhaust treatment apparatus assembled to a DPF according to the present embodiment. FIG. **4** is a front view of the exhaust treatment apparatus assembled to the DPF according to the present embodiment. FIG. **5** is a plan view of the exhaust treatment apparatus according to the present embodiment. FIG. **6** is a front view of the exhaust treatment apparatus according to the present embodiment as viewed from the exhaust downstream side. FIG. **7** is a rear view of the exhaust treatment apparatus according to the present embodiment.
[0038] As illustrated in FIGS. **3** to **7**, exhaust treatment apparatus **100** includes urea-solution evaporation chamber **10** (hereinafter, simply referred to as “chamber”), pipe **20**, injector **30** (see FIG. **4**), reducing agent evaporation plate **40**, and guide plate **50**. Note that pipe **20** corresponds to the first pipe disposed on the side of chamber **10** (urea-solution evaporation chamber).
Chamber **10**
[0039] Chamber **10** includes cylindrical wall **12** formed of, for example, a stainless-steel pipe. In FIGS. **4** and **7**, partitioning line PL extending vertically is shown by a two-dot chain line. In the following description, a cylinder-axis direction is sometimes referred to as an “exhaust direction.” Furthermore, one side in the cylinder-axis direction is sometimes referred to as an “exhaust upstream side,” and the other side in the cylinder-axis direction is sometimes referred to as an “exhaust downstream side.” In addition, a direction orthogonal to the cylinder-axis direction is sometimes referred to as a “radial direction.” Moreover, a direction radially apart from cylinder axis CS**1** is sometimes referred to as a “radial-direction one side” or a “centrifugal direction,” and a direction coming close to cylinder axis CS**1** in the radial direction is sometimes referred to as a “radial-direction other side” or a “centripetal direction.” Further, in FIG. **4** showing the front side of exhaust treatment apparatus **100**, the rightward direction is sometimes referred to as a “right side,” and the leftward direction is sometimes referred to as a “left side.”
[0040] Chamber **10** includes one-side end wall **14** placed at an end on one side in the cylinder-axis direction (exhaust upstream side) and other-side end wall **15** placed at an end on the other side in the cylinder-axis direction (exhaust downstream side).
[0041] As illustrated in FIGS. **3**, **5**, and **7**, one-side end wall **14** is divided into two regions: left wall **14**L placed on the left side from partitioning line PL; and right wall **14**R placed on the right side from partitioning line PL. Note that, in FIG. **7**, which is a rear view of exhaust treatment apparatus **100**, left wall **14**L is illustrated on the right side from partitioning line PL, and right wall **14**R is illustrated on the left side from partitioning line PL. One-side end wall **14** is a circular wall that extends radially about cylinder axis CS**1**. One-side end wall **14** is provided with inlet port **16** for introducing exhaust gas from a DPF side (not shown). Inlet port **16** is an arc-shaped opening that has a predetermined width in the radial direction and extends in a counterclockwise direction from the position of 12 o'clock to the position of 6 o'clock in one-side end wall **14**, which is a circular wall.
[0042] As shown in FIGS. **3** to **6**, other-side end wall **15** is divided into two regions: left wall **15**L placed on the left side from partitioning line PL; and right wall **15**R placed on the right side from

the partitioning line. Other-side end wall **15** closes the end of chamber **10** on the other side in the cylinder-axis direction (exhaust downstream side). Left wall **15**L has a wall surface extending radially from cylinder axis CS**1** in a substantially semicircular shape. In other words, the wall surface of left wall **15**L is a wall surface extending counterclockwise from the position of 12 o'clock to the position of 6 o'clock. Right wall **15**R has a wall surface extending radially from cylinder axis CS**1** in a substantially semicircular shape. In other words, the wall surface of right wall **15**R is a wall surface extending counterclockwise from the position of 6 o'clock to the position of 12 o'clock. Further, the wall surface of right wall **15**R is inclined at a predetermined angle θ toward one side in the cylinder-axis direction (exhaust upstream side) with respect to the wall surface of left wall **15**L (see FIG. **5**).

