(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 343 440 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
13.07.2011 Bulletin 2011/28

(21) Application number: **09824733.1**

(22) Date of filing: **22.10.2009**

(51) Int Cl.:
F01N 3/24 *(2006.01)* ***F01N 3/28*** *(2006.01)*
F01N 3/36 *(2006.01)*

(86) International application number:
PCT/JP2009/068543

(87) International publication number:
WO 2010/053033 (14.05.2010 Gazette 2010/19)

(84) Designated Contracting States:
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 SE SI SK SM TR
Designated Extension States:
AL BA RS

(30) Priority: **05.11.2008 JP 2008284505**

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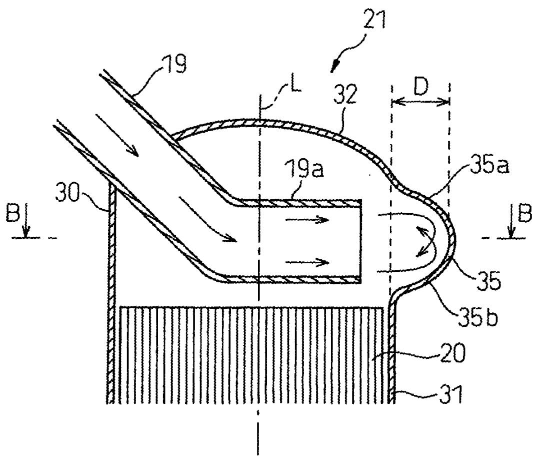
(54) EXHAUST PURIFYING DEVICE FOR INTERNAL COMBUSTION ENGINE

(57) An exhaust purification system provided with an exhaust manifold (19), a catalytic converter (21) which is arranged at a downstream side of the exhaust manifold (19) at an angle with respect to the exhaust manifold (19) and which houses an NO_X storage and reduction catalyst (20), and a reducing agent feed system (22) which feeds reducing agent into exhaust gas which passes through the inside of the exhaust manifold. The part of the inner wall surface of the casing (30) of the catalytic converter which faces the exhaust manifold outlet is provided with a projecting part (35) which projects out toward the diametrically outward direction of the casing (30). Part of the wall surface which defines the projecting part is formed so that a velocity component, in an axial direction of the casing, of at least part of the flow of exhaust gas which flows into the projecting part, is oriented in an opposite direction to the direction heading toward the NO_X storage and reduction catalyst. The exhaust purification system of an internal combustion engine which suppresses an increase in pressure loss of the exhaust gas and causes the reducing agent which was fed from the reducing agent feed system to disperse in the exhaust gas is provided.

Fig.2A



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Description

Technical Field

[0001] The present invention relates to an exhaust purification system of an internal combustion engine.

Background Art

[0002] Exhaust gas which is exhausted from an internal combustion engine contains nitrogen oxides (NO_X) and soot and other particulate matter. Various measures are being devised to purify the gas of these ingredients. As one such measure, an exhaust purification system which is provided with an engine exhaust passage with a catalyst or particulate filter which has an NO_X storage and reduction function (hereinafter referred to as an "NO_X storage and reduction catalyst") and is provided with, at the upstream side of the exhaust from this catalyst in this engine exhaust passage, a reducing agent feed system which feeds a reducing agent, may be mentioned.

[0003] In such an exhaust purification system, when the amount of NO_X stored in the NO_X storage and reduction catalyst becomes great, the reducing agent is fed from the reducing agent feed system to the engine exhaust passage, the NO_X is desorbed from the NO_X storage and reduction catalyst, and the gas is purified of NO_X by reduction.

[0004] Here, when the reducing agent feed system feeds the reducing agent, to enable the desorption and reduction of NO_X at the NO_X storage and reduction catalyst to be performed optimally in the entire NO_X storage and reduction catalyst, it is necessary to make the fed reducing agent uniformly flow into the NO_X storage and reduction catalyst. For this reason, various techniques have been proposed for causing the fed reducing agent to uniformly disperse in the exhaust gas which flows through the inside of the engine exhaust passage.

[0005] For example, in the exhaust purification system which is disclosed in PLT 1, in the exhaust pipe between the reducing agent feed system and the exhaust purification catalyst, a choke is provided which reduces the cross-sectional area of the exhaust flow. In this exhaust purification system, the choke causes the flow of exhaust gas to accelerate to cause disturbances in the exhaust gas and thereby cause the reducing agent which is fed from the reducing agent feed system to disperse.

[0006] Further, the exhaust purification system which is disclosed in PLT 2 is provided, inside of a catalytic converter at the upstream side of the exhaust purification catalyst, with an exhaust introduction pipe which is capped at its front end and is provided with a plurality of through holes, and a partition wall which is provided with a plurality of through holes. Furthermore, the exhaust purification system which is disclosed in PLT 3 is provided, inside of an exhaust pipe between a reducing agent feed system and an exhaust purification catalyst, with a plurality of dispersion plates alternatively arranged. In each of these exhaust purification systems, an exhaust introduction pipe and partition wall or dispersion plates are used to cause disturbances in the exhaust gas and thereby cause the reducing agent which is fed from the reducing agent feed system to disperse in the exhaust gas.

Citation List

Patent Literature

[0007]

PLT 1: Japanese Patent Publication (A) No. 2002-213233
PLT 2: Japanese Patent Publication (A) No. 2003-184544
PLT 3: Japanese Patent Publication (A) No. 2005-325747

Summary of Invention

Technical Problem

[0008] In this regard, the choke, exhaust introduction pipe and partition wall, and dispersion plates which are used in the exhaust purification systems which are described in the above PLTs 1 to 3 all obstruct the flow of exhaust gas so as to cause disturbances in the exhaust gas. For this reason, while it is possible to provide inside of the engine exhaust passage with these components so as to cause the reducing agent to disperse in the exhaust gas, along with this, the pressure loss of the exhaust gas increases. If the pressure loss of the exhaust gas increases in this way, it becomes difficult for exhaust gas to flow out from the combustion chambers of the internal combustion engine and as a result a drop in the engine output, deterioration of the fuel efficiency, etc. are liable to be incurred.

[0009] Therefore, an object of the present invention is to provide an exhaust purification system of an internal combustion engine which can suppress an increase in the pressure loss of the exhaust gas while causing a reducing agent which is fed from a reducing agent feed system to disperse in the exhaust gas.

Solution to Problem

[0010] The present invention solves the above problem by means of the provision of the internal combustion engine described in the claims of the claim section.

[0011] In a first aspect of the present invention, there is provided an exhaust purification system of an internal combustion engine which is provided with an upstream side exhaust passage through which exhaust gas which is exhausted from the internal combustion engine passes, a downstream side exhaust passage which is arranged at a downstream side of the upstream side exhaust passage at an angle with respect to the upstream side exhaust passage, a reducing agent feeding means which feeds reducing agent into the exhaust gas which passes through the inside of the upstream side exhaust passage, and an exhaust purifying means which is provided inside the downstream side exhaust passage, wherein, the part of the inner wall surface, which defines the downstream side exhaust passage and faces the upstream side exhaust passage outlet, is provided with a flow deflection part, and the flow deflection part is positioned at the upstream side from the exhaust purifying means and is formed so that a velocity component, in an axial direction of a downstream side exhaust passage, of at least part of the flow of exhaust gas which flows into the flow deflection part is oriented in an opposite direction to the direction heading toward the exhaust purifying means.

[0012] According to this aspect, due to the flow deflection part which is formed at the inner wall surface, the exhaust gas which is oriented in the opposite direction to the direction heading toward the exhaust purifying means strikes the other exhaust gas. Due to this striking action, the exhaust gas is disturbed and the mixing of the reducing agent and exhaust gas is promoted. Further, the flow deflection part only changes the direction of flow of exhaust gas, so substantially no component is provided which would act as a choke with respect to the flow of exhaust gas, and the pressure loss of the exhaust gas is also not increased much at all.

[0013] Therefore, according to this aspect, it is possible to promote mixing of the reducing agent and exhaust gas due to the disturbance caused in the exhaust gas. Further, substantially no component is provided which would act as a choke with respect to the flow of exhaust gas. For this reason, it is possible to suppress the increase in pressure loss of the exhaust gas while causing the reducing agent which was fed from the reducing agent feed system to disperse in the exhaust gas.

[0014] In a second aspect of the present invention, the region of the wall surface which defines the above flow deflection part at the exhaust purifying means side has a part which is slanted in a direction opposite to the direction heading toward the exhaust purifying means toward the diametrically outward direction of the downstream side exhaust passage.

[0015] In a third aspect of the present invention, there is provided an exhaust purification system of an internal combustion engine which is provided with an upstream side exhaust passage through which exhaust gas which is exhausted from the internal combustion engine passes, a downstream side exhaust passage which is arranged at a downstream side of the upstream side exhaust passage at an angle with respect to the upstream side exhaust passage, a reducing agent feeding means which feeds reducing agent into the exhaust gas which passes through the inside of the upstream side exhaust passage, and an exhaust purifying means which is provided inside the downstream side exhaust passage, wherein, the part of the inner wall surface, which defines the downstream side exhaust passage and faces the upstream side exhaust passage outlet, is provided with a flow deflection part, the flow deflection part is positioned at the upstream side from the exhaust purifying means, and a wall surface of the flow deflection part is formed so that at least part of the exhaust gas which strikes part of the wall surface of the flow deflection part and is increased in velocity component in the direction heading toward an exhaust purifying means strikes another part of the wall of surface of the flow deflection part and is lowered in velocity component of the same direction of the exhaust gas.

[0016] According to this aspect, the exhaust gas which is increased in velocity component in the direction heading toward an exhaust purifying means due to the part of the wall surface of the flow deflection part strikes another part of the wall of surface of the flow deflection part and is lowered in velocity component of the exhaust gas of the direction heading toward the exhaust purifying means. By striking the other part of the wall surface so that the velocity component of the direction heading toward the exhaust purifying means is lowered in this way, the exhaust gas is disturbed and mixing of the reducing agent and the exhaust gas is promoted. Further, the flow deflection part only changes the direction of flow of exhaust gas, so substantially no component is provided which would act as a choke with respect to the flow of exhaust gas and the pressure loss of the exhaust gas is also not increased much at all.

[0017] Therefore, according to this aspect, it is possible to promote mixing of the reducing agent and exhaust gas due to the disturbance caused in the exhaust gas. Further, substantially no component is provided which would act as a choke with respect to the flow of exhaust gas. For this reason, it is possible to suppress the increase in pressure loss of the exhaust gas while causing the reducing agent which was fed from the reducing agent feed system to disperse in the exhaust gas.

