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(54) **COMBINED ACTIVE NOISE CONTROL AND RESONATOR**

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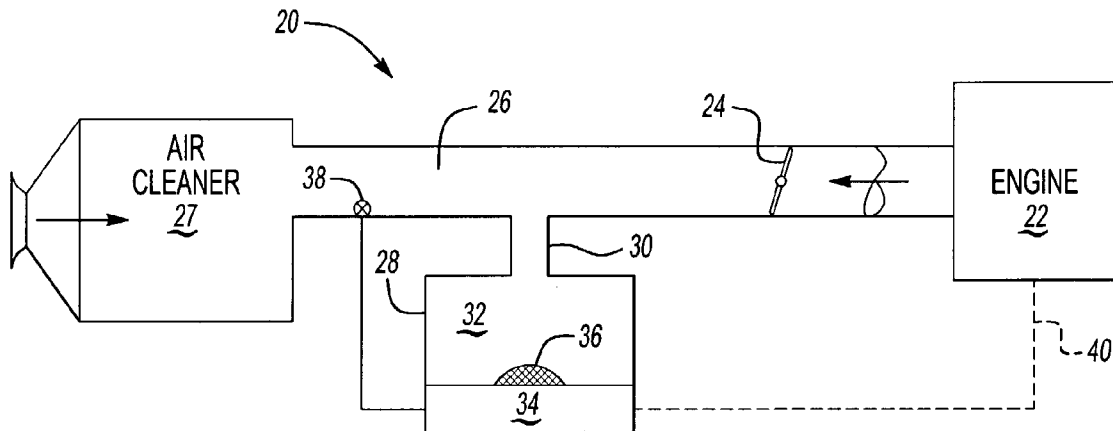
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(57) **ABSTRACT**

A vehicle air supply noise attenuation system utilizes both active and passive methods of noise attenuation. A helmholtz resonator communicates with an air supply duct, and is designed to attenuate a narrow band of noise. An active noise control system, including a speaker and an electronic controller, is mounted within the resonator volume and attenuates noise over a wider band of frequencies. The combination of the active and passive noise control attenuates noise over a wide band of frequencies without requiring an overly large speaker.



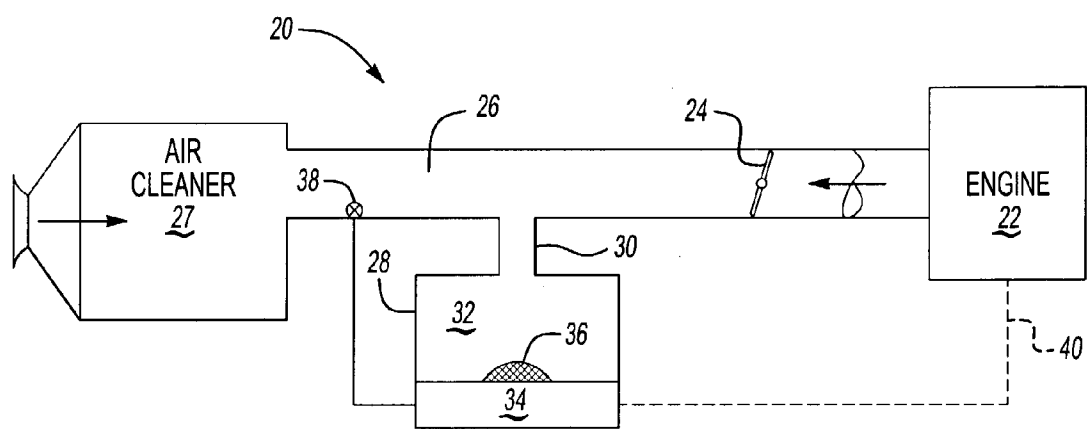


Fig-1

COMBINED ACTIVE NOISE CONTROL AND RESONATOR

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application Serial No. 60/367,020 filed on Mar. 22, 2002.

BACKGROUND OF THE INVENTION

[0002] This invention relates to a combination of an active noise control system for attenuating a wide range of frequencies, combined with a passive resonator designed to attenuate a narrow frequency band.

[0003] Noise control is becoming an increasingly important aspect of the design of vehicle engine components. In particular, an air supply system for supplying air to a vehicle engine also serves as a conduit to take noise from the engine back outwardly towards the inlet of the air supply system. This noise is undesirable. Thus, efforts have been made to attenuate engine noise during operation of the vehicle.

[0004] In general, there have been two types of efforts to attenuate the noise. A first "passive" type of noise attenuation utilizes resonators along the air supply duct. The resonators may include a helmholtz resonator which is a component with a narrow neck communicating with the supply duct and leading to an enlarged volume. A helmholtz resonator can be designed to attenuate a narrow band of frequencies from the undesired sound which is to be attenuated. That is, a helmholtz resonator can be designed to address the "worst" noise, but does not address all of the wide frequency of noise which would be desirably attenuated. Some vehicle applications would desirably have very large resonator volumes, which would be undesirable.

[0005] A second type of vehicle noise control is a so-called "active" noise control system. In an active noise control system, a speaker is driven to create a sound selected to attenuate, or cancel, the engine noise sounds at the present vehicle operating conditions. Active noise control may include a microphone for sensing the actual engine noise, or can utilize a reference source such as a look-up table that will include a desired attenuation for a particular vehicle operational characteristic.

