CLOSE-COUPLED CATALYTIC CONVERTER

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Abstract
A close-coupled catalytic converter according to an exemplary embodiment of the present invention includes: a front catalyst and a rear catalyst that are cylindrically shaped, coated with a metal catalyst, and disposed separately from each other; and a catalyst cover including an upper shell and a lower shell, and the upper and lower shells are semi-cylindrically shaped, wherein an end of the catalyst cover is connected with a front muffler pipe that is connected with an exhaust manifold and the other end of the catalyst cover is connected with a rear muffler pipe that emits an exhaust gas. The structures of a shell for a catalyst and for configuration of an oxygen sensor are simplified so that manufacturing process and cost are reduced and purifying performance is enhanced. Since back pressure is reduced, engine performance is enhanced.
FIG. 1b
FIG. 3
FIG. 5
FIG. 10

A conventional catalytic converter

A catalytic according to an exemplary embodiment

0.88
Uniform distribution rate of fluid velocity of cross section at a front substrate

0.88
Uniform distribution rate of fluid velocity of cross section at a rear substrate

0.97
CLOSE-COUPLED CATALYTIC CONVERTER

CROSS-REFERENCE TO RELATED APPLICATION


BACKGROUND OF THE INVENTION

[0002] (a) Field of the Invention
[0003] The present invention relates to a close-coupled catalytic converter. More particularly, the present invention relates to a close-coupled catalytic converter in which a structure of a shell for a catalyst and a structure for configuration of an oxygen sensor are simplified so that configuration performance is enhanced, and a rate of coating of a front catalyst is optimized so that efficiency of the catalytic converter is enhanced and manufacturing cost is reduced.

[0004] (b) Description of the Related Art
[0005] A catalytic converter (or a catalyst converter) is a device that converts carbon monoxide, hydrocarbon, nitrous oxide, and so on, contained in an exhaust gas into a harmless material like water, carbon dioxide, and so on.
[0006] Conventional catalytic converters have a substrate coated with a metal for a catalyst, and the substrate is supported by a mat and disposed in a metal shell. Platinum (Pt), rhodium (Rh), or palladium (Pd) is used for coating the substrate.
[0007] The conventional catalytic converter can be classified according to position as a manifold catalytic converter (or a warm-up catalytic converter) that is directly connected with an exhaust manifold, an under-floor catalytic converter (UCC) that is separated from an exhaust manifold and configured on a vehicle floor in the middle of a muffler pipe, and a close-coupled catalytic converter (CCC catalytic converter) that is separated from an exhaust manifold but is closer than the under-floor catalytic converter. A catalytic converter configures one or two catalysts according to requirement.

[0008] FIG. 1a and FIG. 1b are a schematic diagram and a perspective view of a conventional CCC catalytic converter, respectively, and FIG. 2 is a schematic diagram of another conventional CCC catalytic converter.

[0009] As shown in FIG. 1a and FIG. 1b, a conventional CCC catalytic converter 1 configures two different catalysts 5 that are almost contacted with each other and inserted into one shell 3, and the conventional CCC catalytic converter 1 is disposed away from an exhaust manifold 7 and emits an exhaust gas. Oxygen sensors 9 are disposed at a forwards part and a rearwards part of the conventional CCC catalytic converter 1, and the conventional CCC catalytic converter 1 is controlled by a theoretical air/fuel ratio.

[0010] However, the two catalysts 5 in the conventional CCC catalytic converter 1 are almost contacted with each other so that efficiency of a cross-section of a rear catalyst is reduced.

[0011] As shown in FIG. 2, a front catalyst 11 and a rear catalyst 13 of another conventional CCC catalytic converter 10 are disposed in a front shell 15 and a rear shell 17 respectively, and connected by a center cone 14. The front catalyst 11 is connected to an exhaust manifold by a front cone 12 that is disposed forward of the front catalyst 11, and the rear catalyst 13 is connected to a muffler pipe by a rear cone 16 that is disposed rearward of the rear catalyst 13. In this case, an oxygen catalyst is configured in the front cone 12 and the center cone 14 respectively.