[0018] In a fourth aspect of the present invention, a region of the wall surface which defines the above flow deflection part at the side away from exhaust purifying means has a part which is slanted in a direction heading toward the exhaust purifying means toward the diametrically outward direction of the downstream side exhaust passage.

[0019] In a fifth aspect of the present invention, the above flow deflection part is provided with a projecting part which is formed by the inner wall surface, which defines the downstream side exhaust passage, projecting out toward the diametrically outward direction of the downstream side exhaust passage.

[0020] According to this aspect, even if the reducing agent which was fed from the reducing agent feeding means is not sufficiently vaporized and flows out from the upstream side exhaust passage in the droplet state, it is possible to receive the droplets inside the projecting part and make them evaporate, so it is possible to keep the reducing agent from flowing into the exhaust purifying means and depositing there in the droplet state.

[0021] In a sixth aspect of the present invention, the cross-section of the above projecting part in the circumferential direction of the downstream side exhaust passage is substantially semi elliptical in shape.

[0022] In a seventh aspect of the present invention, an inlet area of the above projecting part which faces the above downstream side exhaust passage is larger than the cross-sectional area of the upstream side exhaust passage.

[0023] In an eighth aspect of the present invention, a height, in the axial direction of the downstream side exhaust passage, of the above projecting part is larger than a diameter of the upstream side exhaust passage.

[0024] In a ninth aspect of the present invention, the above projecting part extends in the circumferential direction of the above downstream side exhaust passage.

[0025] In a 10th aspect of the present invention, a depth of the above projecting part in the diametrical direction of the downstream side exhaust passage becomes smaller the further from the region which faces the above upstream side exhaust passage outlet.

[0026] In an 11th aspect of the present invention, the above projecting part is formed so that the outer circumference becomes substantially semi elliptical in shape.

[0027] In a 12th aspect of the present invention, the above projecting part is slanted so as to be positioned more at the exhaust purifying means side the further away from the region facing said upstream side exhaust passage outlet in the circumferential direction of the downstream side exhaust passage.

[0028] In a 13th aspect of the present invention, the above upstream side exhaust passage extends, near the outlet thereof, so that a center axis passes though the inside of the projecting part.

[0029] In a 14th aspect of the present invention, the above upstream side exhaust passage extends, near the outlet thereof, at a slant with respect to a center axis of the downstream side exhaust passage.

[0030] In an 15th aspect of the present invention, the above upstream side exhaust passage extends, near the outlet thereof, perpendicular to a center axis of the downstream side exhaust passage.

[0031] In a 16th aspect of the present invention, the above upstream side exhaust passage extends so as to penetrate into the downstream side exhaust passage.

[0032] In a 17th aspect of the present invention, the above upstream side exhaust passage outlet penetrates into the above projecting part.

[0033] In an 18th aspect of the present invention, the above flow deflection part is provided with a projecting part which is formed by the inner wall surface, which defines the downstream side exhaust passage, projecting out toward the diametrically outward direction of the downstream side exhaust passage, and a cross-section of the projecting part in a circumferential direction of the downstream side exhaust passage is substantially rectangular.

[0034] In a 19th aspect of the present invention, the above flow deflection part is provided with a protruding part which projects out from an inner wall surface, which defines the downstream side exhaust passage, toward the diametrically inward direction of the downstream side exhaust passage.

[0035] In a 20th aspect of the present invention, the above upstream side exhaust passage is defined by an exhaust manifold or an exhaust pipe which is directly connected to the exhaust manifold, and the above downstream side exhaust passage is a corn provided at an upstream part of the catalytic converter which houses the exhaust purifying means.

[0036] Below, the present invention will be able to be understood better from the attached drawings and the description of the preferred embodiments.

Brief Description of Drawings

[0037]

FIG. 1 is a view schematically showing an overall internal combustion engine in which the exhaust purification system of the present invention is mounted.

FIG. 2A and FIG. 2B are enlarged views of a catalytic converter of a first embodiment shown in FIG. 1.

FIG. 3A and FIG. 3B are enlarged views of a catalytic converter of a second embodiment.

FIG. 4A and FIG. 4B are enlarged views of a catalytic converter of a third embodiment.

FIG. 5A and FIG. 5B are enlarged views of a catalytic converter of a fourth embodiment.

FIG. 6A and FIG. 6B are enlarged views of a catalytic converter of a fifth embodiment.

FIG. 7A and FIG. 7B are enlarged views of a catalytic converter of a sixth embodiment.

FIG. 8A and FIG. 8B are enlarged views of a catalytic converter of a seventh embodiment.

FIG. 9A and FIG. 9B are enlarged views of a catalytic converter of an eighth embodiment.

Description of Embodiments

[0038] Below, embodiments of the present invention will be explained in detail with reference to the drawings. Note that, in the following explanation, similar components are assigned the same reference numerals.

[0039] FIG. 1 is a view schematically showing an overall internal combustion engine in which the exhaust purification system of the present invention is mounted. Referring to FIG. 1, 1 indicates an engine body, 2 a cylinder block, 3 a piston reciprocating in the cylinder block 2, 4 a cylinder head which is fixed on the cylinder block 2, 5 a combustion chamber which is formed between the piston 3 and the cylinder head 4, 6 an intake valve, 7 an intake port, 8 an exhaust valve, and 9 an exhaust port. As shown in FIG. 1, a spark plug 10 is arranged at the center part of the inner wall surface of the cylinder head 4. A fuel injector 11 is arranged at the circumferential region of the inner wall surface of the cylinder head 4. Further, at the top face of the piston 3, a cavity 12 is formed extending from below the fuel injector 11 to below the spark plug 10.

[0040] An intake port 7 of each cylinder is connected through a corresponding intake tube 13 to a surge tank 14. The surge tank 14 is connected through an intake duct 15 and air flow meter 16 to an air cleaner (not shown). Inside the intake duct 15, a throttle valve 18 which is driven by a step motor 17 is arranged. On the other hand, an exhaust port 9 of each cylinder is connected to an exhaust manifold 19. This exhaust manifold 19 is connected to a catalytic converter 21 which houses an NO_x storage and reduction catalyst 20. Note that, in the present embodiment, the catalytic converter 21 houses the NO_X storage and reduction catalyst 20, but if a reducing agent has to be fed to purify the exhaust gas, any kind of exhaust purifying means may be housed. As such an exhaust purifying means, for example, an oxidation catalyst, a three-way catalyst, a particulate filter, etc. may be mentioned.

[0041] The exhaust manifold 19 is provided with a reducing agent feed system 22 which feeds a reducing agent into the exhaust gas which flows through the exhaust manifold 19. Further, the exhaust manifold 19 and the surge tank 14 are connected to each other via a recirculated exhaust gas (below, referred to as "EGR gas") pipe 26. This EGR gas pipe 26 is provided with an EGR gas control valve 27.

[0042] FIG. 2A and FIG. 2B are enlarged views of the catalytic converter 21 shown in FIG. 1. FIG. 2A is a cross-sectional side view seen from the line A of FIG. 2B, while FIG. 2B is a cross-sectional plan view seen from the line B of FIG. 2A. As shown in FIG. 2A and FIG. 2B, the catalytic converter 21 is provided with a casing 30. This casing 30 houses the NO_X storage and reduction catalyst 20. The casing 30 is provided with a catalyst holder 31 which houses the NO_X storage and reduction catalyst 20 and a cone 32 which is provided at an upstream side of the exhaust from the catalyst holder 31. These catalyst holder 31 and cone 32 of the casing 30 both define the exhaust passage (downstream side exhaust passage) through which the exhaust gas flows.

[0043] In the present embodiment, the NO_X storage and reduction catalyst 20 and the casing 30 (catalyst holder 31 and cone 32) are arranged coaxially. Their axis L extends substantially vertically. Therefore, the exhaust passage which is defined by the casing 30 (that is, the catalyst holder 31 and cone 32) also extends substantially vertically. In the following explanation, the upstream side in the NO_X storage and reduction catalyst 20 will be explained as "upper" while the downstream side will be explained as "lower". Note that, the axis L of the NO_X storage and reduction catalyst 20 and casing 3 does not necessarily have to extend substantially vertically. It may also be arranged to extend horizontally or in any other direction. Further, the NO_X storage and reduction catalyst 20 and the casing 30 do not necessarily have to be arranged coaxially.

[0044] As shown in FIG. 2A and FIG. 2B, the exhaust manifold 19 is connected to the casing 30. Specifically, the exhaust manifold 19 extends through the wall surface of the cone 32 at the upper part of the cone 32 of the casing 30. Therefore, the exhaust manifold 19 enters into the cone 32. As shown in FIG. 2A and FIG. 2B, the exhaust manifold 19 is slanted with respect to the axis L at the location where it passes through the wall surface of the cone 32. Further, the exhaust manifold 19 is bent inside the cone 32 so that the part 19a of the exhaust manifold 19 near the outlet (below, referred to as the "manifold outlet vicinity") extends perpendicular to the axis L, that is, so that it extends perpendicular to the wall surface of the cone 32. As shown in FIG. 2A and FIG. 2B, the outlet of the exhaust manifold 19 faces part of the inner wall surface of the cone 32. The thus configured exhaust manifold 19 defines the exhaust passage (upstream side exhaust passage) through which the exhaust gas which is discharged from the engine body 1 flows.

[0045] At the part of the inner wall surface of the cone 32 which faces the outlet of the exhaust manifold 19, a projecting part 34 is provided which projects out toward the diametrical direction of the casing 30. As shown in the side cross-sectional view of FIG. 2A, the upper wall surface 35a of the projecting part 35 is slanted downward toward the diametrically outward direction of the casing 30, while the lower wall surface 35b of the projecting part 35 is slanted upward toward the diametrically outward direction of the casing 30. In particular, in the present embodiment, the cross-section of the projecting part 35 in the circumferential direction of the casing 30 is substantially semi elliptical in shape.

[0046] Further, as shown in FIG. 2B, this projecting part 35 extends from the region facing the outlet of the exhaust manifold 19 toward the both circumferential directions of the casing 30. If the length from the inner wall surface of the cone 32 in the case of no projecting part 35 to the part of the projecting part which projects out the most in the diametrical direction of the casing 30 is defined as the depth D of the projecting part 35, the depth D of the projecting part 35 becomes shallower the more away from the region facing the outlet of the exhaust manifold 19 in the circumferential direction of the casing 30. That is, the depth D of the projecting part 35 is deepest at the region facing the outlet of the exhaust manifold 19 and becomes shallower the further from there in the circumferential direction. In particular, as shown in FIG. 2B, in the present embodiment, the outer circumference of the projecting part 35 is formed to become substantially semi elliptical in shape. Further, in the present embodiment, the projecting part 35 extends across at least half of the circumference in the circumferential direction of the casing 30.

