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[54] **SOUND ATTENUATING STRUCTURE**
11 Claims, 4 Drawing Figs.
[52] **U.S. Cl.**..... **181/35,**
181/50, 181/62
[51] **Int. Cl.**..... **F01n 1/10,**
F01n 7/16
[50] **Field of Search**..... **181/33,**
33.22, 49, 50, 41, 42, 35, 62, 33.03, 71

ABSTRACT: A sound attenuating structure including an inner wall, and outer wall secured to the inner wall to define a confined space therebetween and a high density metallic material confined within the space between the walls. The material being liquid at the temperature of the noise source. At low operating temperatures mercury can be used and at high operating temperatures, lead or bismuth can be used as the metallic material.

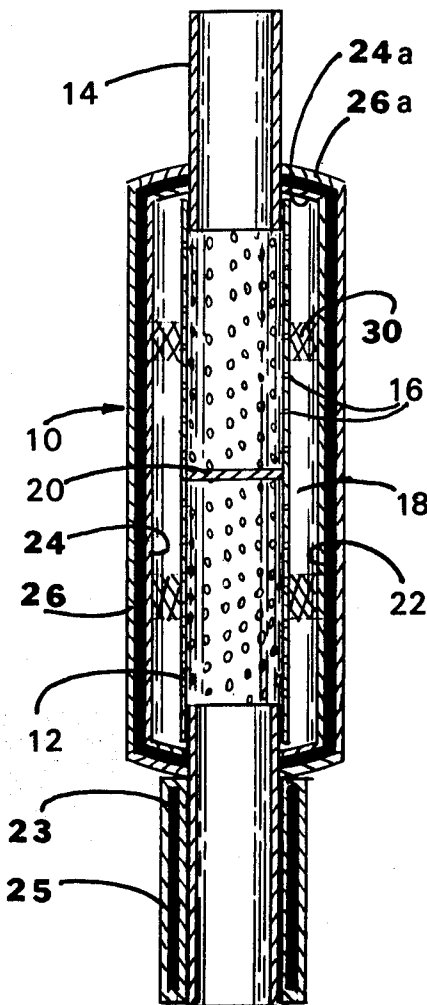


FIG 2

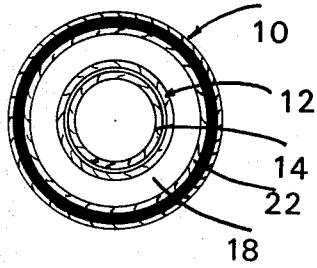


FIG 4

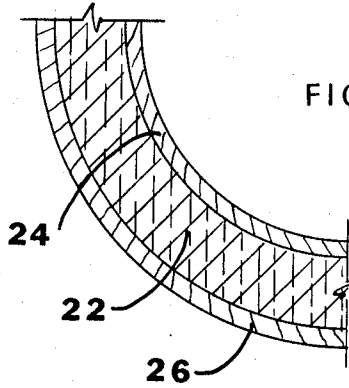


FIG 1

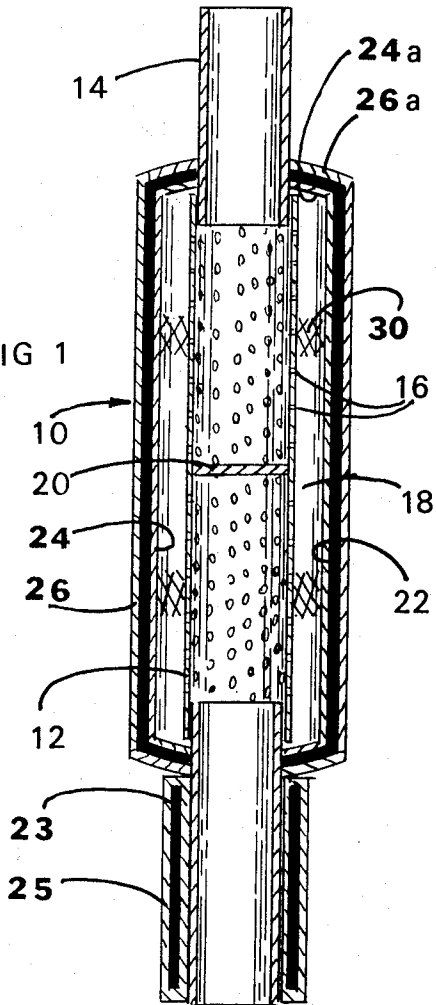
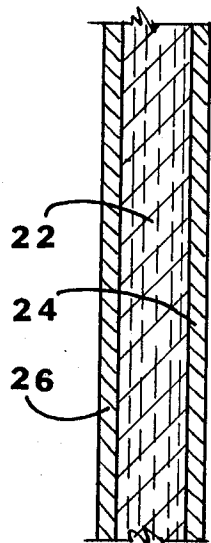


