EXHAUST GAS DIFFUSER

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ABSTRACT

An exhaust gas-cooling device for use on an exhaust gas conveyance system of a vehicle to emit exhaust gases from an engine to an outlet includes a pipe defining an exhaust gas passageway that is in fluid communication with the engine, and a diffuser in fluid communication with the exhaust gas passageway. The diffuser is configured for receiving the pipe, and has a body defining an outlet of the exhaust gas passageway to the ambient, and a diffusing structure disposed on the body generally opposite the outlet. The diffusing structure has a separating structure configured for receiving and diverting the flow of exhaust gas emitted from the pipe, and a guiding structure configured for guiding the diverted flow of exhaust gas along the body to the outlet.
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BACKGROUND OF THE INVENTION

[0001] The present invention relates generally to exhaust gas conveyance systems in vehicles. More specifically, the present invention relates to an exhaust gas-cooling device for reducing the temperature of exhaust gases emitted from a vehicle's engine.

[0002] Exhaust gas conveyance systems on vehicles frequently emit exhaust gases with extremely high temperatures. The high temperatures can be achieved from routine engine operation, particularly on larger vehicles. Further, the high temperatures can also be achieved during a regeneration event, where collected particulate matter that is trapped in a particulate filter is oxidized. During both routine operation and regeneration events, the vehicle's operating environment can be subjected to undesirable high temperatures.

[0003] Thus, there is a need for an exhaust gas-cooling device that can be easily provided on most exhaust gas conveyance systems with little modification to the existing exhaust gas conveyance system.

BRIEF SUMMARY OF THE INVENTION

[0004] The above-listed needs are met or exceeded by the present exhaust gas-cooling device for use on an exhaust gas conveyance system of a vehicle to emit exhaust gases from an engine to an outlet. The exhaust gas cooling device includes a pipe defining an exhaust gas passageway that is in fluid communication with the engine and a diffuser in fluid communication with the exhaust gas passageway. The diffuser is configured for receiving the pipe, and has a body defining an outlet of the exhaust gas passageway to the ambient, and a diffusing structure disposed on the body generally opposite the outlet. The diffusing structure has a separating structure configured for receiving and diverting the flow of exhaust gas emitted from the pipe, and a guiding structure configured for guiding the diverted flow of exhaust gas along the body to the outlet.

[0005] Also provided is a diffuser for use on an exhaust gas conveyance system of a vehicle having a pipe defining an exhaust gas passageway to emit exhaust gases from an engine to an outlet. The diffuser includes a body in fluid communication with the pipe and defining an outlet of the exhaust gas passageway to an ambient. The body is formed of a conductive, corrosion resistant material. The diffuser also includes a diffusing structure disposed on the body generally opposite the outlet, where the diffusing structure has a separating structure configured for receiving and diverting the flow of exhaust gas emitted from the pipe, and a guiding structure adjacent the diffusing structure configured for guiding the diverted flow of exhaust gas along the body to the outlet.

[0006] An alternate embodiment of exhaust gas-cooling device for use on an exhaust gas conveyance system of a vehicle to emit exhaust gases from an engine to an outlet includes a pipe defining an exhaust gas passageway that is in fluid communication with the engine. The cooling device also includes a generally rectangular shaped diffuser in fluid communication with the exhaust gas passageway and configured for receiving the pipe. The diffuser includes a body defining an outlet of the exhaust gas passageway to the ambient, where the body has an upstream surface configured for receiving the pipe. A diffusing structure is disposed on the body generally opposite the outlet. The diffusing structure has a generally concavedly shaped separating structure configured for receiving and diverting the flow of exhaust gas emitted from the pipe, and two generally concavedly shaped guiding structures disposed on each side of the separating structure and configured for guiding the diverted flow of exhaust gas along the body to the outlet.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a perspective view of an exhaust gas cooling device;

[0008] FIG. 2 is a side view of the exhaust gas cooling device;

[0009] FIG. 3 is a plan view of the exhaust gas cooling device; and

[0010] FIG. 4 is a top view of the exhaust gas cooling device.