[0047] The flow of exhaust gas in the thus configured exhaust manifold 19 and casing 30 will be explained next.

The arrows in FIG. 2A and FIG. 2B show the flow of exhaust gas. Inside the exhaust manifold 19, exhaust gas which is exhausted from the engine body 1 and is fed a reducing agent by the reducing agent feed system 22 flows. Therefore, the exhaust gas which flows through the inside of the exhaust manifold 19 of FIG. 2A and FIG. 2B includes reducing agent which is not sufficiently mixed with the exhaust gas.

[0048] The exhaust gas including the reducing agent which has flowed through the inside of the exhaust manifold 19 flows out from the outlet of the exhaust manifold 19 and flows into the inside of the projecting part 35. The exhaust gas which flowed through the bottom of the manifold outlet vicinity 19a strikes the lower wall surface 35b of the projecting part 35. Due to this striking action, the exhaust gas is turned upward in flow direction. On the other hand, the exhaust gas which flowed through the top of the manifold outlet vicinity 19a strikes the upper wall surface 35a of the projecting part 35. Due to this striking action, the exhaust gas is turned downward in flow direction.

[0049] If the exhaust gas which strikes the lower wall surface 35b of the projecting part 35 in this way is turned upward in flow direction and the exhaust gas which strikes the upper wall surface 35a of the projecting part 35 is turned downward in flow direction, these flows of exhaust gas will strike each other. If the two flows of exhaust gas strike each other in this way, the exhaust gas will be stirred and as a result mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas will be promoted.

[0050] Further, even if the exhaust gas which strikes the lower wall surface 35b of the projecting part 35 and is turned upward in flow direction does not strike the exhaust gas which strikes the upper wall surface 35a of the projecting part 35 and is turned downward in flow direction, it strikes the upper wall surface 35a of the projecting part 35. By striking the upper wall surface 35a, the upward velocity component of the exhaust gas will be reduced and, along with this, the exhaust gas will be stirred and the mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas will be promoted.

[0051] Similarly, even if the exhaust gas which strikes the upper wall surface 35a of the projecting part 35 and is turned downward in flow direction does not strike the exhaust gas which strikes the lower wall surface 35b of the projecting part 35 and is turned upward in flow direction, it strikes the lower wall surface 35b of the projecting part 35. By striking the lower wall surface 35b, the downward velocity component of the exhaust gas will be reduced and, along with this, the exhaust gas will be stirred and the mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas will be promoted.

[0052] The exhaust gas which flows inside of the projecting part 35 strikes the wall surface of the projecting part 35 to change direction of flow in the upward and downward directions. As shown by the arrows in FIG. 2B, it flows along the wall surface of the projecting part 35 toward the both circumferential directions of the casing 30. Due to this, the exhaust gas which flows inside of the projecting part 35 spreads uniformly throughout the casing 30. For this reason, the exhaust gas with which the reducing agent is uniformly mixed flows uniformly into the NO_X storage and reduction catalyst 20. Therefore, in the NO_X storage and reduction catalyst 20, the reaction with the reducing agent is performed uniformly across the entire NO_X storage and reduction catalyst 20 and, for example, the NO_X which was stored in the NO_X storage and reduction catalyst 20 is optimally purified.

[0053] Here, according to the exhaust manifold 19 and casing 30 of this embodiment, in promoting mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas, no member is provided reducing the flow area of the exhaust gas. For this reason, even if the exhaust gas flows through the above configured exhaust manifold 19 and casing 30, almost no pressure loss will occur. Therefore, according to this embodiment of the present invention, it is possible to promote mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas without causing almost any pressure loss of the exhaust gas.

[0054] Further, the reducing agent in the exhaust gas which flows through the inside of the exhaust manifold 19 will sometimes not be sufficiently vaporized at the outlet of the exhaust manifold 19 and will flow out from the exhaust manifold 19 in the droplet state. However, in the exhaust manifold 19 and casing 30 of this embodiment, even if the reducing agent flows out from the exhaust manifold 19 in the droplet state, almost all of it will flow into the projecting part 35. Furthermore, the droplets which flow into the projecting part 35 easily evaporate due to the disturbance in exhaust gas occurring inside the projecting part 35. For this reason, even if the reducing agent flows out from the exhaust manifold 19 in the droplet state, the reducing agent will be kept from flowing into the NO_X storage and reduction catalyst 20 and depositing there in the droplet state.

[0055] Note that, in the above embodiment, the projecting part 35 extends by substantially the same length from the region facing the outlet of the exhaust manifold 19 in the both circumferential directions. However, the projecting part 35 does not necessarily have to extend by the same length to the two sides in the circumferential direction. It may also be configured so as to extend longer at one side than the other side.

[0056] Further, in the above embodiment, the projecting part 35 extends from the region facing the outlet of the exhaust manifold 19 in the circumferential direction, that is, on the plane perpendicular to the axis L. However, the projecting part 35 may also be configured to be slanted with respect to the circumferential direction, that is, to extend at a slant with respect to the plane perpendicular to the axis L. For example, the projecting part 35 may also be slanted so as to be positioned lower the further away in the circumferential direction from the region facing the outlet of the exhaust manifold 19.

[0057] Next, referring to FIG. 3A and FIG. 3B, a second embodiment of the present invention will be explained. FIG. 3A and FIG. 3B are enlarged views of the catalytic converter 21 of the second embodiment, similar to FIG. 2A and FIG. 2B. The exhaust purification system of the second embodiment is configured basically similar to the configuration of the exhaust purification system of the first embodiment. However, in the exhaust purification system of the first embodiment, the cross-section of the projecting part 35 in the circumferential direction of the casing 30 is substantially semi elliptical in shape, while in the exhaust purification system of the second embodiment, the cross-section of the projecting part 35 in the circumferential direction of the casing 30 is substantially rectangular.

[0058] As shown in FIG. 3A, the projecting part 40 is provided with a vertical wall surface 40a which extends parallel to the axis L, an upper horizontal wall surface 40b which is connected to the top part of the vertical wall surface 40a and which extends perpendicular to the axis L, and a lower horizontal wall surface 40c which is connected to the bottom part of the vertical wall surface 40a and which extends perpendicular to the axis L.

[0059] The flow of exhaust gas in the thus configured exhaust manifold 19 and casing 30 will be explained. The exhaust gas which contains the reducing agent and has flowed through the inside of the exhaust manifold 19 flows out from the outlet of the exhaust manifold 19 and flows into the projecting part 40. The lower horizontal wall surface 40c of the projecting part 40 extends substantially parallel to the manifold outlet vicinity 19a, so the exhaust gas which flows through the bottom of the manifold outlet vicinity 19a is difficult to strike the lower horizontal wall surface 40c of the projecting part 40, but even so a part of the exhaust gas has a downward velocity component and therefore strikes the lower horizontal wall surface 40c. Due to this striking action, the exhaust gas is turned upward in flow direction and strikes the exhaust gas which flowed out from the exhaust manifold 19 to the inside of the projecting part 40.

[0060] On the other hand, the upper horizontal wall surface 40b of the projecting part 40 also extends substantially parallel to the manifold outlet vicinity 19a, so the exhaust gas which flowed through the top of the manifold outlet vicinity 19a is difficult to strike the upper horizontal wall surface 40b of the projecting part 40, but even so part of the exhaust gas has an upward velocity component and therefore strikes the upper horizontal wall surface 40b. Due to this striking action, the exhaust gas is turned downward in flow direction and strikes the exhaust gas which flowed out from the exhaust manifold 19 to the inside of the projecting part 40.

[0061] By the flows of exhaust gas striking each other in this way, the exhaust gas is stirred and thereby mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas is promoted. Further, in this embodiment as well, no member is provided which reduces the flow sectional area of the exhaust gas, so it is possible to promote mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas without causing almost any rise in the pressure loss of the exhaust gas.

[0062] Further, as explained above, part of the exhaust gas which strikes the lower horizontal wall surface 40c of the projecting part 40 to be turned upward in flow direction, strikes the upper horizontal wall surface 40b of the projecting part 40. By striking this upper horizontal wall surface 40b, the upward velocity component of the exhaust gas is made to fall. Along with this, the exhaust gas is stirred and the mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas is promoted. Furthermore, part of the exhaust gas which strikes the upper horizontal wall surface 40b of the projecting part 40 to be turned downward in flow direction, strikes the lower horizontal wall surface 40c of the projecting part 40. By striking this lower horizontal wall surface 40c, the downward velocity component of the exhaust gas is made to fall. Along with this, the exhaust gas is stirred and the mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas is promoted.

[0063] Next, referring to FIG. 4A and FIG. 4B, a third embodiment of the present invention will be explained. FIG. 4A and FIG. 4B are enlarged views of the catalytic converter 21 of the third embodiment similar to FIG. 2A and FIG. 2B. The exhaust purification system of the third embodiment is configured basically similar to the configuration of the exhaust purification system of the first embodiment. However, in the exhaust purification system of the second embodiment, the cross-section of the projecting part 35 in the circumferential direction of the casing 30 is substantially semi elliptical in shape, while in the exhaust purification system of the third embodiment, the cross-section of the projecting part 45 in the circumferential direction of the casing 30 is substantially circular.

[0064] As shown in FIG. 4A, the projecting part 45 is provided with a upper wall surface 45a which slants once upward toward the diametrically outward direction of the casing 30, then slants downward, and a lower wall surface 45b which slants once downward toward the diametrically outward direction of the casing 30, then slants upward.

[0065] The flow of exhaust gas in the thus configured exhaust manifold 19 and casing 30 will be explained. The exhaust gas which contains the reducing agent and flows through the inside of the exhaust manifold 19 flows out from the outlet of the exhaust manifold 19 and flows into the projecting part 45. The lower wall surface 45b of the projecting part 45 slants once downward, then slants upward, so when the exhaust gas which flows through the bottom of the manifold outlet vicinity 19a flows into the projecting part 45, first it flows along the downward slanted part of the lower wall surface 45b. After this, it strikes the upward slanted part of the lower wall surface 45b of the projecting part 45. Due to this striking action, the exhaust gas is turned upward in flow direction.

[0066] On the other hand, the upper wall surface 45a of the projecting part 45 slants once upward, then slants downward, so when the exhaust gas which flows through the top of the manifold outlet vicinity 19a flows into the projecting part 45, first it flows along the upward slanted part of the upper wall surface 45a. After this, it strikes the downward slanted part of the upper wall surface 45a of the projecting part 45. Due to this striking action, the exhaust gas is turned downward in flow direction.

[0067] After this, the exhaust gas which strikes the lower wall surface 45b of the projecting part 45 and flows upward and the exhaust gas which strikes the upper wall surface 45a of the projecting part 45 and flows downward strike each other, whereby mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas is promoted.