FIG 3



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SOUND ATTENUATING STRUCTURE

BACKGROUND OF THE INVENTION

Sound attenuation of noise transmitted through air is conventionally accomplished by either isolating the noise source or filtering the sound producing frequencies. In a typical muffler for an engine exhaust, a through tube is used to allow for the steady flow of exhaust gas without increasing the back pressure of the gas and sound attenuation is accomplished by absorbing the exhaust gas pressure pulses in a series of cavities connected to the through tube through small orifices or perforations. Porous packing is often placed within the cavities to increase the efficiency of noise suppression. Muffling of the noise is also increased by placing baffles in the flow path, however, these baffles tend to increase the back pressure of the gas.

Sound isolation is accomplished by introducing elastic discontinuities between the noise source and the structure transmitting the noise. Such discontinuities may take the form of felt, cork, rubber or springs in the mountings of the noise source. However, all of these attempts to suppress the noise have not produced an acceptable reduction in noise and standards have now been established by the U.S. government which must be met in order to reduce noise levels, particularly in industrial and automobile engines.

SUMMARY OF THE INVENTION

The sound attenuating structure disclosed herein provides a reduction in objectionable noises either by sound isolation or sound filtering. This is accomplished by using a liquid metallic material having a high density to absorb the noise by damping vibrations. The metallic material must be liquid at the operating temperature of the device to provide a limp structure which will not reradiate the noise vibrations. At low temperature operation, mercury can be used to provide effective sound attenuation and at high temperature operation, lead or bismuth can be used as the metallic material. These latter metallic materials have a density higher than 600 pounds per cubic foot and are liquid at temperatures above 500° F.

Other objects will become apparent from the following description when read in connection with the accompanying drawing.

DESCRIPTION OF THE DRAWING

FIG. 1 is a sectional view of a typical muffler having a casing formed of the sound attenuating structure of this invention;

FIG. 2 is taken on line 2-2 of FIG. 1 showing a cross section of the muffler casing;

FIG. 3 is an enlarged view of a portion of the sound attenuating structure; and

FIG. 4 is an enlarged view of a portion of the cross section of the structure shown in FIG. 2.

DESCRIPTION OF THE INVENTION

The sound attenuating structure 10 of this invention is shown as forming the outer wall of a conventional type muffler for the exhaust of an internal combustion engine. These mufflers generally include a through tube 12 connected in an engine exhaust pipe 14. The through tube 12 is provided with a number of perforations 16. The sound attenuating structure 10 forms the outer wall of the muffler and is spaced from the through tube 12 and is closed at each end to define a cavity 18 around the through tube 12. This 24a of muffler does not impede the flow of exhaust gas through the tube 12. The pulsating or alternating pulses of the exhaust gas will be transmitted through the perforations 16, into the cavity 18 where they are normally suppressed. A baffle 20 can be provided in the through tube to increase the sound attenuation characteristic of the muffler. However, the baffle will introduce an increase in back pressure, reducing the efficiency of the engine.

