A diesel particulate filter assembly having a housing and a filter structure disposed within the housing for trapping particulate material in received exhaust gas as such received exhaust gas passes through the housing along a longitudinal axis of the housing. The filter structure has walls of particulate collecting, gas passing material. The walls pass portions of the exhaust gas while trapping particulate material in such passing exhaust gas. The walls are disposed the oblique to the direction of the received exhaust gas.
DIESEL PARTICULATE FILTER

TECHNICAL FIELD

[0001] This disclosure generally to exhaust gas treatment systems and more particularly to diesel particulate filters used in such systems.

BACKGROUND

[0002] As is known in the art, most current diesel exhaust gas treatment systems today include a DOC (Diesel Oxidation Catalyst) followed by a DPF (Diesel Particulate Filter). The DPF includes a substrate (sometimes referred to as a substrate brick or brick) with the outlet end closed on the inlet channel and the inlet end closed on the outlet channel. Exhaust gas flows through the inlet channel, crosses the wall of cells, and then exits through the outlet channel. The particles are filtrated in the inlet channel.

[0003] As is also known in the art, particulate filters are used in the exhaust systems of internal combustion engines, especially diesel engines, (diesel particulate filters or DPF) to trap and remove particulate matter which is primarily formed of carbon based material. As the engine exhaust passes through the DPF, the particulates are trapped in the filter and accumulate over time. This leads to an increase in the resistance of the exhaust gas flow through the DPF, and therefore, to an increase in the backpressure on the engine. This increase in backpressure has an adverse effect on engine operation, and especially on fuel consumption. In order to reduce backpressure to acceptable levels, the DPF is periodically regenerated by burning off the accumulated particulates, most of which are combustible.

[0004] As is also known in the art, a traditional cordierite or SiC DPF system needs to undergo a regeneration process to burn out soot collected on the DPF wall surface. A few problems are associated with this procedure: 1. A fuel penalty because diesel fuel is injected either through post injection or down pipe injection to generate high exhaust temperature. Usually fuel penalty is in the range of 3 to 5%; 2. Unevenly distributed soot resulted from poor flow uniformity will lead to high temperature gradient inside DPF substrate, and cause durability issue such as ring-off-crack failure; and 3. Very low or even negative NOx conversion efficiency is found during DPF regeneration, usually takes more than 10 minutes. This is becoming an issue for level III emission requirements.

SUMMARY

[0005] In accordance with the present disclosure, a diesel particulate filter assembly is provided having: a housing and a filter structure disposed within the housing for trapping particulate material in received exhaust gas as such received exhaust gas passes through the housing along a longitudinal axis of the housing. The filter structure has walls of particulate collecting, gas passing material; such walls passing portions of the exhaust gas while trapping particulate material in such passing exhaust gas. The walls are disposed oblique to the direction of the received exhaust gas.

[0006] In one embodiment, a diesel particulate filter assembly is provided having a housing and a filter structure disposed within the housing for trapping particulate material in received exhaust gas as such received exhaust gas passes through the housing along a longitudinal axis of the housing. The filter structure forms a plurality of channels separated by walls of particulate collecting, gas passing material. The walls pass portions of the exhaust gas from one of the channels to another adjacent one of the channels while trapping particulate material in such passing exhaust gas. The walls are disposed oblique to the direction of the received exhaust gas.

[0007] In one embodiment, a diesel particulate filter assembly is provided having a housing having an inlet for receiving an inlet flow of exhaust gas from a diesel engine and a filter structure disposed within the housing. The filter structure is provided for trapping particulate material in the received exhaust gas as such received exhaust gas passes in an outlet flow through an outlet of the housing with the inlet flow and the outlet flow being disposed along a longitudinal axis of the housing. The filter structure forms a plurality of channels for passing portions of the received exhaust gas, such channels being separated by porous walls of particulate collecting, gas passing material, such walls passing portions of the exhaust gas from one of the channels to another adjacent one of the channels while trapping particulate material in such passing exhaust gas. The separating walls of each one of such channels is disposed oblique to the direction of the received exhaust gas.