[0068] Further, even if the exhaust gas which strikes the upwardly slanted part of the lower wall surface 45b of the projecting part 45 and is turned upward in flow direction does not strike the exhaust gas which strikes the downwardly slanted part of the upper wall surface 45a of the projecting part 45 and is turned downward in flow direction, it strikes the upper wall surface 45a of the projecting part 45. By striking this upper wall surface 45a, the upward velocity component of the exhaust gas is made to fall and, along with this, the exhaust gas is stirred and mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas is promoted.

[0069] On the other hand, even if the exhaust gas which strikes the downwardly slanted part of the upper wall surface 45a of the projecting part 45 and is turned downward in flow direction does not strike the exhaust gas which strikes the upwardly slanted part of the lower wall surface 45b of the projecting part 45 and is turned upward in flow direction, it strikes the lower wall surface 45b of the projecting part 45. By striking this lower wall surface 45b, the downward velocity component of the exhaust gas is made to fall and, along with this, the exhaust gas is stirred and mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas is promoted.

[0070] Further, in this embodiment as well, no member is provided which reduces the flow sectional area of the exhaust gas, so it is possible to promote mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas without causing almost any rise in the pressure loss of the exhaust gas.

[0071] In this regard, no matter what shape of projecting parts shown in the first embodiment to the third embodiment, it is possible to promote the mixing of the reducing agent and the exhaust gas without causing almost any rise in the pressure loss of the exhaust gas. Here, no matter what shape of the projecting part is employed, it is believed the exhaust gas which flows through the bottom of the manifold outlet vicinity 19a strikes the lower wall surface of the projecting part and is turned upward in flow direction and thereby mixing of the reducing agent and exhaust gas is promoted. Therefore, it can be said that the projecting part can be any shape so long as part of its wall surface causes the velocity component in the axial direction of the casing 30 of at least part of the flow of the exhaust gas which flows into the projecting part to be directed upward.

[0072] Further, no matter what shape of the projecting parts shown in the first embodiment to the third embodiment is employed, it is believed that the exhaust gas which flows through the top of the manifold outlet vicinity 19a strikes the upper wall surface of the projecting part and is turned downward in flow direction and is made to strike the other exhaust gas which flows into the projecting part, whereby the mixing of the reducing agent and the exhaust gas is promoted. Therefore, it can be said that the projecting part can be any shape so long as at least part of the exhaust gas which strikes the wall surface and is increased in downward velocity component strikes the exhaust gas which is not increased in downward velocity component even if striking the wall surface of the projecting part.

[0073] Furthermore, no matter what shape of the projecting parts shown in the first embodiment to the third embodiment is employed, it is believed that the exhaust gas which flows through the top of the manifold outlet vicinity 19a strikes the upper wall surface of the projecting part and is turned downward in flow direction, then strikes the lower wall surface of the projecting part, whereby the downward velocity component of the exhaust gas is made to fall and, due to this, mixing of the reducing agent and the exhaust gas is promoted. Similarly, it is believed that the exhaust gas which flows through the bottom of the manifold outlet vicinity 19a strikes the lower wall surface of the projecting part and is turned upward in flow direction, then strikes the upper wall surface of this projecting part, whereby the upward velocity component of the exhaust gas is made to fall and, due to this, mixing of the reducing agent and the exhaust gas is promoted. Therefore, it can be said that the projecting part can be any shape so long as it is formed so that at least part of the exhaust gas which strikes part of its wall surface and is increased in velocity component in the direction toward the exhaust purifying means strikes the other part of the wall surface of the projecting part and causes the velocity component of the same direction as this exhaust gas to fall.

[0074] Next, referring to FIG. 5A and FIG. 5B, a fourth embodiment of the present invention will be explained. FIG. 5A and FIG. 5B are enlarged views of the catalytic converter 21 of the fourth embodiment, similar to FIG. 2A and FIG. 2B. The exhaust purification system of the fourth embodiment is configured basically similar to the configuration of the exhaust purification system of the first embodiment. However, in the exhaust purification system of the first embodiment, the manifold outlet vicinity 19a extends perpendicular with respect to the axis L, while in the present embodiment, the manifold outlet vicinity 50a extends at a slant with respect to the axis L.

[0075] As shown in FIG. 5A, the exhaust manifold 50 of the present embodiment extends passing through the wall surface of the cone 32 at the upper part of the cone 32 of the casing 30. As shown in FIG. 5A, the exhaust manifold 50 is slanted with respect to the axis L of the casing 30 at the location passing through the wall surface of the cone 32. Further, the exhaust manifold 50 extends straight in the cone 32. For this reason, the manifold outlet vicinity 50a also extends at a slant with respect to the axis L and extends at a slant with respect to the wall surface of the cone 32.

[0076] Further, as shown in FIG. 5A and FIG. 5B, the manifold outlet vicinity 50a extends toward the projecting part 35. In other words, the manifold outlet vicinity 50a extends so that its axis M enters the projecting part 35.

[0077] The flow of exhaust gas in the thus configured exhaust manifold 50 and casing 30 will be explained. The manifold outlet vicinity 50a extends toward the projecting part 35, so the exhaust gas which contains the reducing agent and flowed through the exhaust manifold 50 flows out from the outlet of the exhaust manifold 50 and into the projecting part 35. The exhaust gas which flowed through the bottom of the manifold outlet vicinity 50a strikes the lower wall surface 35b of the projecting part 35. Due to this striking action, the exhaust gas is turned upward in flow direction. On the other hand, the exhaust gas which flowed through the top of the manifold outlet vicinity 50a flows along the upper wall surface 35a of the projecting part 35 and is turned downward in flow direction or strikes the upper wall surface 35a and is turned downward in flow direction.

[0078] In this way, the exhaust gas which strikes the lower wall surface 35b and is turned upward in flow direction and the exhaust gas which flows along or strikes the upper wall surface 35a and is turned downward in flow direction strike each other, whereby mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas is promoted. Further, the exhaust gas which strikes the lower wall surface 35b and is turned upward in flow direction strikes the upper wall surface 35a, while the exhaust gas which strikes the upper wall surface 35a and is turned downward in flow direction strikes the lower wall surface 35a, whereby again mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas is promoted. Further, in this embodiment as well, no member is provided which reduces the flow sectional area of the exhaust gas, so it is possible to promote mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas without causing almost any rise in the pressure loss of the exhaust gas.

[0079] Note that, in the present embodiment, the projecting part 35 is preferably configured to extend slanted with respect to the circumferential direction, that is, slanted with respect to the plane perpendicular to the axis L. In particular, by making the projecting part 35 slant so as to be positioned lower the further from the region facing the outlet of the exhaust manifold 19 in the circumferential direction, it becomes easier for the exhaust gas which flows thereinto at a slant with respect to the projecting part 35 to flow inside the projecting part 35 in the circumferential direction.

[0080] Next, referring to FIG. 6A and FIG. 6B, a fifth embodiment of the present invention will be explained. FIG. 6A and FIG. 6B are enlarged views of the catalytic converter 21 of the fifth embodiment, similar to FIG. 2A and FIG. 2B. The exhaust purification system of the fifth embodiment is configured basically similar to the configuration of the exhaust purification system of the fourth embodiment. However, in the exhaust purification system of the fourth embodiment, the exhaust manifold 50 passes through the wall surface of the cone 32 to extend inside of the cone 32, while in the exhaust purification system of the fifth embodiment, the exhaust manifold 55 does not pass through the wall surface of the cone 32 and accordingly does not extend to the inside of the cone 32.

[0081] As shown in FIG. 6A, the exhaust manifold 55 of the present embodiment is directly connected at its outlet part to the cone 32 of the casing 30. Further, the exhaust manifold 55 extends at a slant with respect to the axis L and extends at a slant with respect to the wall surface of the cone 32. Furthermore, as shown in FIG. 6A, the manifold outlet vicinity 55a extends toward the projecting part 35. In other words, the manifold outlet vicinity 55a extends so that its axis M enters inside of the projecting part 35.

[0082] In the thus configured exhaust manifold 55 and casing 30, the manifold outlet vicinity 55a extends toward the projecting part 35, so most of the exhaust gas which contains the reducing agent and flows through the exhaust manifold 50 flows out from the outlet of the exhaust manifold 55 and into the projecting part 35. The exhaust gas which flows through the bottom of the manifold outlet vicinity 50a strikes the lower wall surface 35b of the projecting part 35 and is turned upward in flow direction. On the other hand, the exhaust gas which flows through the top of the manifold outlet vicinity 50a flows along the upper wall surface 35a of the projecting part 35 or strikes the upper wall surface 35a and is turned downward in flow direction. These flows of exhaust gas strike each other, whereby mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas is promoted.

[0083] Further, the distance from the outlet of the exhaust manifold 55 to the projecting part 35 is long, so part of the exhaust gas which flows out from the outlet of the exhaust manifold 55 does not flow into the projecting part 35, but flows directly into the NO_X storage and reduction catalyst 20. Here, if the exhaust gas flows into the projecting part 35, the direction of flow of exhaust gas suddenly changes, so some pressure loss occurs. As opposed to this, part of the exhaust gas which flows out from the outlet of the exhaust manifold 55 flows directly into the NO_X storage and reduction catalyst 20, so the flow rate of the exhaust gas which flows into the projecting part 35 is reduced and along with this the pressure loss is also reduced. Further, in the present embodiment as well, no member is provided which narrows the flow sectional area of the exhaust gas. For this reason, in the present embodiment, it is possible to suppress the rise of the pressure loss of the exhaust gas while promoting mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas.

[0084] In this regard, no matter what shape of exhaust manifold shown in the above-mentioned first, fifth, and sixth embodiments, it is possible to promote mixing of the reducing agent and exhaust gas without raising the pressure loss of the exhaust gas much at all. Here, no matter what shape of exhaust manifold shown in these embodiments is employed, it is believed that the manifold outlet vicinity extends toward the projecting part, that is, so that its axis M enters the projecting part, whereby mixing of the reducing agent and the exhaust gas is promoted. Therefore, it can be said that the exhaust manifold may be any shape so long as the axis M of the outlet vicinity passes through the inside of the projecting part.

[0085] Next, referring to FIG. 7A and FIG. 7B, a sixth embodiment of the present invention will be explained. FIG. 7A and FIG. 7B are enlarged views of the catalytic converter 21 of the sixth embodiment, similar to FIG. 2A and FIG. 2B. The exhaust purification system of the sixth embodiment is configured basically similar to the configuration of the exhaust purification system of the first embodiment. However, in the exhaust purification system of the first embodiment, the projecting part 35 extends over at least half of the circumference in the circumferential direction of the casing 30, while in the present embodiment, the projecting part 60 extends over only less than half of the circumference in the circumferential direction of the casing 30.