The vibrations normally set up in the casing of the muffler by the pulsating gases admitted into the cavity 18 are damped

by means of the attenuating structure 10 which includes a high density metallic material 22 completely surrounding the cavity 18. The liquid metallic material 22 is confined between an inner wall 24 and an outer wall 26. The inner wall 24 can be formed of a thin resilient material which is capable of withstanding the temperature of the exhaust gases and is closed at each end by an end wall 24a secured to the exhaust tube 14. A stainless steel foil can be used as the inner wall 24. If the inner wall is made of a thin material it should be supported on an expanded metallic mesh 30 to maintain the shape of the inner wall 24. As an alternate a perforate tube can be used in place of the metallic mesh to support the inner wall 24. The outer wall 26 is formed of a conventional steel material and is closed at each end by an end wall 26a secured to the exhaust tube 14.

In high temperature applications, materials which have been found satisfactory for providing sound attenuation are lead and bismuth which have densities of 700 pounds, and 612 pounds per cubic foot. Both of these materials will be liquid at temperatures above 500° F. In the preferred embodiment, lead has been used as the basic material. The melting temperature can be reduced by using lead alloys if required.

In devices where a low temperature is contemplated, mercury can be used as the liquid metallic material since it is liquid at normal temperatures and has a density of 800 pounds per cubic foot.

Although the structure has been shown in the disclosed embodiment as the casing for the muffler of an internal combustion engine, it is also within the contemplation of this invention to use the structure to isolate noises emanating from other sources. For example, a layer of lead 23 can be wrapped around the exhaust or entrance pipe 14 from the engine and confined within an outer shell 25. The vibrations induced in the exhaust pipe will then be damped by the liquid lead surrounding the exhaust pipe. It is also possible to provide layers of liquid metallic material within the housing of an internal combustion engine. The cavities in a housing cast as a water cooled engine can be filled with the liquid metallic material to isolate engine noises within the housing.

The particular physical characteristic which produces the sound attenuation is not known. However, it is believed that by backing the thin inner wall 24 with a high density liquid metallic material, that the material will damp the vibrations induced in the inner wall due to the inability of a liquid material to radiate the vibrations.

RESUME

The invention disclosed herein provides sound attenuation by using a liquid metallic material having a high density to damp the vibrations. The high density liquid material provides a limp sound shield which will not respond to the normal objectionable sound vibrations. Enclosing the liquid metallic material within a confined space provides a continuous shield around the entire muffler. It has also been found advantageous to use a thin resilient material as the inner wall.

I claim:

1. A sound attenuating muffler for an internal combustion engine, said muffler comprising an inner wall positioned to receive noise vibrations;

an outer wall spaced from said inner wall to define a closed cavity; and

a metallic material having a density of at least 500 pounds per cubic foot which is capable of becoming liquid at the operating temperature of the noise source confined in the space between said inner and outer walls.

2. The structure according to claim 1 wherein said material is selected from the group consisting of lead, bismuth, and mercury.

3. The structure according to claim 1 wherein said inner wall is in the form of a cylindrical tube and said outer wall is concentric with and spaced from said inner wall.

4. The structure according to claim 1 wherein said inner wall is formed from a stainless steel foil.

5. The structure according to claim 4 including means for supporting said inner wall.

6. The structure according to claim 5 wherein said supporting means comprises a metallic mesh.

7. A muffler for an internal combustion engine having an exhaust pipe, said muffler comprising:

a tube having a series of perforations connected to the exhaust pipe of the engine;

an inner shell concentric with said through tube and spaced therefrom to form a cavity around said perforate tube;

an outer shell spaced from said inner shell and forming a closed confined space therebetween; and

a metallic material confined within said space between said

inner and outer shell and which is liquid at the operating temperature of the exhaust gases.

8. An internal combustion engine muffler according to claim 7 wherein said inner shell is formed of stainless steel.

9. An internal combustion engine muffler according to claim 7 including means for supporting said inner wall.

10. An internal combustion engine muffler according to claim 9 wherein said supporting means comprises an expanded mesh to support said inner wall.

11. An internal combustion engine muffler according to claim 7 wherein said outer wall is spaced from said inner wall at least one-eighth of an inch.

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