A deflector member is positioned within the flow of exhaust gases being discharged from the exhaust pipe of an internal combustion engine into a chamber of greater transverse cross-section than said exhaust pipe and containing a flow-through catalyst support, so as to deflect the high velocity discharge stream and provide a substantially uniform flow front as the exhaust gases approach the flow-through catalyst support within said chamber.
This invention pertains to the automotive emission control art, and more particularly to a method and apparatus for deflecting or re-distributing the flow of exhaust gases discharged from an exhaust pipe into a treatment container of larger cross-sectional area so as to more evenly distribute such discharge flow through a porous or honeycomb support member positioned within such container for treating said gases.

When attempting to treat exhaust gases being emitted from the exhaust pipe of an internal combustion engine by passing them through a suitable catalyst support of larger cross-sectional area than the exhaust pipe, it was found that the high velocity kinetic energy of the exhaust gas stream did not dissipate when passing from the relatively small diameter exhaust pipe into the catalyst support chamber of substantially larger diameter. Accordingly, the high velocity gases tended to flow through the center of the catalyst support with a rather small proportion passing through the remainder of the support, thereby materially reducing the overall potential efficiency of the catalyst support.

In the past, it has been a common expedient to utilize a long diffuser when transitioning a flow from a small diameter conduit to a large diameter conduit in order to maintain an even flow front. The long diffuser, which is usually of an extended conical configuration, maintains an even flow front, except for any boundary layer effects, while transitioning the flow to the larger diameter conduit. However, the utilization of a long diffuser is not feasible in limited space applications, such as automotive exhaust systems. Accordingly, the present invention not only provides a substantially even flow front for the catalyst support, but does so with a novel compact structure which is easy to fabricate.

SUMMARY OF THE INVENTION

A deflector member is positioned within a high velocity exhaust stream at a location which is downstream from where such exhaust stream is discharged from a conduit of one diameter into a conduit or cylindrical container of a larger diameter. The deflector member functions to deflect the high velocity stream discharged axially into the larger diameter conduit by the smaller diameter conduit so as to produce turbulence and redistribute the flow of exhaust gases in a substantially even flow front for presentation to a flow-through catalyst support positioned within the larger diameter conduit. By dissipating the kinetic energy of the high velocity stream as it is discharged from the smaller conduit into the larger conduit, it is possible to redistribute the flow of exhaust gases into a substantially even flow front and thereby provide for efficient utilization of the catalyst support.

An object of the invention has been to provide means for deflecting the flow of high velocity exhaust gases as they enter a treatment chamber from an exhaust conduit so as to dissipate the high velocity and produce turbulence, so as to thereby redistribute the flow of gases and produce a substantially even flow front as such gases approach a flow-through catalyst support structure within the treatment chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates one embodiment of a deflector member secured to the discharge end of an exhaust pipe, as would be seen in a vertical or horizontal view.

FIG. 2 is an end elevation view of the embodiment shown in FIG. 1.

FIGS. 3, 4, and 5 are further embodiments of flow deflector members which may be mounted adjacent the end of an exhaust conduit in the same manner as the member shown in FIG. 1.

FIG. 6 schematically illustrates the flow path of discharge gases entering a treatment chamber without the use of the present deflector member.

FIG. 7 is a schematic view illustrating the flow path of exhaust gases entering a treatment chamber which have been deflected in accordance with the present invention.

FIG. 8 is a graph illustrating the distribution of flow velocity through a catalyst support positioned within a treatment chamber, both with and without the utilization of a flow deflector member of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, a flow deflector member 10 is shown positioned downstream of and spaced apart from the exit end 12 of an exhaust conduit 14. The deflector member is maintained in axial alignment with the longitudinal axis of exhaust conduit 14 by means of a plurality of support members or braces 16. Although the deflector member is shown in FIGS. 1 and 2, as a flat disc 10, the deflector member may in fact be in the form of a shaped body, such as a conical body 18, a frusto-conical body 20, or an ellipsoidal shaped body 22 as shown in FIGS. 3, 4, and 5 respectively.

Referring now to FIGS. 6 and 7, an exhaust pipe or conduit 14, such as may be connected to the exhaust manifold of an internal combustion engine, axially communicates with a chamber 24 of a catalyst support container 26 through an opening 28 formed in one end of such container. The opposite end 32 of the container 26 is provided with an axially aligned opening 34 in communication with a discharge conduit 36. A flow-through catalyst support 38, which may be of a porous or honeycomb structure of any suitable material such as disclosed in U. S. Pat. No. 3,112,184, is positioned within treatment chamber 24 of container 26 so as to receive axial flow therethrough. As shown by the arrows A in FIG. 6, most of the exhaust gases from the small diameter exhaust pipe 14 do not expand upon entering chamber 24, but merely pass through the center of the catalyst support 38 due to the kinetic energy of the exhaust gas stream. However, as shown by arrows B of FIG. 7, when a flow deflector such as disc 10, is positioned downstream from the exit end of exhaust pipe 14 and in axial alignment therewith so as to be within the high velocity exhaust stream discharge therefrom, the deflector dissipates the high velocity stream, produces turbulence, and redistributes the flow of the gases in the exhaust stream so as to provide a substantially uniform flow front as the exhaust gases approach the flow-through catalyst support 38.