DETAILED DESCRIPTION OF THE INVENTION

[0011] Referring now to FIGS. 1-3, an exhaust gas-cooling device is depicted generally at 10, and includes an exhaust gas conveyance system 12 and a diffuser 14. The exhaust gas conveyance system 12 is mounted on a vehicle (not shown) forming an exhaust gas passageway 16 which routes the exhaust gases from the vehicle's engine (not shown) to a remote location where the gases can be expelled into the ambient.

[0012] In the direction of flow of the exhaust gases, the exhaust gas conveyance system 12 can incorporate aftertreatment devices (not shown), such as an oxidation catalyst member (not shown) and a particulate filter (not shown). The oxidation catalyst member oxidizes unburned fuel and oil to reduce harmful emissions, and the particulate filter removes particulate matter from the exhaust gases. When particulate matter gets trapped in the particulate filter, a periodic or continuous regeneration event oxidizes the collected particulate matter. The regeneration event typically produces large amounts of heat, which increases the heat of the exhaust gases.

[0013] The diffuser 14 of the exhaust gas-cooling device 10 is located downstream of the particulate filter. For purposes of this application, the terms “downstream” and “upstream” refer to the direction of gas flow from the engine out into the ambient.

[0014] As shown in FIG. 3, an interior portion 18 of the tailpipe 12 is received in the diffuser 14 and an exterior portion 20 extends outwardly from the diffuser. The distal end 22 of the exterior portion 20 defines a tailpipe outlet 22 for exhaust gases. Preferably, the tailpipe 12 is generally cylindrical and generally linear at the exterior portion 20 and further, the tailpipe is generally cylindrical and curved at the interior portion 18. In the preferred embodiment, the interior portion 18 forms an angle 0 with respect to the exterior portion 20, wherein the angle 0 is preferably less than 90-degrees. In the most preferred embodiment, the angle 0 is about 45-degrees.

[0015] The exhaust gas-cooling device 10 has a generally rectangular or “box”-shaped body 24 for receiving the exhaust gases. The body 24 includes an upstream surface 26 which receives the tailpipe 12, a downstream surface 28 generally opposite the upstream surface, and a first and second side surfaces 30, 32. The body 24 is preferably made of a conductive material that is corrosion resistant. More preferably, the body 24 is made of a metal, such as stainless steel.
[0016] The upstream surface 26, downstream surface 28, and side surfaces 30, 32 of the body 24 define an exhaust gas passageway outlet 34 to the ambient. In the preferred embodiment, the entire bottom portion of the body 24 is open to the ambient, however, it is contemplated that the bottom portion may be partially enclosed with an aperture being open to the ambient. Additionally, other configurations of outlet 34 are contemplated.

[0017] The exhaust gas-cooling device 10 is configured for reducing the bulk temperature of the exhaust gases using a diffusing structure 36. In the preferred embodiment, the diffusing structure 36 is attached to or integral with the body 24 and forms a top portion 38 of the body. The diffusing structure 36 has a separating structure 40 running along at least a portion of the length “L” of the body 24, and a guiding structure 42 on each side of the separating structure. Preferably, the separating structure 40 is generally concavely contoured (as viewed from the exterior of the diffuser 14) and runs the entire length “L” of the body 24. The separating structure 40 is configured to receive the exhaust gas flow, and to divert the flow. Preferably, the concave contours of the separating structure 40 transition into the generally convex contours (as viewed from the exterior of the diffuser 14) of the guiding structure 42. The guiding structures 42 run parallel to the separating structure 40, and in cross-section, the top portion 38 of the body 24 has an alternating “ridge-groove-ridge” shape.