[0008] In one embodiment, the channels have an inlet channel section and an outlet channel section, the inlet channel section being upstream of the outlet channel section.

[0009] In one embodiment, the assembly has a main channel in addition to the plurality of channels, such main channel being disposed between an inner wall of the housing and the filter structure.

[0010] In one embodiment, the particulate collecting, gas passing material is paper.

[0011] In one embodiment the filter structure is removable mounted within the housing.

[0012] The details of one or more embodiments of the disclosure are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the disclosure will be apparent from the description and drawings, and from the claims.

DESCRIPTION OF DRAWINGS

[0013] FIG. 1 is a diagrammatical, side cross sectional sketch of a diesel particulate filter (DPF) assembly according to the disclosure;

[0014] FIG. 1A is a diagrammatical, side cross sectional sketch of one of a plurality of channels used in a filter structure used in the diesel particulate filter (DPF) assembly of FIG. 1;

[0015] FIG. 1B is a diagrammatical, perspective sketch of a diesel particulate filter (DPF) assembly of FIG. 1;

[0016] FIG. 2 is a diagrammatical, perspective sketch of a filter structure according to another embodiment of the disclosure;

[0017] FIG. 2A is a diagrammatical, perspective sketch of an exemplary one of a plurality of channels used in the diesel particulate filter assembly of FIG. 2;

[0018] FIG. 2B is an exploded diagrammatical, perspective sketch of the exemplary one of the plurality of channels used in the diesel particulate filter assembly of FIG. 2; such sketch showing an inlet channel section and an outlet channel section of such exemplary one of the plurality of channel;
Like reference symbols in the various drawings indicate like elements.

DETAILED DESCRIPTION

Referring now to FIGS. 1, 1A and 1B, a diesel particulate filter (DPF) assembly 10 is shown. The assembly includes: a two-piece housing 12 having an inlet 14 for receiving an inlet flow 16 of exhaust gas from a diesel engine, not shown; and, a filter structure 18 disposed within the housing 12 for trapping particulate material in the received exhaust gas as such received exhaust gas passes in an outlet, filtered gas flow 20 through an outlet 22 of the housing 12. The inlet flow 16 and the outlet flow 20 are disposed along a longitudinal axis 24 of the housing 12.

The filter structure 18, here porous paper, forms a plurality of channels 30, 32, 34 for passing portions of the received exhaust gas flow 16. The channels 30, 32 and 34 have an inlet for receiving the gas flow 16 and an outlet for exhausting the filtered gas flow 20, the inlet being upstream of the outlet. The channels 34, an exemplary one being shown more clearly in FIG. 1A, are separated one from another by porous walls 40 of particulate collecting, gas passing material. Each one of the channels 34 has an inlet channels section 341 and a downstream outlet channels section 340, separated by a portion of wall 40 indicated as wall 40S, as shown more cleanly in FIG. 1A. The walls 40 pass portions of the exhaust gas indicated by the arrows from one of the channels 34 to another adjacent one of the channels 34 while trapping particulate material in such passing exhaust gas in the separating wall 40S. The separating wall 40S of each one of such channels 34 is disposed along an axis 38 oblique to the longitudinal axis 24 of the housing 12 (and therefore oblique to the direction of the received exhaust gas, as shown in FIG. 1A).

More particularly, the filter structure 18 has a main channel, i.e., channel 30 in addition to the plurality of channels 32, such main channel 30 being disposed between an inner wall 42 of the housing 12 and the filter structure 18. Exhaust gas can anywhere to pass the filter wall 40 depends on how much pressure loss it will experience. The flow is always towards the path having the least pressure drop. If all of the exhaust gas passed through at the end of top channel 30, there will be great pressure loss (soot deposit will creates even much higher pressure loss as time goes on); therefore a portion of the exhaust gas enters the channels 34, more particularly the inlet channel section 341 and passes through the separating wall 40S to the adjacent outlet channel section 340, as indicated by the arrows 35.