[0043] Chamber **10** is divided into two spaces: left chamber part **10**L placed on the left side from partitioning line PL; and right chamber part **10**R placed on the right side from partitioning line PL. The total length of left chamber part **10**L in the cylinder-axis direction is constant length CL**0** (see FIG. **5**). Meanwhile, the total length of right chamber part **10**R in the cylinder-axis direction gradually shortens from the position of 6 o'clock toward the position of 3 o'clock in a counterclockwise direction because the wall surface of right wall **15**R is inclined toward one side in the cylinder-axis direction (exhaust upstream side) with respect to cylinder axis CS**1**. Specifically, the total length of right chamber part **10**R in the cylinder-axis direction shortens from length CL**0** to length CL**1** (see FIG. **5**). As a result, the cross-sectional area of right chamber part **10**R (cross-sectional area of right chamber part **10**R on a plane orthogonal to the cylinder-axis direction) is narrowed from the other side in the cylinder-axis direction toward the one side in the cylinder-axis direction.

Pipe **20**

[0044] FIG. **8** is a right-side view of the exhaust treatment apparatus according to the present embodiment. FIG. **9** is a left-side view of the exhaust treatment apparatus according to the present embodiment. As illustrated in FIGS. **3** to **6**, **8** and **9**, pipe **20** includes pipe axis PS and pipe peripheral wall **22**, and is formed of, for example, a stainless-steel pipe. Pipe axis PS is shown by a dashed line in FIG. **5**. Pipe **20** includes bent part PS**1** bent at the central part in the pipe-axis direction. Part PS**2** on one side from bent part PS**1** in the pipe-axis direction (pipe-axis-direction one-side part PS**2**) extends along cylinder axis CS**1**. Part PS**3** on the other side from bent part PS**1** in the pipe-axis direction (pipe-axis-direction other-side part PS**3**) extends in a direction inclined at a predetermined angle a with respect to cylinder axis CS**1** (see FIG. **5**). The inclination angle a of pipe-axis-direction other-side part PS**3** with respect to cylinder axis CS**1** corresponds to inclination angle θ of the wall surface of right wall **15**R with respect to the wall surface of left wall **15**L (α=0).

[0045] One-side end of pipe **20** in the pipe-axis direction is a closed end blocked by one-side end wall **14**. The other-side end of pipe **20** in the pipe-axis direction is an open end. Inlet **24** is provided in pipe peripheral wall **22** in pipe-axis-direction one-side part PS**2**. Outlet **26** is provided in pipe-axis-direction other-side part PS**3** as an open end. Outlet **26** is placed outside chamber **10**.

[0046] Pipe peripheral wall **22** is placed in such a manner that pipe peripheral wall **22** is surrounded by cylindrical wall **12** from the outside. This forms a circumferentially extending circumferential space **18** between pipe peripheral wall **22** and cylindrical wall **12**. In the same manner as chamber **10** divided into two spaces by partitioning line PL, circumferential space **18** is also divided into two spaces: left circumferential space **18**L (see FIG. **6**) positioned on the left side from partitioning line PL; and right circumferential space **18**R (see FIG. **6**) positioned on the right side from partitioning line PL. In the same manner as the cross-sectional area of right chamber part **10**R, the cross-sectional area of right circumferential space **18**R is also narrowed from the other side toward the one side in the cylinder-axis direction. One side of left circumferential space **18**L (exhaust upstream side) leads to inlet port **16**. This allows the exhaust gas from DPF to be introduced into left circumferential space **18**L through inlet port **16**, and then the introduced exhaust gas can move from left circumferential space **18**L to right circumferential space **18**R.

Furthermore, the exhaust gas that has moved to right circumferential space **18**R can move from the other side in the cylinder-axis direction toward the one side in the cylinder-axis direction. That is, the exhaust gas from DPF can move from left circumferential space **18**L toward the one side of right circumferential space **18**R in the cylinder-axis direction. The direction of flow of the exhaust gas is indicated by a thick arrow in FIG. **3**.