FIG. 8 graphically illustrates the flow velocity profile across the surface of the catalyst support with, and without the use of the flow deflector of the present invention. Since the purpose of the graph is merely to illustrate the difference in flow profile across the surface.
of the catalyst support, both with and without the utilization of the deflector member, specific figures are not deemed necessary since the relative relationship will be exemplified irrespective of the specific figures utilized. The lower axis shows increase in velocity extending outwardly from the ordinant, whereas the vertical axis illustrates an increase in radial distance from the center line of the catalyst support container. Without the use of the flow deflector, very high flow velocities are exhibited centrally of the catalyst support which rapidly taper off to extremely low velocity adjacent outer peripheral portions thereof. However, with the utilization of the flow deflector a substantially uniform flow velocity distribution is provided across the face of the catalyst support, thereby maximizing the efficiency of the treatment of the gases passing therethrough.

Although the operation of the invention would appear obvious to one skilled in the art from the foregoing disclosure, the following specific example is provided to illustrate the improved operation obtained through the utilization of the present invention. An exhaust pipe having a diameter of approximately two inches was axially connected to one end of a cylindrical container or conduit having a diameter of approximately five inches. The container was provided with a flow-through support catalyst manufactured in accordance with U. S. Pat. No. 3,112,184. Flow distribution measurements were made relative to the flow discharged from the exhaust pipe into the container, both with and without the utilization of a circular flow deflector. When utilizing the circular deflector, it was in the form of a 1½ inch diameter stainless steel disc, one-sixteenth inch thick, positioned within the cylindrical container approximately 2 inches downstream from and in axial alignment with the exit end of the exhaust pipe. The flow distribution results are shown in the following table:

<table>
<thead>
<tr>
<th>Distance from Center Line of Container</th>
<th>Flow in Feet Per Minute Without Deflector</th>
<th>Flow in Feet Per Minute With Deflector</th>
</tr>
</thead>
<tbody>
<tr>
<td>0&quot;</td>
<td>400</td>
<td>275</td>
</tr>
<tr>
<td>½&quot;</td>
<td>425</td>
<td>275</td>
</tr>
<tr>
<td>1&quot;</td>
<td>280</td>
<td>300</td>
</tr>
<tr>
<td>1½&quot;</td>
<td>180</td>
<td>250</td>
</tr>
<tr>
<td>2&quot;</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>2¼&quot;</td>
<td>50</td>
<td>85</td>
</tr>
</tbody>
</table>

Although we prefer to manufacture the deflector members from stainless steel, it will be apparent to those skilled in the art that any heat and corrosion resistant material may be utilized. Further, the spacing between the deflector member and the end of the exhaust pipe will of course vary with respect to the relative cross-sectional areas between the exhaust pipe and the catalyst support container which may be of any desired shape; however, the deflector member should be positioned in axial alignment with the longitudinal axis of the exhaust pipe. Accordingly, although we have disclosed the now preferred embodiments of our invention, it will be apparent to those skilled in the art that various changes and modifications may be made thereto without departing from the spirit and scope thereof as defined in the appended claims.

We claim:
1. In the exhaust system of an internal combustion engine wherein an exhaust conduit of one cross-sectional area communicates with a conduit having a larger cross-sectional area, the improvement comprising, deflector means positioned in spaced-apart relationship from and in axial alignment with a discharge end of said exhaust conduit for deflecting a high velocity exhaust gas stream discharged by said exhaust conduit and producing turbulence so as to provide a substantially even flow front within said larger diameter conduit, said deflector means having a continuous uninterrupted planar surface forming an end thereof closer to the discharge end of said exhaust conduit, said continuous uninterrupted planar surface having an area less than the cross-sectional area of said exhaust conduit, said deflector means being spaced apart from and unsupported by the inner periphery of said larger diameter conduit, and said deflector means having wall portions extending along an outer periphery thereof away from said continuous uninterrupted planar surface and freely spaced from the inner periphery of said larger diameter conduit.
2. In an exhaust system as defined in claim 1 wherein said deflector means is in the form of a disc member.
3. In an exhaust system as defined in claim 1 wherein said deflector means is in the form of a conical body.
4. In an exhaust system as defined in claim 1 wherein said deflector means is in the form of a frusto-conical body.
5. In an exhaust system as defined in claim 1 wherein said deflector means is in the form of an ellipsoidal body.
6. In an exhaust system as defined in claim 1 wherein said continuous uninterrupted planar surface portion is positioned transversely of a longitudinal axis of said exhaust conduit for dissipating the kinetic energy from the high velocity exhaust stream.
7. In an exhaust system as defined in claim 1 wherein said deflector means includes a planar surface portion positioned transversely of a longitudinal axis of said exhaust conduit and tapered side wall portions extending away from said planar surface for redistributing the flow of gases within said larger diameter conduit.

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