[0012] However, this conventional catalytic converter requires a plurality of cones and shells so that a manufacturing cost of canning is high, and also requires a plurality of welding processes so that the manufacturing process is increased.

[0013] When an oxygen sensor is configured to the conventional CCC catalytic converter, a cylindrical boss is fixed to a shell by welding so that a configuration angle of the oxygen sensor is limited by a shape of the shell. Therefore, when the configuration angle of the oxygen sensor is changed, a shape of the shell must be changed.

[0014] Because of a size of a diameter of a front shell, an assembly tool may often interfere with the shell during assembly of the shell to an exhaust manifold, a pipe, and so on. A front catalyst must be disposed as close as possible near an engine in order that a catalytic converter reaches a light-off temperature (a temperature of activating the catalyst) quickly. However, it is difficult to dispose the front catalyst near an engine because of the above-mentioned interference.

[0015] The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY OF THE INVENTION

[0016] The present invention has been made in an effort to provide a close-coupled catalytic converter having the advantages that a structure of a shell for a catalyst and a structure for configuration of an oxygen sensor are simplified so that configuration performance is enhanced, and a rate of coating of a front catalyst is optimized so that efficiency of the catalytic converter is enhanced and manufacturing cost is reduced.

[0017] Also, the present invention has been made in an effort to provide a close-coupled catalytic converter having the advantages that a front catalyst is closely disposed near an engine so that the light-off characteristic is improved, a coating ratio of a front catalyst is optimized, and efficiency of a cross-section of a rear catalyst is improved so that efficiency of a CCC catalytic converter is improved.

[0018] A CCC catalytic converter according to an exemplary embodiment of the present invention includes: a front catalyst and a rear catalyst that are cylindrically shaped, coated with a metal catalyst, and disposed separately from each other; and a catalyst cover including an upper shell that covers upper parts of the front catalyst and the rear catalyst and a lower shell that covers lower parts of the front catalyst and the rear catalyst, and the upper and lower shells are semi-cylindrically shaped, wherein an end of the catalyst cover is connected with a front muffler pipe that is connected with an exhaust manifold and the other end of the catalyst cover is connected with a rear muffler pipe that emits an exhaust gas.

[0019] An oxygen sensor may be disposed between the front catalyst and the rear catalyst.

[0020] The oxygen sensor may be inserted into an oxygen sensor boss that is formed along a circumference shape of
the upper shell and the lower shell so that one edge of the oxygen sensor boss is longer than the other edge.

[0021] The oxygen sensor boss may have an internal surface that is manufactured according to a configuration angle of the oxygen sensor.

[0022] A diameter of the front catalyst may be a first predetermined length in order not to interfere with an assembly tool for assembling the lower shell and the front muffler pipe.

[0023] The front catalyst may be disposed near to the front muffler pipe at a second predetermined length in order to reduce a time to reach a temperature of activating the catalyst.

[0024] A length of the front catalyst may be shorter than that of the rear catalyst.

[0025] The front catalyst may include a first coating portion and a second coating portion that are coated with a different amount and a different kind of a metal catalyst respectively.

[0026] The catalyst cover may be protrusive at the front catalyst and the rear catalyst, and the catalyst cover may be concaved at a front part of the front catalyst, at a rear part of the rear catalyst, and at a part between the front catalyst and the rear catalyst.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The above and other features of the present invention will now be described in detail with reference to certain exemplary embodiments thereof illustrated in the accompanying drawings which are given hereinbelow by way of illustration only, and thus are not limiting of the present invention, and wherein:

[0028] FIG. 1a and FIG. 1b are a schematic diagram and a perspective view of a conventional CCC catalytic converter respectively;

[0029] FIG. 2 is a schematic diagram of another conventional CCC catalytic converter;

[0030] FIG. 3 is schematic diagram of a CCC catalytic converter according to an exemplary embodiment of the present invention;

[0031] FIG. 4 is a perspective view of the CCC catalytic converter according to an exemplary embodiment of the present invention;

[0032] FIG. 5 is an internal perspective view of the CCC catalytic converter according to an exemplary embodiment of the present invention;

[0033] FIG. 6 is a bottom side perspective view of the CCC catalytic converter according to an exemplary embodiment of the present invention;