Injector **30**

[0047] Injector **30** is disposed on cylindrical wall **12** in left chamber part **10**L (see FIG. **4**). The injection port of injector **30** is directed from the side of cylindrical wall **12** to left circumferential space **18**L. This allows injector **30** to inject the reducing agent (urea solution) toward the exhaust gas introduced into left circumferential space **18**L from inlet port **16**. In FIG. **4**, the direction of flow of the exhaust gas is indicated by a hatched arrow, and the direction of flow of the reducing agent is indicated by a white arrow.

Reducing Agent Evaporation Plate **40**

[0048] FIG. **10** is a bottom view of the exhaust treatment apparatus according to the present embodiment. As illustrated in FIGS. **3** to **10**, reducing agent evaporation plate **40** is a flat plate member disposed along cylindrical wall **12** in circumferential space **18**. Specifically, reducing agent evaporation plate **40** extends circumferentially in a counterclockwise direction from the position of 9 o'clock to the position of 4 o'clock between cylindrical wall **12** and pipe peripheral wall **22**. That is, reducing agent evaporation plate **40** extends circumferentially from left circumferential space **18**L to right circumferential space **18**R. In addition, reducing agent evaporation plate **40** includes inner wall surface WS**1** facing pipe peripheral wall **22** and outer wall surface WS**2** facing cylindrical wall **12**. Inner wall surface WS**1** is placed such that the reducing agent injected from injector **30** comes into contact with inner wall surface WS**1**. Exhaust gas and the reducing agent (urea solution) flow through the gap between pipe peripheral wall **22** and inner wall surface WS**1**. Exhaust gas flows through the gap between cylindrical wall **12** and outer wall surface WS**2**. This allows the reducing agent flowing through the gap between pipe peripheral wall **22** and inner wall surface WS**1** to be decomposed into ammonia by the heat of the exhaust gas flowing through the gap between cylindrical wall **12** and outer wall surface WS**2**. Note that chamber **10** decomposes the reducing agent (urea solution) into ammonia by the heat of the exhaust gas, and is therefore referred to as a “urea-solution evaporation chamber.”

[0049] The total length of reducing agent evaporation plate **40** in left circumferential space **18**L in the cylinder-axis direction is constant length VL**0** (see FIG. **10**). Similarly to the total length of right chamber part **10**R in the cylinder-axis direction, the total length of reducing agent evaporation plate **40** in right circumferential space **18**R in the cylinder-axis direction gradually shortens from the position of 6 o'clock to the position of 4 o'clock in the counterclockwise direction because the wall surface of right wall **15**R is inclined to one side in the cylinder-axis direction (the exhaust upstream side) with respect to cylinder axis CS**1**. Specifically, the total length of reducing agent evaporation plate **40** in right circumferential space **18**R in the cylinder-axis direction shortens from length VL**0** to length VL**1** (see FIG. **10**).

Guide Plate **50**

[0050] Guide plate **50** is bent at central part **51** in the cylinder-axis direction, similarly to pipe **20** bent at the central part in the pipe-axis direction (bent part PS**1**). Guide plate **50** extends radially from the 12 o'clock position of pipe peripheral wall **22** to cylindrical wall **12**, with radial-direction one side being connected to cylindrical wall **12** and the radial-direction other side being connected to pipe peripheral wall **22**. Guide plate **50** blocks the movement of the exhaust gas and ammonia that have moved from left circumferential space **18**L (see FIG. **6**) to right circumferential space **18**R (see FIG. **6**) so that the exhaust gas and ammonia do not return from right circumferential space **18**R to left circumferential space **18**L. Note that the exhaust gas and ammonia move, in right circumferential space **18**R, from the other side to the one side in the cylinder-axis direction.

[0051] While guide plate **50** blocks the movement of the exhaust gas and ammonia from right circumferential space **18**R to left circumferential space **18**L, guide plate **50** guides the exhaust gas and ammonia that have moved toward the one side in the cylinder-axis direction in right circumferential space **18**R, from right circumferential space **18**R toward inlet **24**.

[0052] The exhaust gas and ammonia guided to inlet **24** enter a position on one side of the pipe axis of pipe **20**, move from this position to a position on the other side of the pipe axis, and are discharged from outlet **26** to the outside of chamber **10**. A diffusion chamber is connected to chamber **10** to diffuse the exhaust gas and ammonia (see FIG. **1**). This causes ammonia to react with nitrogen oxides contained in the exhaust gas, and the nitrogen oxides are reduced to nitrogen and water in the reaction process.

