Title: AIR CLEANER BOX ASSEMBLY

Abstract: An improved air cleaner box assembly (10) for an automobile is disclosed. The assembly uses a series of tubes in the face of the box to ensure adequate air flow to the engine of the automobile while simultaneously maintaining satisfactory acoustic properties.
BACKGROUND OF THE INVENTION

This invention replaces a traditional inlet snorkel to an automotive air cleaner box with an array of tubes that perforate the air box housing.

Current automotive air cleaner boxes typically use a single inlet with a bell-shaped mouth. Attached to the mouth is a snorkel, which runs to a location within the engine compartment of the vehicle where sufficient air can be fed into it. The overall size and diameter of the snorkel are tuned to meet airflow and acoustic requirements. In general, a larger snorkel diameter allows greater airflow into the air cleaner box, but, at the same time, tends to generate more noise. In contrast, less noise is generated with a smaller snorkel diameter, but airflow may not be sufficient for proper operation of the automotive engine.

There are several disadvantages to the use of snorkels in air cleaner assemblies, including the amount of materials and space used. Another disadvantage is that the open end of the snorkel must frequently be located in a position where ingestion of water or snow is a possibility.

One way in which sound abatement can be effected in these systems is to attach a resonant cavity to the snorkel. Systems using resonant cavities, however, generally use even more materials and space than those using a snorkel alone.

There are other systems that utilize dual inlets to meet specific system requirements. In these systems, one inlet remains open at all times while the
other inlet has an actuated flap that opens the second inlet during periods of high engine flow. These systems can be highly effective, but can add considerable cost and complexity to the system.

It has been suggested that the snorkel assembly may be replaced with a perforated wall in the air cleaner housing. Although perforated-wall systems typically use less material and space than snorkel systems, their acoustic properties are still limited.

What is needed is an air cleaner box assembly that provides favorable acoustic performance in the automobile, while eliminating unnecessary design complexity and use of space and materials.

SUMMARY OF THE INVENTION

One object of the invention is to provide an automotive air cleaner box assembly that allows for broadband noise reduction while maintaining adequate air flow into the engine of the automobile.

Another object of the invention is to reduce the amount of engine compartment space required by the air cleaner box assembly.

A further object of the invention is to reduce the number of discrete components needed for the air cleaner box assembly.

A still further object of the invention is to reduce the weight of the components used by the air cleaner box assembly.

These objects may be accomplished by placing an array of inlet tubes on a face of the box. The length, number, and location of these tubes may be adjusted to provide the desired acoustic and airflow properties. The ability to modify the
length of the tubes provides an increased ability to tune the acoustic performance of the assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a known automotive air cleaner box assembly.

FIG. 2 illustrates a suggested modification to a known automotive air cleaner box assembly.

FIG. 3 illustrates a different view of a suggested modification to a known automotive air cleaner box assembly.

FIG. 4 illustrates a face plate for an air cleaner box assembly constructed in accordance with an embodiment of the invention.

FIG. 5 illustrates a side view for the face plate in FIG. 4.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a known automotive air cleaner box assembly 10, including air cleaner box 20, snorkel 30, and resonator 40. In this configuration, air enters the opening 31 of snorkel 30, and then travels through the snorkel through an opening (not shown), typically shape of a bell mouth, in the face of the air cleaner box 20. The air then passes through a filter medium (not shown), and the filtered air then travels out of the air cleaner box 20 via an outlet tube 50 and into the engine of the automobile (not shown). The resonator 40 is typically configured to help achieve desired acoustical properties for the automobile. Depending on where in engine compartment the opening of the
snorkel 31 is located, it is susceptible to being infiltrated with water, ice, snow, or road debris.

FIGS. 2 and 3 illustrate a suggested modification to a known automotive air cleaner box assembly 110. The assembly 110 includes an air cleaner box 120, having an array of holes 122 on a face of the box 124. Air to be used in the combustion process in the engine enters the air cleaner box 120 through the holes 122 on the face 124 of the box 120. The air then passes through a filter medium of any suitable type (not shown) in order to remove impurities from the air. The filtered air then travels out of the air cleaner box 120 via an outlet tube 150 and into the engine of the automobile (not shown). Although a configuration of the sort illustrated in FIGS. 2 and 3 may use less material than the configuration shown in FIG. 1, the ability to adjust acoustic properties is still somewhat limited.