[0034] FIG. 7a and 7b are a partial cross-sectional view and a perspective view of the CCC catalytic converter respectively showing a configuration of an oxygen sensor boss according to an exemplary embodiment of the present invention;

[0035] FIG. 8 is a schematic diagram of the CCC catalytic converter according to an exemplary embodiment of the present invention showing assembly of a coating state;

[0036] FIG. 9 is a perspective view of the CCC catalytic converter according to an exemplary embodiment of the present invention showing assembly of a catalyst cover and a front muffler pipe, with an assembly tool; and

[0037] FIG. 10 is an analysis diagram showing flow improvement by comparing the uniform distribution rate of fluid velocity at a cross-section of a substrate of the CCC catalytic converter according to an exemplary embodiment of the present invention with the uniform distribution rate of fluid velocity at a cross-section of a substrate of a conventional CCC catalytic converter.

DESCRIPTION OF REFERENCE NUMERALS INDICATING PRIMARY ELEMENTS IN THE DRAWINGS

[0038] 100: CCC catalytic converter 110: catalyst cover
112: lower shell 114: upper shell
120: oxygen sensor boss 122: oxygen sensor
130: front catalyst 132: first coating portion
134: second coating portion 140: rear catalyst
200: exhaust manifold 300: front muffler pipe
400: rear muffler pipe 500: assembly tool

[0039] It should be understood that the appended drawings are not necessarily to scale, presenting a somewhat simplified representation of various preferred features illustrative of the basic principles of the invention. The specific design features of the present invention as disclosed herein, including, for example, specific dimensions, orientations, locations, and shapes will be determined in part by the particular intended application and use environment. Certain features of the illustrated embodiments have been enlarged or distorted relative to others to facilitate visualization and clear understanding.

[0040] In the figures, reference numbers refer to the same or equivalent parts of the present invention throughout the several figures of the drawing.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0041] Hereinafter reference will now be made in detail to various embodiments of the present invention, examples of which are illustrated in the accompanying drawings and described below. While the invention will be described in conjunction with exemplary embodiments, it will be understood that present description is not intended to limit the invention to those exemplary embodiments. On the contrary, the invention is intended to cover not only the exemplary embodiments, but also various alternatives, modifications, equivalents and other embodiments, which may be included within the spirit and scope of the invention as defined by the appended claims.

[0042] FIG. 3 is schematic diagram of a CCC catalytic converter according to an exemplary embodiment of the present invention. FIG. 4 is a perspective view of the CCC catalytic converter according to an exemplary embodiment of the present invention, and FIG. 5 is an internal perspective view of the CCC catalytic converter according to an exemplary embodiment of the present invention. FIG. 6 is a bottom side perspective view of the CCC catalytic converter according to an exemplary embodiment of the present invention. FIG. 7a and 7b are respectively a partial cross-sectional view and a perspective view of the CCC catalytic converter showing configuration of an oxygen sensor boss according to an exemplary embodiment of the present invention, and FIG. 8 is a schematic diagram of the CCC catalytic converter according to an exemplary embodiment of the present invention showing assembly of a coating state.
FIG. 9 is a perspective view of the CCC catalytic converter according to an exemplary embodiment of the present invention showing assembly of a catalyst cover and a front muffler pipe, and FIG. 10 is an analysis diagram showing flow improvement by comparing the uniform distribution rate of fluid velocity at a cross-section of a substrate of the CCC catalytic converter according to an exemplary embodiment of the present invention with the uniform distribution rate of fluid velocity at a cross-section, of a substrate of a conventional CCC catalytic converter.

[0043] As shown in FIG. 3 to FIG. 8, a close-coupled catalytic converter (CCC converter) according to an exemplary embodiment of the present invention includes a catalyst cover 110 including a lower shell 112 and an upper shell 114, a oxygen sensor 122 disposed on the lower shell 112, and a front catalyst 130 and a rear catalyst 140 that are coated with a metal catalyst for purifying an exhaust gas and are disposed in the lower shell 112 and the upper shell 114.