[0053] Exhaust treatment apparatus **100** according to the present embodiment is for reducing nitrogen oxides contained in exhaust gas by mixing, with a reducing agent, the exhaust gas discharged from an internal combustion engine, exhaust treatment apparatus **100** including: chamber **10** that includes cylindrical wall **12** and cylinder axis CS**1** and includes one-side end and another-side end in the cylinder-axis direction, the one-side end including inlet port **16** for introducing the exhaust gas, the another-side end being closed; pipe **20** that includes: pipe peripheral wall **22**; pipe axis PS; inlet **24** provided in one-side portion of the pipe axis; and outlet **26** provided in another-side portion of the pipe axis and positioned outside the chamber, pipe **20** being disposed so that circumferential space **18** is formed along cylindrical wall **12** in the circumferential direction by being surrounded by cylindrical wall **12** from the outside; injector **30** that injects the reducing agent from the side of cylindrical wall **12** toward circumferential space **18**; and guide plate **50** that guides the exhaust gas and the injected reducing agent from the side of circumferential space **18** toward inlet **24**.

[0054] With the above configuration, the exhaust gas flows along the outer circumference direction of pipe **20**. The entire pipe peripheral wall **22** of pipe **20** can be efficiently heated by the heat of the exhaust gas flowing along the outer circumference direction of the pipe, thereby efficiently promoting the evaporative decomposition of the reducing agent passing through pipe **20**.

[0055] Exhaust treatment apparatus **100** in the above embodiment further includes reducing agent evaporation plate **40** disposed in circumferential space **18** so that the injected reducing agent comes into contact with reducing agent evaporation plate **40**, and guide plate **50** guides the exhaust gas and the reducing agent that has been evaporated by being in contact with reducing agent evaporation plate **40**, from the side of circumferential space **18** toward inlet **24**. Accordingly, reducing agent evaporation plate **40** is disposed so that the reducing agent comes into contact with reducing agent evaporation plate **40**, and thus it is possible to further efficiently promote the evaporative decomposition of the reducing agent.

[0056] In exhaust treatment apparatus **100** of the above embodiment, reducing agent evaporation plate **40** is disposed along cylindrical wall **12**. Thus, the area of reducing agent evaporation plate **40** can be widened along cylindrical wall **12**, and the evaporative decomposition of the reducing agent is promoted depending on the widened area, so that the evaporative decomposition of the reducing agent can be sufficiently performed.

[0057] In exhaust treatment apparatus **100** in the above embodiment, one-side portion of the pipe axis extends along the cylinder axis, inlet **24** is provided in pipe peripheral wall **22** in the one-side portion of the pipe axis, and the other side portion of the pipe axis extends in a direction is inclined at a predetermined angle with respect to the cylinder axis. Thus, adjusting the direction in which the other side portion of the pipe axis is inclined allows for corresponding to the layout variation of exhaust treatment apparatus **100** set for each vehicle type.

[0058] In exhaust treatment apparatus **100** of the above embodiment, guide plate **50** extends radially from pipe peripheral wall **22** to cylindrical wall **12**, a radial-direction one side is connected to cylindrical wall **12**, and the radial-direction other side is connected to pipe peripheral wall **22**. This allows the reducing agent flowing to the side of cylindrical wall **12** to be guided to the side of pipe peripheral wall **22** together with the exhaust gas, and allows the guided reducing agent to be