[0006] As examples, the controller for the active noise system may sense the actual sound through a microphone and then determine what noise should be passed through the speaker to cancel the engine noise. Alternatively, the control might sense engine rpm, and the look-up table stores a particular predicted noise to be cancelled for the sensed rpm and the particular vehicle which includes the system.

[0007] Active noise control shows much promise. However, a vehicle having a relatively greater amount of noise in a narrow frequency band might require a very large speaker to cancel a wide band of frequencies. That is, since the bulk of the noise is in a narrow band of frequencies, the speaker may be necessarily larger than would be desired since it must cancel the higher noise volume narrow band along with the lesser volume noises that occur across a wider band.

[0008] Of course complicating these issues is the fact that space is at a premium in the vehicle engine compartment, and the large speaker is expensive both in cost and in required space.

SUMMARY OF THE INVENTION

[0009] In the disclosed embodiment of this invention, both passive and active noise control are combined into a single system. In particular, a helmholtz resonator is placed along a duct leading from an air cleaner to the inlet manifold. The helmholtz resonator is designed to attenuate a narrow band of noise which is particularly problematic. That is, the vehicle designer will select the particular narrow band that is to be attenuated and which may present the "worst" problem. The resonator, if designed properly, will attenuate this narrow band with good success. The know-how, etc. to design such a helmholtz resonator is within the skill of a worker in this art.

[0010] At the same time, an active noise control system is utilized in combination with the helmholtz resonator. The active noise control includes a speaker that can be driven to attenuate a wider band of frequencies. Since the helmholtz resonator is already attenuating the noise problem in the narrow band, the speaker need not be sized to handle all of that volume. Instead, the speakers can be smaller and designed to address the lesser volume wider band noises.

[0011] In a most preferred embodiment of this invention, the speaker is mounted within the helmholtz resonator chamber. Thus, no additional space is required.

[0012] These and other features of the present invention can be best understood from the following specification and drawings, the following of which is a brief description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is a schematic view of an inventive system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] As shown in FIG. 1, a vehicle engine air supply system 20 incorporates the engine 22 receiving air through a throttle valve 24. Air flows through a duct 26 from an air cleaner 27.

[0015] A helmholtz resonator 28 is mounted on the duct 26. As is known, a narrow neck 30 communicates a larger volume chamber 32 to the duct 26. Also, a speaker 36 is preferably mounted within the chamber 32, and is driven by an electronic controller 34. Controller 34 is also preferably mounted adjacent to or within the resonator 28. A microphone 38 may be placed in the duct 26 to sense the noise that is to be cancelled. How the sensed noise is utilized by the controller 34 to select a particular drive for the speaker 36 is known generally in this art. As an alternative, the electronic controller could be provided with a look-up table and feedback of the rpm at the engine 22. The feedback is shown schematically at 40. The sensed rpm from the engine 22 can be tied to a particular drive for the speaker 36 from a look-up table. The look-up table is designed given the particular features of the vehicle incorporating the system 20 at various rpm. This portion of the invention is also as known. That is, the operation of the controller 34 to select how to drive the speaker is known generally in this art.

[0016] The present invention thus allows the designer of a vehicle air supply system to utilize both active and passive noise attenuation systems. As described above, a narrow band of noise which creates the greatest problem is selected

and the resonator **28** is designed to address this narrow band. Speaker **36** is intended to address a wider band of noise. Since the speaker **36** is mounted within the resonator, no additional space is necessary.

[0017] Although a preferred embodiment of this invention has been disclosed, a worker in this art would recognize that modifications would come within the scope of this invention. For that reason, the following claims should be studied to determine the true scope and content of this invention.

What is claimed is:

1. A vehicle air supply system comprising:
 - a duct for supplying air to a vehicle engine;
 - a resonator volume communicating with said duct, said resonator volume being designed to attenuate a noise emanating through said duct from a vehicle engine; and
 - an active noise control system including a controller and a speaker, said controller driving said speaker to attenuate engine noise over a wide band of frequencies.
2. A vehicle air supply system as recited in claim 1, wherein said speaker is mounted within said resonator volume.
3. An air supply system as set forth in claim 1, wherein said resonator is a helmholtz resonator having a narrow neck communicating said duct to an enlarged volume.
4. A vehicle air supply system comprising:
 - a duct for supplying air to a vehicle engine;
 - a resonator volume communicating with said duct, said resonator volume being designed to attenuate a noise emanating through said duct from a vehicle engine; and

an active noise control system including a controller and a speaker, said controller driving said speaker to attenuate engine noise over a wide band of frequencies, said duct communicating an air cleaner to said vehicle engine through a throttle.

5. A system as set forth in claim 4, wherein said helmholtz resonator is mounted between said air cleaner and said throttle body.

6. A vehicle air supply system as recited in claim 4, wherein said speaker is mounted within said resonator volume.

7. A vehicle air supply system comprising:

a duct for supplying air to a vehicle engine;

a helmholtz resonator having a narrow neck communicating said duct to an enlarged volume, said volume being designed to attenuate a noise passing through said duct from a vehicle engine;

an active noise control system including a controller and a speaker, said controller driving said speaker to attenuate engine noise over a wide band of frequencies;

said speaker being mounted within said resonator volume; and

an air cleaner mounted to provide air to said duct, and a throttle body, said resonator communicating with said duct intermediate said air cleaner and said throttle body.

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