[0044] A front connecting flange 112a is formed at an end of the CCC catalytic converter 100 and the front connecting flange 112a connects the CCC catalytic converter 100 with a front muffler pipe 300 that is connected to an exhaust manifold 200. A rear connecting flange 112b is formed at the other end of the CCC catalytic converter 100 and the rear connecting flange 112b connects the CCC catalytic converter 100 with a rear muffler pipe 400 that emits an exhaust gas passing through the CCC catalytic converter 100.

[0045] The CCC catalytic converter 100 includes the upper shell 114, which covers an upper part of the front catalyst 130 and the rear catalyst 140, and the lower shell 112, which covers a lower part of the front catalyst 130 and the rear catalyst 140, wherein the upper shell 114 and the lower shell 112 are semi-cylindrically shaped.

[0046] The catalyst cover 110 is protrusive at the front catalyst 130 and the rear catalyst 140, and the catalyst cover 110 is concave at a front part of the front catalyst 130, at a rear part of the rear catalyst 140, and at a part between the front catalyst 130 and the rear catalyst 140.

[0047] The lower shell 112 and the upper shell 114 may be connected by a protrusion, a hook, inserting, or welding. However, the CCC catalytic converter 100 according to an exemplary embodiment of the present invention is integrally formed by connecting with a connecting flange or redundant welding. Therefore, a manufacturing cost of the CCC catalytic converter 100 may be reduced and a welding process may be minimized.

[0048] As shown in FIG. 6, an oxygen sensor boss 120 is formed on the lower shell 112 for configuring an oxygen sensor 122.

[0049] As shown in FIG. 7, an oxygen sensor boss 120 is fixed to the lower shell 112 that is rounded so that the oxygen sensor boss 120 is formed along a circumference shape of the lower shell 112 and one edge of the oxygen sensor boss 120 is longer than the other edge. That is, the shape of the oxygen sensor boss 120 is a dissymmetrical cylinder.

[0050] Thus, it is inclined gradually from an upper part of the lower shell 112 to a lower part of the lower shell 112 so that a length of an upper half of the cylinder is shorter than that of a lower half of the cylinder.

[0051] An internal surface of the oxygen sensor boss is manufactured in a straight line or a curved line according to a configuration angle of the oxygen sensor 122. So, when the configuration angle of the oxygen sensor 122 is changed, a shape of the shell 112 is not required to be changed. Thus, just changing the internal surface of the oxygen sensor boss 120 can correspond to changing the configuration angle of the oxygen sensor 122.

[0052] As shown in FIG. 8, the front catalyst 130 includes a first coating portion 132 and a second coating portion 134 that are coated with a different amount and a different kind of a metal catalyst respectively.

[0053] The first coating portion 132 may be coated with palladium (Pd) and the second coating portion 134 may be coated with a mixture of palladium (Pd) and rhodium (Rh). The larger the coating amount of the metal catalyst, the better the ability for purifying the exhaust gas. However, a metal catalyst is expensive and so an optimized coating ratio is required.

[0054] In the CCC catalytic converter 100 according to an exemplary embodiment of the present invention, when a length of the first coating portion 132 is determined to be 50 mm (±10 mm), a coated volume may be about 0.350, while when a length of the first coating portion 132 is determined to be 40 mm, a coated volume may be about 0.270 and when a length of the first coating portion 132 is determined to be 60 mm, a coated volume may be about 0.410. Various coating ratios and kinds of metal catalyst may be used according to a vehicle and an amount of exhaust gas.

[0055] As shown in FIG. 10, the front catalyst 130 and the rear catalyst 140 are disposed separately. Because the front catalyst 130 and the rear catalyst 140 are disposed separately, a mixture area of the exhaust gas is formed so that efficiency of a cross-section of rear catalyst 140 is improved and efficiency of the CCC catalytic converter 100 is improved. In the CCC catalytic converter 100 according to an exemplary embodiment of the present invention, a uniform distribution rate of fluid velocity is increased from 0.88 in a conventional CCC catalytic converter to 0.97 in the exemplary embodiment of the present invention. Namely, the rate is increased by about 10%.