[0086] The flow of exhaust gas in the thus configured exhaust manifold 19 and casing 30 will be explained. In the same way as the projecting part 35 of the first embodiment, the exhaust gas which flows into the projecting part 60 strikes the wall surface of the projecting part 60 and is changed in direction of flow in the vertical direction. Along with this, mixing of the reducing agent and the exhaust gas is promoted.

[0087] On the other hand, in the present embodiment, the projecting part 60 is small in width W in the circumferential direction of the casing 30, so unlike the projecting part 35 of the first embodiment, the exhaust gas which flows into the projecting part 60 is difficult to flow along the wall surface of the projecting part 60 toward the both circumferential directions of the casing 30. For this reason, in the projecting part 60, the inflowing exhaust gas does not spread in the circumferential direction, so a large disturbance is caused. Due to this as well, mixing of the reducing agent and the exhaust gas is promoted.

[0088] If reducing the width W in the circumferential direction of the inlet of the projecting part 60 in this way, it is possible to mix the reducing agent and the exhaust gas better. However, if making the width W in the circumferential direction of the inlet of the projecting part 60 too small and making it smaller than the diameter "d" of the outlet of the exhaust manifold 19, the width W of the inlet of the projecting part 60 acts as a choke and the pressure loss of the exhaust gas increases. For this reason, the width W of the inlet of the projecting part 60 is preferably larger than the diameter "d" of the outlet of the exhaust manifold 19.

[0089] Similarly, if the height of the inlet of the projecting part 60 in the vertical direction (height in axial direction of casing 30) is also smaller than the diameter of the outlet of the exhaust manifold 19, the height "h" of the inlet of the projecting part 60 acts as a choke and the pressure loss of the exhaust gas increases. For this reason, the height "h" of the inlet of the projecting part 60 is preferably larger than the diameter "d" of the outlet of the exhaust manifold 19.

[0090] More accurately, the inlet of the projecting part 60 acts as a choke when the cross-sectional area X of the inlet of the projecting part 60 which faces the space inside the casing 30 (cone 32) becomes smaller than the cross-sectional area of the outlet of the exhaust manifold 19. Therefore, to prevent an increase in the pressure loss of the exhaust gas due to the choke of the inlet of the projecting part 60, it is necessary that the cross-sectional area X of the inlet of the projecting part 60 is smaller than the cross-sectional area of the outlet of the exhaust manifold 19.

[0091] Next, referring to FIG. 8A and FIG. 8B, a seventh embodiment of the present invention will be explained. FIG. 8A and FIG. 8B are enlarged views of the catalytic converter 21 of the seventh embodiment, similar to FIG. 2A and FIG. 2B. The exhaust purification system of the seventh embodiment is configured basically similar to the configuration of the exhaust purification system of the first embodiment. However, in the exhaust purification system of the first embodiment, the outlet of the exhaust manifold 19 does not enter inside of the projecting part 35, while in the present embodiment, the outlet of the exhaust manifold 19 enters inside the projecting part 35.

[0092] Here, part of the reducing agent which was fed from the reducing agent feed system 22 sometimes will flow through the inside of the exhaust manifold 19 as droplets without dispersing into the exhaust gas which flows through the inside of the exhaust manifold 19. Such a reducing agent in the droplet state drops down from the outlet of the exhaust manifold 19 in the gravity direction and flows into the NO_X storage and reduction catalyst 20. If, in this way, the reducing agent flows into the NO_X storage and reduction catalyst 20 in the droplet state without being mixed with the exhaust gas, the exhaust gas may not be sufficiently purified. For this reason, it is necessary that the reducing agent be prevented from flowing into the NO_X storage and reduction catalyst 20 in the droplet state.

[0093] In the present embodiment, as explained above, the outlet of the exhaust manifold 19 enters inside of the projecting part 35. For this reason, even if the reducing agent drops down from the outlet of the exhaust manifold 19 in the gravity direction in the droplet state, this reducing agent will not directly drop down on to the NO_X storage and reduction catalyst 20 and will deposit on the lower wall surface 3b of the projecting part 35.

[0094] Here, as explained above, inside of the projecting part 35, the exhaust gas is disturbed, so due to this, the reducing agent in the droplet state which are deposited on the lower wall surface 35b of the projecting part 35 is evaporated, then is mixed with the exhaust gas. Therefore, according to the present embodiment, even if part of the reducing agent which is fed from the reducing agent feed system 22 flows out from the exhaust manifold 19 as is in the droplet state, this reducing agent and exhaust gas can be suitably mixed.

[0095] Next, referring to FIG. 9A and FIG. 9B, an eighth embodiment of the present invention will be explained. FIG. 9A and FIG. 9B are enlarged views of the catalytic converter 21 of the eighth embodiment, similar to FIG. 2A and FIG. 2B. The exhaust purification system of the eighth embodiment is configured basically similar to the configuration of the exhaust purification system of the first embodiment. However, in the exhaust purification system of the first embodiment, the part of the inner wall surface of the cone 32 which faces the outlet of the exhaust manifold 19 is provided with the projecting part 35, while in the present embodiment, two protruding members 71, 72 are provided which project out toward the diametrically inward direction of the casing 30.

[0096] As shown by the side cross-sectional view of FIG. 9A, the lower wall surface 71a of the upper protruding member 71 is slanted downward in the diametrically outward direction of the casing 30. Further, the upper wall surface 71b of the upper protruding member 71 is slanted upward in the diametrically outward direction of the casing 30. On the other hand, the upper wall surface 72a of the lower protruding member 72 is slanted upward in the diametrically outward direction of the casing 30, while the lower wall surface 72b of the lower protruding member 72 is slanted downward in the diametrically outward direction of the casing 30. In the illustrated embodiment, the lower wall surface 71a of the upper protruding member 71 and the upper wall surface 72a of the lower protruding member 72 are curved in a concave shape.

[0097] Further, as shown in FIG. 9B, these protruding members 71, 72 extend from the region facing the outlet of the exhaust manifold 19 toward the both circumferential directions of the casing 30. If the length from the inner wall surface of the cone 32 in the case of no protruding members 71, 72 to the part of the protruding members 71, 72 which projects out the most in the diametrical direction of the casing 30 is defined as "D", the depth D of the protruding members 71, 72 becomes shallower the more away from the region facing the outlet of the exhaust manifold 19 in the circumferential direction of the casing 30. In particular, as shown in FIG. 9B, in the present embodiment, the inner circumferences of the protruding members 71, 72 are formed to become substantially semi elliptical in shape. Further, in the present embodiment, the protruding members 71, 72 extend across at least half of the circumference in the circumferential direction of the casing 30.

[0098] In the thus configured exhaust manifold 19 and casing 30 as well, similar effects can be obtained as with the first embodiment shown in FIG. 2A and FIG. 2B. That is, the exhaust gas which contains the reducing agent and flows through the inside of the exhaust manifold 19 flows out from the outlet of the exhaust manifold 19 and flows into the space between the two protruding members 71, 72. The exhaust gas which flows through the bottom of the manifold outlet vicinity 19a strikes the upper wall surface 72a of the lower protruding member 72. Due to this striking action, the exhaust gas is turned upward in flow direction. On the other hand, the exhaust gas which flowed through the top of the manifold outlet vicinity 19a strikes the lower wall surface 71a of the upper protruding member 71. Due to this striking action, the exhaust gas is turned downward in flow direction.

[0099] If, in this way, the exhaust gas which strikes the upper wall surface 72a of the lower protruding member 72 is turned upward in flow direction and the exhaust gas which strikes the lower wall surface 71a of the upper protruding member 71 is turned downward in flow direction, these flows of exhaust gas will strike each other. By the two flows of exhaust gas striking each other, the exhaust gas is stirred, whereby mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas is promoted.

[0100] Further, even if the exhaust gas which strikes the upper wall surface 72a of the lower protruding member 72 and is turned upward in flow direction does not strike the exhaust gas which strikes the lower wall surface 71a of the upper protruding member 71 and is turned downward in flow direction, it strikes the lower wall surface 71a of the upper protruding member 71. By striking the lower wall surface 71a, the upward velocity component of the exhaust gas will be reduced and, along with this, the exhaust gas will be stirred and the mixing of the reducing agent which is contained in the exhaust gas and the exhaust gas will be promoted. The same can be said for the exhaust gas which strikes the lower wall surface 71a of the upper protruding member 71 and is turned downward in flow direction.

[0101] Note that, in the above eighth embodiment, the inner wall surface of the casing 30 is provided with protruding members 71, 72 separated from the casing 30, but it is also possible to deform the inner wall surface itself of the casing 30 so as to project out to the diametrically inward direction of the casing 30 so as to provide protruding parts at the inner wall surface of the casing 30. Therefore, summarizing these, it can be said that the exhaust purification system of the present embodiment is provided with protruding parts which project out from the inner wall surface defining the casing 30 toward the diametrically inward direction of the casing 30.

[0102] Summarizing the above embodiments, it can be said that the part of the inner wall surface of the casing 30 which faces the exhaust manifold outlet vicinity 19a is provided with flow deflection parts (for example, the projecting parts 35, 40, 45, 60 and protruding parts 71, 72 provided at the inner wall surface of the above casing 30), and the flow deflection part is positioned at the upstream side from the NO_X storage and reduction catalyst 20 and is formed so that the velocity component, in the axial line direction of the casing 30, of the flow of at least part of the exhaust gas which flows into the flow deflection part is directed to the opposite direction from the direction heading toward the NO_X storage and reduction catalyst 20.

[0103] Alternatively, it can be said that the part of the inner wall surface of the casing 30 which faces the exhaust manifold outlet vicinity 19a is provided with the flow deflection part, the flow deflection part is provided at the upstream side from the NO_X storage and reduction catalyst 20, and the wall surface of the flow deflection part is formed so that at least part of the exhaust gas which strikes part of the wall surface of the flow deflection part and is increased in velocity component in the direction heading toward the NO_X storage and reduction catalyst 20 strikes the other part of the wall surface of the flow deflection part and is made to fall in velocity component in the same direction of the exhaust gas.

[0104] Note that, in the above embodiment, the exhaust manifold 19 which was connected to the engine body 1 was directly connected to the casing 30 of the catalytic converter 21, but it is also possible to connect the exhaust pipe which is directly or indirectly connected to the exhaust manifold 19, to the casing 30 of the catalytic converter 21.

[0105] Further, it is also possible to combine the above embodiments with each other to obtain an exhaust purification system. For example, by combining the exhaust purification systems of the second embodiment and the fourth embodiment, it is possible to obtain an exhaust purification system where the cross-section of the projecting part in the circumferential direction of the casing 30 is rectangular and where the manifold outlet vicinity extends at a slant with respect to the axis L. Further, for example, by combining the exhaust purification systems of the second embodiment and eighth embodiment, it is possible to obtain an exhaust purification system where the lower wall surface 71a of the upper protruding member 71 and the upper wall surface 72a of the downstream side protruding member 72 are perpendicular to the axial direction of the casing 30.