FIG. 4 illustrates an embodiment of the present invention. In this figure, a face 224 of an automotive air cleaner box (not shown) uses an array of tubes 222, rather than holes. The number, location, and length of the tubes 222 may be modified to provide enhanced acoustical features for the air cleaner box.

FIG. 5 illustrates a side view of FIG. 4. As can be seen in this figure, the tubes 222 extend beyond the back side 228 of face 224. It is understood that the number and arrangement of tubes 222 may be of any suitable configuration. It is also understood that the tubes 222 may be of any suitable length and may, in fact, be of different lengths from one another. It is further understood that the tubes 222 may extend beyond the front side of face 224 or beyond both the front and back sides of face 224. It is still further understood that face 224 may be of
any suitable thickness in order to provide desired features of the air cleaner box assembly, such as weight and strength. One of skill in the art will readily recognize that the above-listed parameters may be adjusted in order to provide the desired air-flow and acoustic properties for the air cleaner box and that these parameters will differ based on the particular automotive application.

The foregoing disclosure has been set forth merely to illustrate the invention and is not intended to be limiting. Since modifications of the disclosed embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and equivalents thereof.
CLAIMS

1. A vehicle air cleaner box assembly comprising: an air cleaner box; an outlet tube connected to said air cleaner box! and hardware for mounting said air cleaner box to said vehicle! wherein said air cleaner box has a face with a plurality of tubes through which air enters said air cleaner box.

2. The assembly of claim 1, further comprising a filter medium for use in said air cleaner box.

3. An air cleaner box for a vehicle comprising: an inlet through which air enters said box! and an outlet through which air exits said box! wherein said inlet is formed from a plurality of tubes.

4. The box of claim 3, wherein a number of said plurality of tubes is adjusted based on one or more desired acoustic properties.

5. The box of claim 4, wherein locations of said plurality of tubes are adjusted based on said one or more desired acoustic properties.

6. An air cleaner box for a vehicle comprising:

a face with a plurality of tubes through which air enters said air cleaner box.

7. The box of claim 6, wherein a number of said plurality of tubes is adjusted based on one or more desired acoustic properties.
8. The box of claim 7, wherein locations of said plurality of tubes is adjusted based on said one or more desired acoustic properties.

9. The box of claim 6, wherein one or more of said tubes extends beyond a back side of said face.

10. The box of claim 6, wherein one or more of said tubes extends beyond a front side of said face.

11. The box of claim 9, wherein at least one of said plurality of tubes is of a different length than a remainder of said plurality of tubes.

12. The box of claim 9, wherein said plurality of tubes are the same length.

13. The box of claim 8, wherein lengths of said plurality of tubes are adjusted based on said one or more desired acoustic properties.

14. The box of claim 13, wherein said one or more desired acoustic properties includes sound level.

15. The box of claim 13, wherein said one or more desired acoustic properties includes frequency response.
A. CLASSIFICATION OF SUBJECT MATTER
INV. F02M35/14
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)
F02M F02B

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
<td>X</td>
<td>JP 03 290052 A (NIPPON DENSO CO; TOYOTA MOTOR CORP) 19 December 1991 (1991-12-19) abstract; figures 4-8,10</td>
<td>1-15</td>
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<tr>
<td>X</td>
<td>US 2005/097702 A1 (NI ZUGEN [CN]) 12 May 2005 (2005-05-12) paragraph [0019] - paragraph [0022]; figures 1-4</td>
<td>1-3,6,9, 10, 12</td>
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<tr>
<td>X</td>
<td>DE 199 32 826 A1 (MANN &amp; HUMMEL FILTER [DE]) 25 January 2001 (2001-01-25) column 5, line 60 - column 7, line 14; figures 3-6</td>
<td>1-9, 12-15</td>
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search
23 October 2008

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31/10/2008

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<tr>
<td>X</td>
<td>JP 2004 044424 A (TOYODA GOSEI KK) 12 February 2004 (2004-02-12) abstract; figures 2,5,6</td>
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<td>JP 3290052</td>
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