[0056] As shown in FIG. 9, a diameter L1 of the front catalyst 11 shown in FIG. 4 is reduced by about 12.7 mm compared to a diameter L3 of the conventional front catalyst 11 shown in FIG. 1a, so that a space for an assembly tool to assemble the CCC catalytic converter 100 is provided. Interference of the CCC catalytic converter 100 and the assembly tool, therefore, can be prevented so that assembly process is easily performed.

[0057] The diameter L1 of the front catalyst 130 is a first determined length, and the first determined length can be varied according to a vehicle or an amount of exhaust gas.

[0058] A length L5 of the front catalyst 130 shown in FIG. 4 is reduced about 14.7 mm compared to a length L2 of the conventional front catalyst 11 shown in FIG. 1b. Therefore, the length of the front catalyst 130 is shorter than that of the rear catalyst 140. The length of the front catalyst 130 may be shortened because of the optimized ratio for coating.

[0059] A length L4 shown in FIG. 4 is shortened by about 29 mm compared to a length L1 in FIG. 1b.

[0060] Therefore, performance of the CCC catalytic converter 100 is improved since the CCC converter can achieve a light-off temperature three seconds faster than that of a conventional CCC catalytic converter.

[0061] The diameter, length, and position of the front catalyst 130 can be varied according to a vehicle or an amount of the exhaust gas.

[0062] The CCC catalytic converter according to an exemplary embodiment of the present invention can omit a
welding process compared to the conventional CCC catalytic converter and does not require components like shells, cones, and so on, so that the number of components can be reduced. Because a number of components can be reduced, weight of an exhaust system can be reduced and manufacturing cost can be lowered.

[0063] According to an exemplary embodiment of the present invention, a structure of a shell for a catalyst and a structure for configuration of an oxygen sensor are simplified so that configuration performance is enhanced, and the manufacturing process is reduced so that cost is reduced.

[0064] The performance of the CCC catalytic converter is enhanced because the coating ratio of the front catalyst is optimized and the position of the CCC catalytic converter is close to an engine.

[0065] As described above, manufacturing cost may be reduced, weight of the CCC catalytic converter may be lowered, back pressure may be reduced, and engine performance may be enhanced.

[0066] While this invention has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. A close-coupled catalytic converter comprising:
   - a front catalyst and a rear catalyst that are cylindrically shaped, coated with a metal catalyst, and disposed separately from each other; and
   - a catalyst cover comprising an upper shell that covers an upper part of the front catalyst and the rear catalyst, and a lower shell that covers a lower part of the front catalyst and the rear catalyst, and the upper and lower shells are semi-cylindrically shaped, wherein an end of the catalyst cover is connected with a front muffler pipe that is connected with an exhaust manifold and the other end of the catalyst cover is connected, with a rear muffler pipe that emits exhaust gas.

2. The close-coupled catalytic converter of claim 1, wherein an oxygen sensor is disposed between the front catalyst and the rear catalyst.

3. The close-coupled catalytic converter of claim 2, wherein the oxygen sensor is inserted into an oxygen sensor boss that is formed along a circumference shape of the upper shell and the lower shell so that one edge of the oxygen sensor boss is longer than the other edge.

4. The close-coupled catalytic converter of claim 3, wherein the oxygen sensor boss has an internal surface that is manufactured according to a configuration angle of the oxygen sensor.

5. The close-coupled catalytic converter of claim 1, wherein a diameter of the front catalyst is a first predetermined length in order not to interfere with an assembly tool for assembling the lower shell and the front muffler pipe.

6. The close-coupled catalytic converter of claim 5, wherein the front catalyst is disposed near to the front muffler pipe at a second predetermined length in order to reduce a time to reach a temperature of activating the catalyst.

7. The close-coupled catalytic converter of claim 1, wherein a length of the front catalyst is shorter than that of the rear catalyst.

8. The close-coupled catalytic converter of claim 1, wherein the front catalyst comprises a first coating portion and a second, coating portion that are coated with a different amount and a different kind of a metal catalyst respectively.

9. The close-coupled catalytic converter of claim 1, wherein the catalyst cover is protrusive at the front catalyst and the rear catalyst, and the catalyst cover is concaved at a front part of the front catalyst, at a rear part of the rear catalyst, and at a part between the front catalyst and the rear catalyst.

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