[0106] Note that, the present invention has been explained in detail based on specific embodiments, but a person skilled in the art could make various changes, modifications, etc. without departing from the claims and concept of the present invention.

Reference Signs List

[0107]

19, 50, 55	exhaust manifold
19a, 50a, 55a	manifold outlet vicinity
20	NO_X storage and reduction catalyst
21	catalytic converter
30	casing
31	catalyst holder
32	cone
35, 40, 45, 60	projecting part

Claims

1. An exhaust purification system of an internal combustion engine which is provided with an upstream side exhaust passage through which exhaust gas which is exhausted from the internal combustion engine passes, a downstream side exhaust passage which is arranged at a downstream side of said upstream side exhaust passage at an angle with respect to the upstream side exhaust passage, a reducing agent feeding means which feeds reducing agent into the exhaust gas which passes through the inside of the upstream side exhaust passage, and an exhaust purifying means which is provided inside the downstream side exhaust passage,
   wherein, the part of the inner wall surface, which defines the downstream side exhaust passage and faces the upstream side exhaust passage outlet, is provided with a flow deflection part, and said flow deflection part is positioned at the upstream side from the exhaust purifying means and is formed so that a velocity component, in an axial direction of a downstream side exhaust passage, of at least part of the flow of exhaust gas which flows into said flow deflection part is oriented in an opposite direction to the direction heading toward the exhaust purifying means.

2. An exhaust purification system of an internal combustion engine as set forth in claim 1, wherein the region of the wall surface which defines said flow deflection part at the exhaust purifying means side has a part which is slanted in a direction opposite to the direction heading toward the exhaust purifying means toward the diametrically outward direction of the downstream side exhaust passage.

3. An exhaust purification system of an internal combustion engine which is provided with an upstream side exhaust passage through which exhaust gas which is exhausted from the internal combustion en-

gine passes, a downstream side exhaust passage which is arranged at a downstream side of said upstream side exhaust passage at an angle with respect to the upstream side exhaust passage, a reducing agent feeding means which feeds reducing agent into the exhaust gas which passes through the inside of the upstream side exhaust passage, and an exhaust purifying means which is provided inside the downstream side exhaust passage,
wherein, the part of the inner wall surface, which defines the downstream side exhaust passage and faces the upstream side exhaust passage outlet, is provided with a flow deflection part, said flow deflection part is positioned at the upstream side from the exhaust purifying means, and a wall surface of said flow deflection part is formed so that at least part of the exhaust gas which strikes part of the wall surface of said flow deflection part and is increased in velocity component in the direction heading toward an exhaust purifying means strikes another part of the wall of surface of said flow deflection part and is lowered in velocity component of the same direction of said exhaust gas.

4. An exhaust purification system of an internal combustion engine as set forth in claim 3, wherein a region of the wall surface which defines said flow deflection part at the side away from exhaust purifying means has a part which is slanted in a direction heading toward the exhaust purifying means toward the diametrically outward direction of the downstream side exhaust passage.

5. An exhaust purification system of an internal combustion engine as set forth in any one of claims 1 to 4, wherein said flow deflection part is provided with a projecting part which is formed by the inner wall surface, which defines the downstream side exhaust passage, projecting out toward the diametrically outward direction of the downstream side exhaust passage.

6. An exhaust purification system of an internal combustion engine as set forth in claim 5, wherein the cross-section of said projecting part in the circumferential direction of the downstream side exhaust passage is substantially semi elliptical in shape.

7. An exhaust purification system of an internal combustion engine as set forth in claim 5 or 6, wherein an inlet area of said projecting part which faces said downstream side exhaust passage is larger than the cross-sectional area of the upstream side exhaust passage.

8. An exhaust purification system of an internal combustion engine as set forth in claim 7, wherein a height, in the axial direction of the downstream side exhaust passage, of said projecting part is larger than a diameter of the upstream side exhaust passage.

9. An exhaust purification system of an internal combustion engine as set forth in any one of claims 5 to 8, wherein said projecting part extends in the circumferential direction of said downstream side exhaust passage.

10. An exhaust purification system of an internal combustion engine as set forth in claim 9, wherein a depth of said projecting part in the diametrical direction of the downstream side exhaust passage becomes smaller the further from the region which faces said upstream side exhaust passage outlet.

11. An exhaust purification system of an internal combustion engine as set forth in claim 9 or 10, wherein said projecting part is formed so that the outer circumference becomes substantially semi elliptical in shape.

12. An exhaust purification system of an internal combustion engine as set forth in any one of claims 9 to 11, wherein said projecting part is slanted so as to be positioned more at the exhaust purifying means side the further away from the region facing said upstream side exhaust passage outlet in the circumferential direction of the downstream side exhaust passage.

13. An exhaust purification system of an internal combustion engine as set forth in any one of claims 5 to 12, wherein said upstream side exhaust passage extends, near the outlet thereof, so that a center axis passes though the inside of the projecting part.

14. An exhaust purification system of an internal combustion engine as set forth in any one of claims 5 to 13, wherein said upstream side exhaust passage extends, near the outlet thereof, at a slant with respect to a center axis of the downstream side exhaust passage.

15. An exhaust purification system of an internal combustion engine as set forth in any one of claims 5 to 13, wherein said upstream side exhaust passage extends, near the outlet thereof, perpendicular to a center axis of the downstream side exhaust passage.

16. An exhaust purification system of an internal combustion engine as set forth in any one of claims 5 to 15, wherein said upstream side exhaust passage extends so as to penetrate into the downstream side exhaust passage.

17. An exhaust purification system of an internal combustion engine as set forth in any one of claims 5 to 16, wherein said upstream side exhaust passage outlet penetrates into said projecting part.

18. An exhaust purification system of an internal combustion engine as set forth in claim 1 or 3, wherein said flow deflection part is provided with a projecting part which is formed by the inner wall surface, which defines the downstream side exhaust passage, projecting out toward the diametrically outward direction of the downstream side exhaust passage and wherein a cross-section of said projecting part in a circumferential direction of the downstream side exhaust passage is substantially rectangular.

19. An exhaust purification system of an internal combustion engine as set forth in any one of claims 1 to 18, wherein said flow deflection part is provided with a protruding part which projects out from an inner wall surface, which defines the downstream side exhaust passage, toward the diametrically inward direction of the downstream side exhaust passage.

20. An exhaust purification system of an internal combustion engine as set forth in any one of claims 1 to 19, wherein said upstream side exhaust passage is defined by an exhaust manifold or an exhaust pipe which is directly connected to the exhaust manifold, and said downstream side exhaust passage is a corn provided at an upstream part of the catalytic converter which houses the exhaust purifying means.