[0018] In the preferred embodiment, the exhaust gas passageway 16 for the flow of exhaust gas is through the exterior portion 20 and into the interior portion 18 of the tailpipe 12. In the interior portion 18, the exhaust gas is directed toward the diffusing structure 36, and out of the tailpipe outlet 22 adjacent to the separating structure 40. When the flow exits the tailpipe outlet 22, it has an angle of incidence $\beta$ on the separating structure 40. Preferably, the angle of incidence $\beta$ is less than 90-degrees, and more preferably, the angle of incidence $\beta$ is about 45-degrees. The exhaust gas impacts the diffusing structure 36 at the angle of incidence $\beta$, and the separating structure 40 diffuses the flow momentum of the gases by abruptly changing the direction of flow.

[0019] While the preferred embodiment includes an angled tailpipe 12 configuration, it is contemplated that a linear pipe or any other configuration of tailpipe 12 can also be used. However, it is preferred that the angle of incidence $\beta$ of the exhaust gas flow onto the diffusing structure be less than 90-degrees.

[0020] The flow impacts the separating structure 40 and diverts the flow to both sides of the separating structure 40 and to the guiding structures 42 as indicated by the arrows “F” on FIG. 1. The arrows “F” illustrate some example flow lines, however the flow path of the exhaust gas should not be limited to the arrows “F”.

[0021] Preferably, the separating structure 40 gradually transitions into the guiding structure 42, and the guiding structure 42 preferably gradually transitions into the side surfaces 30, 32. In this configuration, the exhaust gas is gradually directed along the body 24 and to the exhaust gas passageway outlet 34 where it can exit to the ambient.

[0022] The separating structure 40 and the guiding structure 42 diffuse the momentum of the exhaust gas. With the exhaust gas passageway outlet 34 disposed opposite the diffusing structure 36, the exhaust gas mixes with the ambient air. The impact of the exhaust gas onto the diffusing structure 36 together with the mixing of the ambient air prevents the emission of a developed jet of hot exhaust gas from the exhaust gas passageway 16.

[0023] Additionally, the body 24 of the diffuser 14 creates a partial chamber where the exhaust gas is stagnated. Since the gas is stagnant, heat is emitted from the exhaust gas to the metal body 24. The body 24 acts as a heat shield to conduct the heat over a large, uniform surface, where the heat can be redistributed more gradually to the ambient.

[0024] Further, the guiding structure 42 of the diffuser guides the flow of exhaust gases along a large metal surface of the body 24. This allows the exhaust flow to emit its heat energy through convection to the metal housing. While the preferred embodiment of guiding structure 42 includes two convexly contoured surfaces, any surface that permits the flow of gas along a large metal surface to the exhaust gas passageway 16 is contemplated.

[0025] The present exhaust gas-cooling device 10 further reduces the temperature of the exhaust gases as compared to conventional devices. Further, the configuration of the diffuser makes it easy to retrofit onto existing exhaust gas conveyance systems by replacing the conventional tailpipe with the tailpipe 12 and the diffuser 14 of the present invention. Further still, it is contemplated that the diffuser 14 include a separate interior pipe that is configured to connect to the tailpipe 12 of the vehicle.

[0026] While particular embodiments of the present exhaust gas-cooling device 10 have been shown and described, it will be appreciated by those skilled in the art that changes and modifications may be made thereto without departing from the invention in its broader aspects and as set forth in the following claims.