As noted above, the particulate collecting, gas passing material, i.e., walls 40, is paper. Further, the filter structure 18 is removable mounted within the separable two-piece housing 12 when it is required to change the filter structure 18. Here, for example, for 0.2 m (height)×0.25 m (width) filter with 100 folders (channels) total surface area will be: 100×0.2×0.25=5 m², the porosity of fiber paper can be larger than 80%, DPF trap efficiency can reach 99.9% with much lower pressure loss than traditional DPF.

Referring now to FIG. 2, an alternative embodiment of the diesel particulate filter structure 18 is shown. Here the filter structure 18 is a cylindrical filter structure having with a plurality of channels 34 and fits as a removable member within a cylindrical housing 12. An exemplary one of the channels 34 is shown in FIGS. 2A and 2B. It is noted that the channels 34a has an inlet channels section 341 and a downstream outlet channels section 340 separated by separating wall 40S. The walls 40 pass portions of the exhaust gas from one of the channels 34a to another adjacent one of the channels 34a through the separating wall 40S while trapping particulate material in such passing exhaust gas. The separating walls 40S of each one of such channels 34 is twisted and also oblique to the direction of the received exhaust gas (indicated by arrow 16). Here, for example, the Fiber paper DPF filter has for a 8"×12" filter with 100 folders (channels) total surface area of: 2×100×0.1×0.25=5 meter square and the porosity of fiber paper can be larger than 80%, DPF trap efficiency can reach 99.9% with much lower pressure loss than traditional DPF.

The channels 34 may be fastened together in any convenient manner such as with metal bands, not shown, as are used to fasten together the slats in a wooden rain barrel. A number of embodiments of the disclosure have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the disclosure. Accordingly, other embodiments are within the scope of the following claims.

What is claimed is:

1. A diesel particulate filter assembly, comprising: a housing; a filter structure disposed within the housing for trapping particulate material in received exhaust gas as such received exhaust gas passes through the housing along a longitudinal axis of the housing, such filter structure having walls of particulate collecting, gas passing material, such walls passing portions of the exhaust gas while trapping particulate material in such passing exhaust gas, the walls being disposed oblique to the direction of the received exhaust gas.

2. A diesel particulate filter assembly, comprising: a housing; a filter structure disposed within the housing for trapping particulate material in received exhaust gas as such received exhaust gas passes through the housing along a longitudinal axis of the housing, such filter structure forming a plurality of channels separated by walls of particulate collecting, gas passing material, such walls passing portions of the exhaust gas from one of the channels to another adjacent one of the channels while trapping particulate material in such passing exhaust gas, the walls being disposed oblique to the direction of the received exhaust gas.

3. A diesel particulate filter assembly, comprising: a housing having an inlet for receiving an inlet flow of exhaust gas from a diesel engine; a filter structure disposed within the housing for trapping particulate material in the received exhaust gas as such received exhaust gas passes in an outlet flow through an outlet of the housing with the inlet flow and the outlet flow being disposed along a longitudinal axis of the housing, such filter structure forming a plurality of channels for passing portions of the received exhaust gas, such channels being separated by porous walls of particulate collecting, gas passing material, such walls passing portions of the exhaust gas from one of the channels to another adjacent one of the channels while trapping particulate material in such passing exhaust gas, the separating walls of each one of such channels
the walls being disposed oblique to the direction of the received exhaust gas.

4. The filter assembly recited in claim 3 wherein the channels have an inlet channel section and an outlet channel section, the inlet channel section being upstream of the outlet channel section.

5. The filter assembly recited in claim 2 wherein the assembly has a main channel in addition to the plurality of channels, such main channel being disposed between an inner wall of the housing and the filter structure.

6. The filter assembly recited in claim 1 wherein the particulate collecting gas passing material is paper.

7. The filter assembly recited in claim 6 wherein the filter structure is removable mounted within the housing.