Fig.1

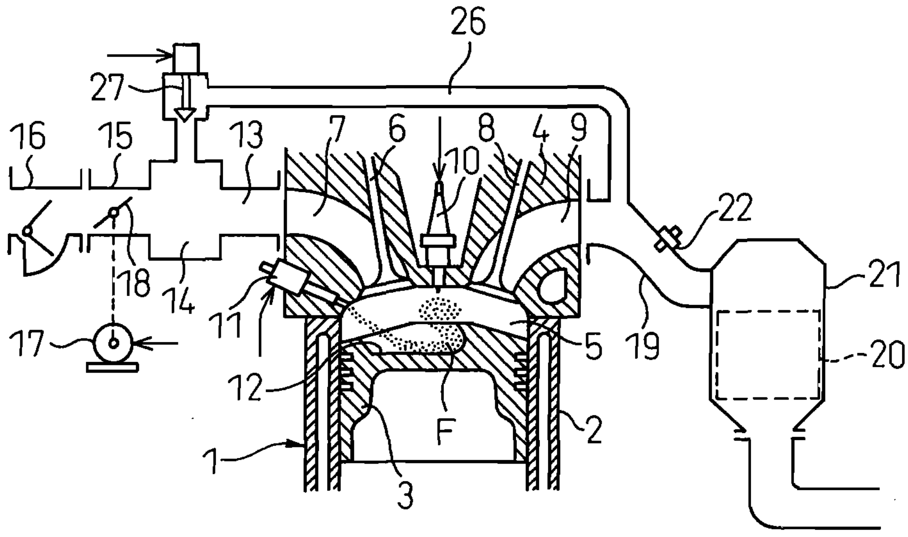


Fig.2A

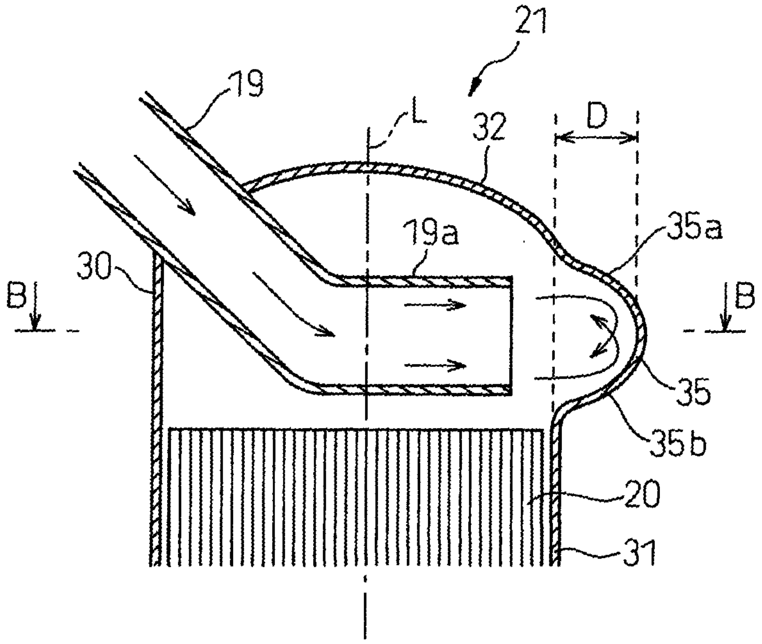


Fig.2B

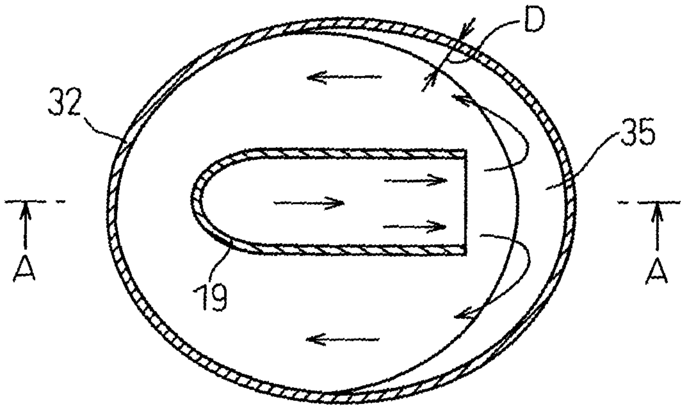


Fig.3A

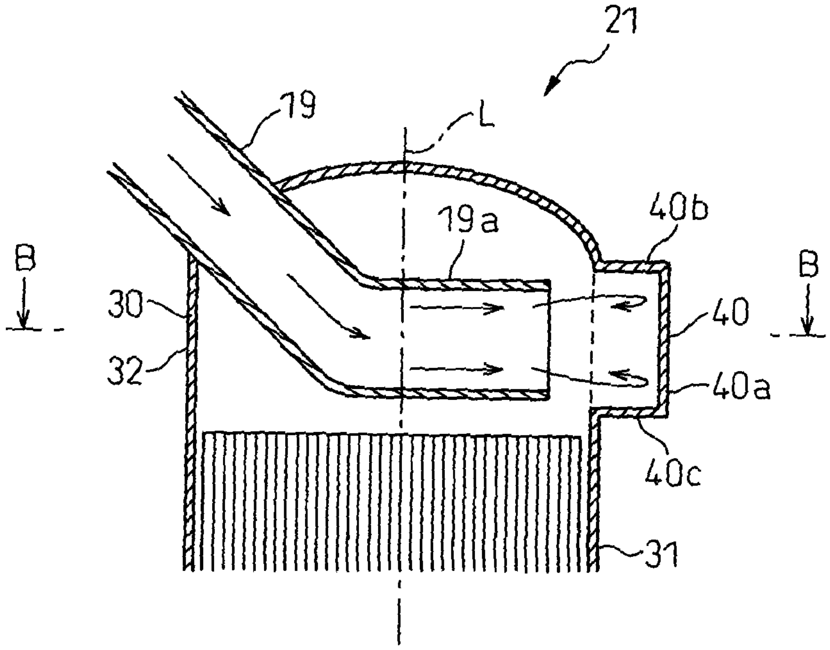


Fig.3B

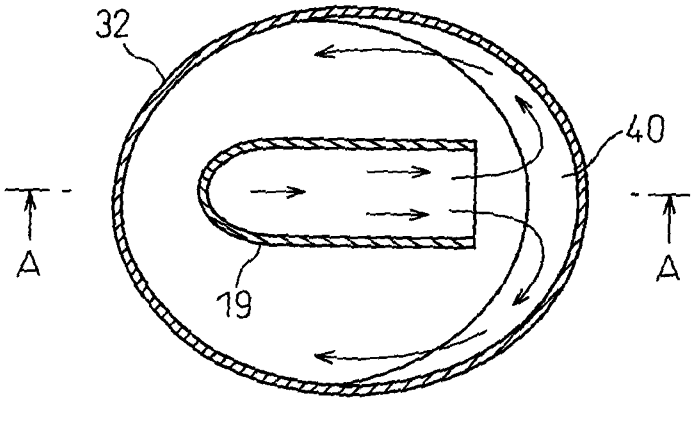


Fig.4A

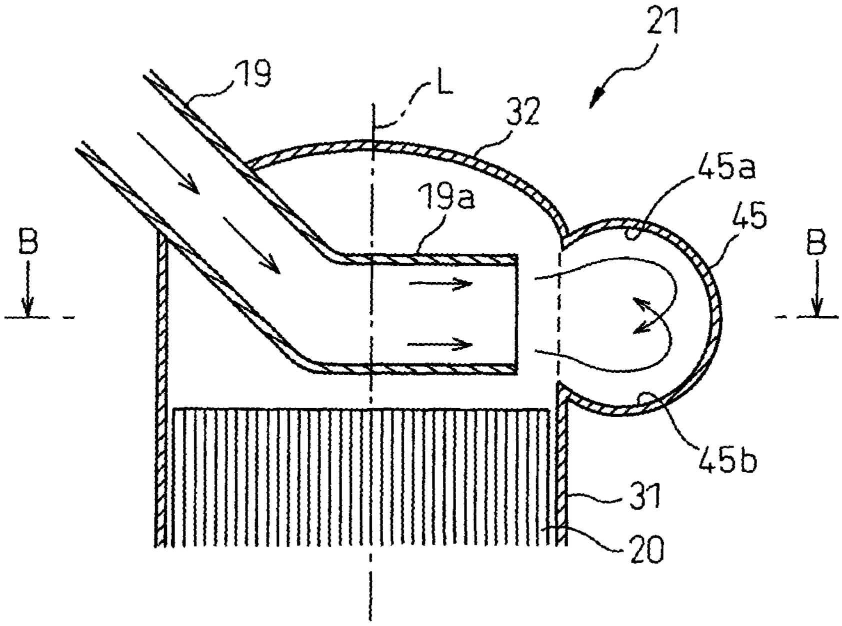


Fig.4B

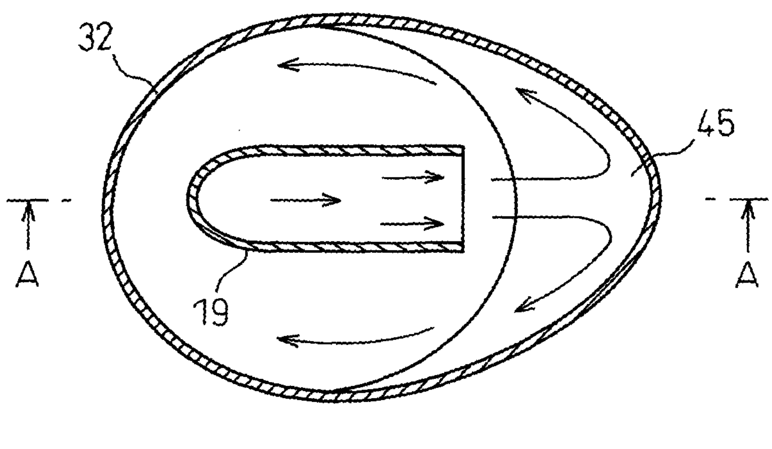


Fig.5A

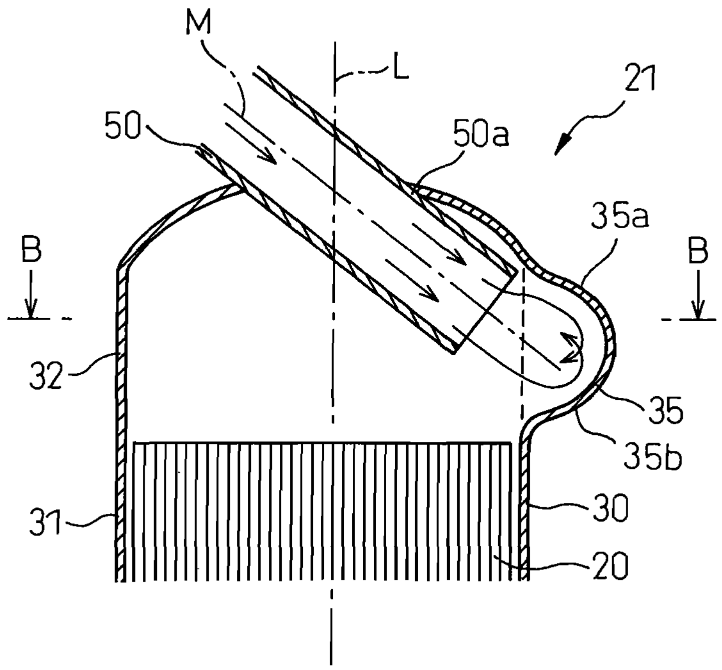


Fig.5B

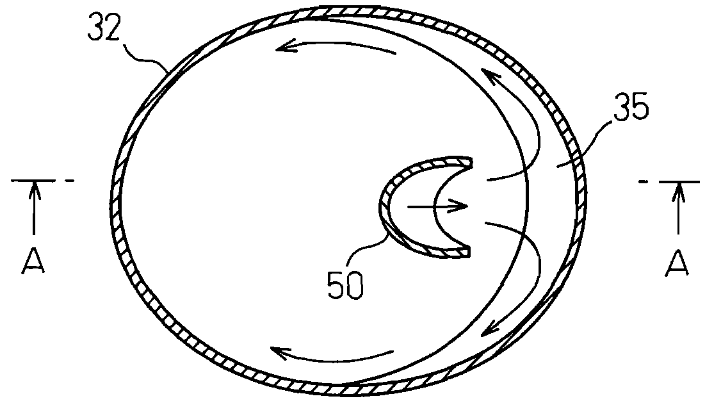


Fig.6A

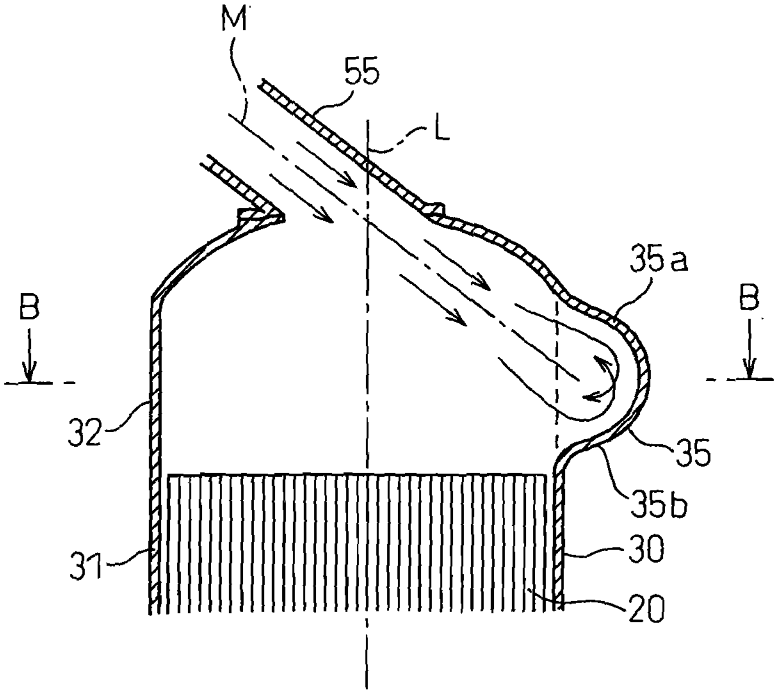


Fig.6B

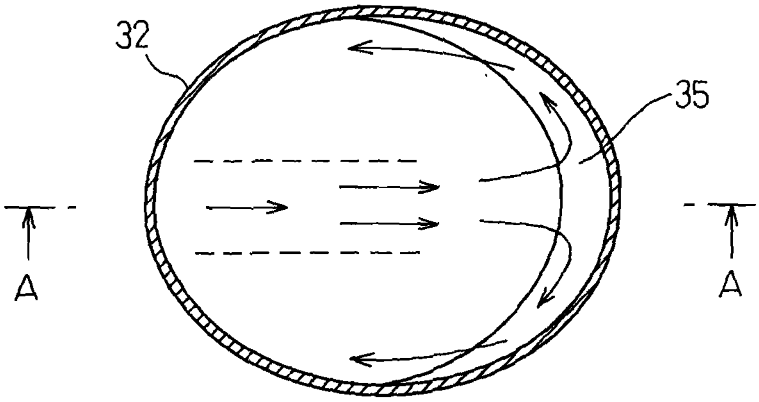


Fig.7A

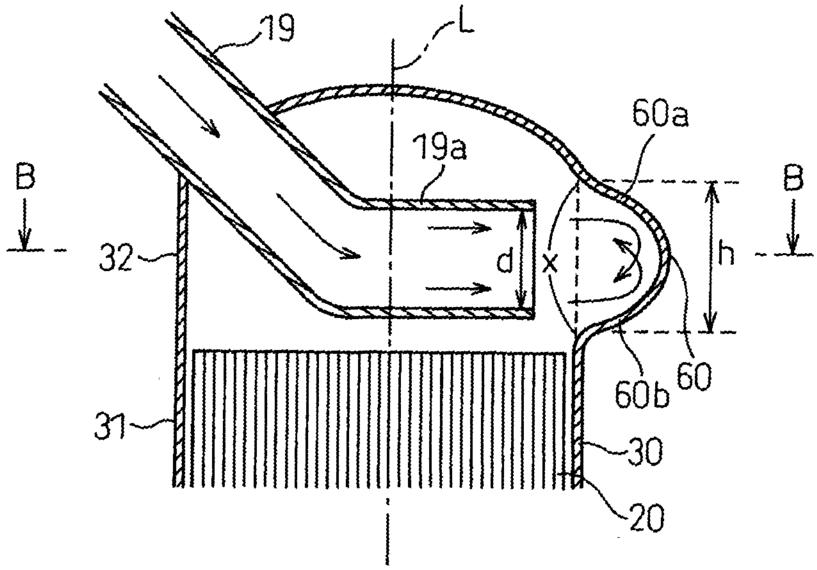


Fig.7B

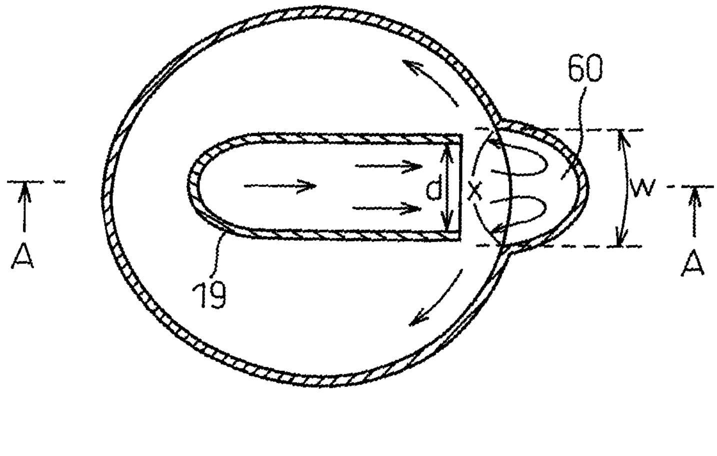


Fig. 8A

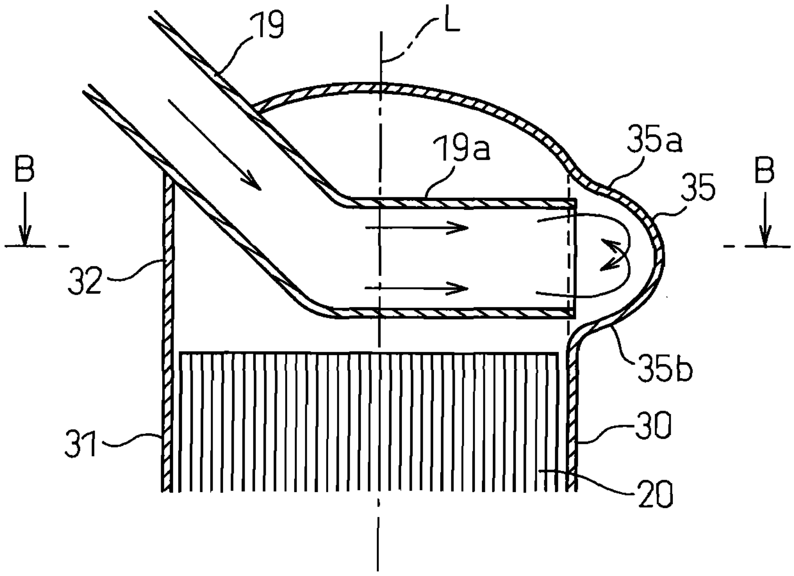


Fig. 8B

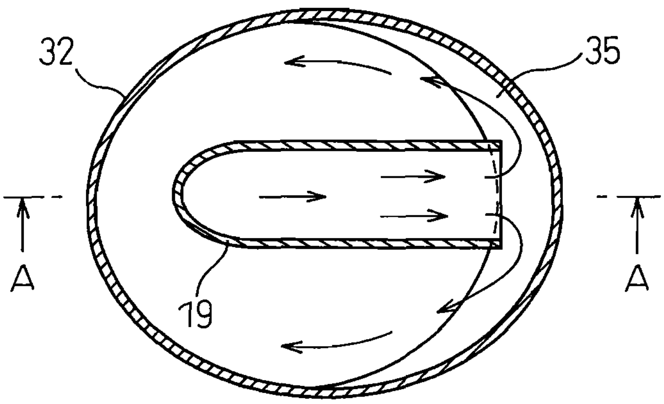


Fig.9A

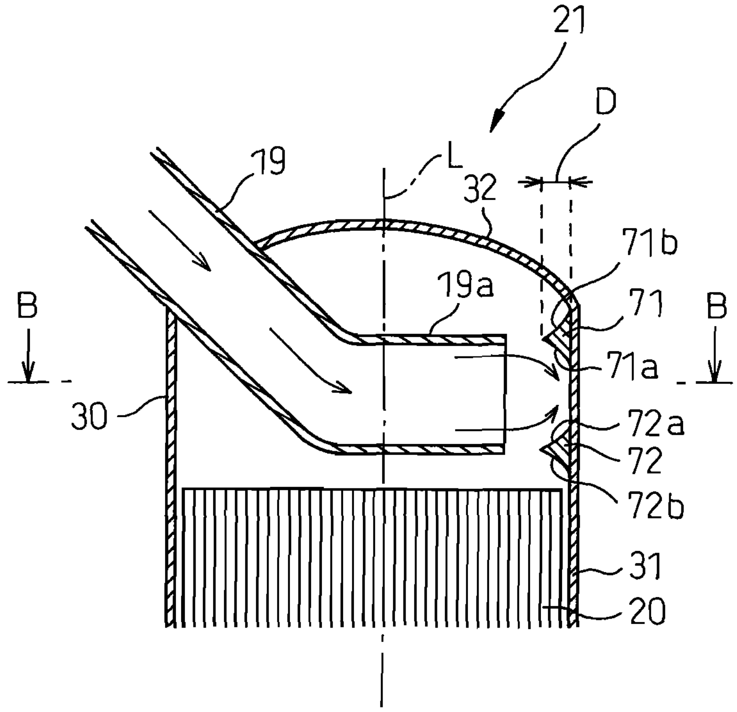
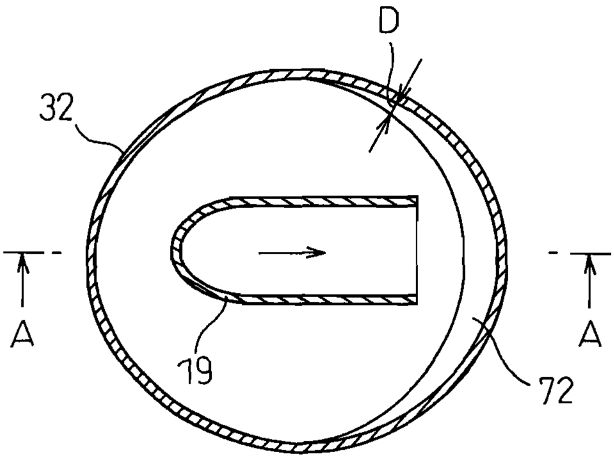


Fig.9B



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/068543

A. CLASSIFICATION OF SUBJECT MATTER
F01N3/24(2006.01)i, *F01N3/28*(2006.01)i, *F01N3/36*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F01N3/24, F01N3/28, F01N3/36

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 50-84954 A (Daimler-Benz A.G.), 09 July 1975 (09.07.1975), page 3, upper left column, line 9 to upper right column, line 6; fig. 3 to 4 & DE 2358732 A1	1-4,19 5-18,20