guided, together with the exhaust gas, to inlet **24** provided in pipe peripheral wall **22**.
Variations
[0059] Next, exhaust treatment apparatus **100** according to a variation of the present embodiment is described with reference to FIGS. **11** to **16**. FIG. **11** is a plan view of an exhaust treatment apparatus according to a variation of the present embodiment. FIG. **12** is a front view of the exhaust treatment apparatus according to the variation of the present embodiment. FIG. **13** is a right-side view of the exhaust treatment apparatus according to the variation of the present embodiment. FIG. **14** is a left-side view of the exhaust treatment apparatus according to the variation of the present embodiment. FIG. **15** is a bottom view of the exhaust treatment apparatus according to the variation of the present embodiment. FIG. **16** is a rear view of the exhaust treatment apparatus according to the variation of the present embodiment. In the variation, configurations different from those of the above-described embodiment are mainly described, and the same components are denoted by the same reference numerals, and descriptions thereof are omitted.
[0060] In the above-described embodiment, inlet **24** of pipe **20** is provided in pipe peripheral wall **22** in pipe-axis-direction one-side part PS**2**. In contrast, in the variation illustrated in FIGS. **11** to **16**, inlet **24**A is provided so as to extend from pipe-axis-direction one-side part PS**2** to pipe-axis-direction other-side part PS**3**. This allows the exhaust gas and the reducing agent that have moved from left chamber part **10**L to right chamber part **10**R to be introduced into pipe **20**.
[0061] Further, in the above-described embodiment, inlet port **16** for introducing the exhaust gas from DPF into chamber **10** is provided in left wall **14**L and is not provided in right wall **14**R. In contrast, in the variation, inlet port **16** is provided in left wall **14**L, and inlet holes **16**A for introducing the exhaust gas into chamber **10** are provided in right wall **14**R. This makes it possible to reduce the exhaust pressure loss in chamber **10**.
[0062] Note that, in exhaust treatment apparatus **100** in the above-described embodiment, chamber **10**, pipe **20**, and guide plate **50** are applied as components composing SCR, but may be applied as components composing another exhaust treatment apparatus such as DPF.
[0063] The above-described embodiment is merely an example of implementation of the present disclosure, and the technical scope of the present disclosure should not be construed as limited by the embodiment. That is, the present disclosure can be implemented in various forms without departing from its spirit or key features.
INDUSTRIAL APPLICABILITY
[0064] The present disclosure is suitably used for a vehicle including an exhaust treatment apparatus that is required to efficiently promote the evaporative decomposition of a reducing agent.

Claims

1. An exhaust treatment apparatus for reducing nitrogen oxides contained in exhaust gas by mixing, with a reducing agent, the exhaust gas discharged from an internal combustion engine, the exhaust treatment apparatus comprising: a chamber that includes a cylindrical wall extending in a cylinder-axis direction and includes one-side end and another-side end in the cylinder-axis direction, the one-side end including an inlet port for introducing the exhaust gas, the another-side end being closed; a pipe that includes: a pipe peripheral wall extending in a pipe-axis direction; an inlet provided in one-side portion of a pipe axis; and an outlet provided in another-side portion of the pipe axis and positioned outside the chamber, the pipe being disposed so that a circumferential space is formed between the cylindrical wall and the pipe peripheral wall by being surrounded by the cylindrical wall from an outside; an injector that injects the reducing agent toward the circumferential space; and a guide plate that guides the exhaust gas and the injected reducing agent from a side of the circumferential space toward the inlet.
2. The exhaust treatment apparatus according to claim 1, further comprising a reducing agent

evaporation plate that is disposed in the circumferential space so that the injected reducing agent comes into contact with the reducing agent evaporation plate, wherein the guide plate guides the exhaust gas and the reducing agent that has been evaporated by being in contact with the reducing agent evaporation plate, from the side of the circumferential space toward the inlet.

3. The exhaust treatment apparatus according to claim 2, wherein the reducing agent evaporation plate is disposed along the cylindrical wall.

4. The exhaust treatment apparatus according to claim 2, wherein a gap is provided between the reducing agent evaporation plate and the cylindrical wall.

5. The exhaust treatment apparatus according to claim 1, wherein the one-side portion of the pipe axis extends along the cylindrical-axis direction, the inlet is provided in the pipe peripheral wall in the one side portion of the pipe axis, and the another-side portion of the pipe axis extends in a direction inclined at a predetermined angle with respect to the cylinder-axis direction.

6. The exhaust treatment apparatus according to claim 1, wherein the guide plate extends radially from the pipe peripheral wall to the cylindrical wall, one side of the guide plate in a radial direction is connected to the cylindrical wall, and another side of the guide plate in the radial direction is connected to the pipe peripheral wall.