1. An exhaust gas-cooling device for use on an exhaust gas conveyance system of a vehicle to emit exhaust gases from an engine to an outlet, comprising:
   a. a pipe defining an exhaust gas passageway that is in fluid communication with the engine;
   b. a diffuser in fluid communication with said exhaust gas passageway and configured for receiving said pipe, said diffuser comprising:
      i. a body defining an outlet of said exhaust gas passageway to an ambient;
      ii. a diffusing structure disposed on said body generally opposite said outlet, said diffusing structure having a separating structure configured for receiving and diverting the flow of exhaust gas emitted from said pipe, and a guiding structure configured for guiding the diverted flow of exhaust gas along said body to said outlet.
2. The exhaust gas-cooling device of claim 1 wherein said body comprises an upstream surface that receives said pipe, and a downstream surface generally opposite said upstream surface.
3. The exhaust gas-cooling device of claim 2 wherein said body comprises first and second side surfaces.
4. The exhaust gas-cooling device of claim 1 wherein said body is formed of a conductive, corrosion resistant material.
5. The exhaust gas-cooling device of claim 4 wherein said body is formed of stainless steel.
6. The exhaust gas-cooling device of claim 1 wherein said separating structure is generally concavely contoured.
7. The exhaust gas-cooling device of claim 1 wherein said guiding structure is disposed adjacent said separating structure and comprises at least one generally convex contour.
8. The exhaust gas-cooling device of claim 1 wherein said guiding structure and said separating structure are generally parallel and form a "ridge-groove-ridge" shape in profile.

9. The exhaust gas-cooling device of claim 1 wherein said pipe has an interior portion disposed within said body, and an exterior portion disposed outside of said body, wherein said interior portion is angled with respect to said exterior portion.

10. The exhaust gas-cooling device of claim 9 wherein said interior portion of said pipe defines a pipe outlet for emitting exhaust gases into said diffuser.

11. The exhaust gas-cooling device of claim 1 wherein said diffusing structure is configured to receive the exhaust gases at an angle of incidence of less than 90-degrees.

12. A diffuser for use on an exhaust gas conveyance system of a vehicle having a pipe defining an exhaust gas passageway to emit exhaust gases from an engine to an outlet, said diffuser comprising:

- a body in fluid communication with the pipe and defining an outlet of the exhaust gas passageway to an ambient, said body formed of a conductive, corrosion resistant material;
- a diffusing structure disposed on said body generally opposite said outlet, said diffusing structure having a separating structure configured for receiving and diverting the flow of exhaust gas emitted from the pipe, and a guiding structure adjacent said diffusing structure configured for guiding the diverted flow of exhaust gas along said body to said outlet.

13. The diffuser of claim 12 wherein said body comprises an upstream surface that is configured to receive the pipe, and a downstream surface generally opposite said upstream surface.

14. The diffuser of claim 13 wherein said body comprises first and second side surfaces, and wherein said upstream surface, said downstream surface, said first surface and said second surface define said outlet of the exhaust gas passageway.

15. The diffuser of claim 12 wherein said separating structure is generally concavely contoured.

16. The diffuser of claim 12 wherein said guiding structure is disposed adjacent said separating structure and comprises at least one generally convex contour.

17. The diffuser of claim 12 wherein said separating structure extends at least along at least a portion of the length of said body.

18. The diffuser of claim 12 wherein said body further comprises an interior pipe disposed in the interior of said body, said interior pipe configured to be in fluid communication with the pipe to define the exhaust gas passageway.

19. The diffuser of claim 18 wherein said interior pipe directs the exhaust gas at said diffusing structure at an angle of incidence of less than 90-degrees.

20. An exhaust gas-cooling device for use on an exhaust gas conveyance system of a vehicle to emit exhaust gases from an engine to an outlet, comprising:

- a pipe defining an exhaust gas passageway that is in fluid communication with the engine;
- a generally rectangular shaped diffuser in fluid communication with said exhaust gas passageway and configured for receiving said pipe, said diffuser comprising:
  - a body defining an outlet of said exhaust gas passageway to an ambient, said body having an upstream surface configured for receiving said pipe;
  - a diffusing structure disposed on said body generally opposite said outlet, said diffusing structure having a generally concavely shaped separating structure configured for receiving and diverting the flow of exhaust gas emitted from said pipe, and two generally convexly shaped guiding structures disposed on each side of said separating structure and configured for guiding the diverted flow of exhaust gas along said body to said outlet.

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