X Y A	JP 2007-211663 A (Honda Motor Co., Ltd.), 23 August 2007 (23.08.2007), entire text; all drawings (Family: none)	3-11,13-15, 20 16,18 1-2,12,17,19
Y	JP 2003-193835 A (Toyota Motor Corp.), 09 July 2003 (09.07.2003), fig. 4 (Family: none)	16

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
16 December, 2009 (16.12.09)	28 December, 2009 (28.12.09)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/068543

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2007/0234713 A1 (Jared D.BLAISDELL), 11 October 2007 (11.10.2007), paragraph [0017]; fig. 1 to 2 (Family: none)	18
A	JP 2006-77576 A (Meidensha Corp.), 23 March 2006 (23.03.2006), entire text; all drawings (Family: none)	1-20
A	DE 2345383 A1 (DAIMLER BENZ AG.), 20 March 1975 (20.03.1975), entire text; all drawings (Family: none)	1-20
A	JP 2006-9793 A (Yumex Corp.), 12 January 2006 (12.01.2006), entire text; all drawings (Family: none)	1-20
A	JP 2002-536589 A (Emitec Gesellschaft Fuer Emissionstechnologie Mbh), 29 October 2002 (29.10.2002), entire text; all drawings & US 2002/0017097 A1 & EP 1151184 A & WO 2000/047878 A1 & DE 19905032 A1	1-20
P,A	JP 2009-47091 A (Toyota Motor Corp.), 05 March 2009 (05.03.2009), entire text; all drawings & WO 2009/025262 A1	1-20

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- JP 2003184544 A **[0007]**
- JP 2005325747 A **[0007]**