

Sound Attenuator

The invention relates to a sound attenuator, particularly for application to surfaces defining a room area.

For the attenuation of acoustic rooms such as, for instance, sound studios, but wind tunnel systems too, sound attenuators are known for application to surfaces such as walls and ceilings defining a room area.

Hitherto, for sound attenuation complicated wedge structures comprising wedges approximately 60 to 120 cm long have been applied to the walls and ceilings of the rooms requiring sound attenuation. These wedges mainly consisting of foamed material protrude far into the room by roughly 1 m, depending on their length as dictated by the lengths of the sound waves.

Also known are flat-shaped sound attenuators which are also applied to the walls and ceilings of acoustic rooms. Such flat sound attenuators comprise a porous absorber and a Helmholtz resonator.

The invention is based on the object of providing a sound attenuator of the aforementioned kind which takes up little space in the depth of the room and has a sound attenuating effect over a wideband range of frequencies. In addition, it is intended to permit simple and low-cost manufacture thereof.

To achieve this object a sound attenuator in accordance with the invention is proposed, particularly for application to surfaces defining a room area, comprising a first attenuator element for low sound frequencies and a second attenuator element for high sound frequencies, said first attenuator element including a plate absorber disposed spaced away from a wall surface by a spacer

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element and said second spacer element including a porous absorber disposed on said plate absorber. Due to this configuration of a sound attenuator according to the invention voluminous wedge structures are avoided. The sound attenuator according to the invention is made up particularly simply of two attenuator elements, the first attenuator element serving the absorption of sound frequencies lower than 500 Hz. The second attenuator element disposed on the first attenuator element attenuates the higher sound frequencies by friction and other energy losses. The sound attenuator according to the invention features a compact design and particularly a smooth surface, thus minimizing wasted space. When employed in wind tunnel systems the flow losses caused by the wedge structures hitherto employed are reduced by the configuration according to the invention.

In accordance with the advantageous aspect of the invention as set forth in claim 2 the spacer element is configured frame-shaped and the plate absorber disposed on the spacer element encloses together with the wall or ceiling surface a cavity. Configuring the sound attenuator with a cavity facing the surface defining the room area results in a particularly good attenuation of low sound frequencies.

In accordance with a further aspect of the invention the plate absorber consists of a flexible material, thus resulting in the sound attenuation in the low frequency range being further improved.

In accordance with one advantageous aspect of the invention the plate absorber is a closed-cell film of plastics material, particularly a film of polyurethane.

In accordance with another particularly advantageous aspect of the invention the thickness of the plate absorber is between 20 μm and 200 μm , it being particularly advantageous

when the plate absorber has a thickness of between 25 μm and 50 μm .

In accordance with a further advantageous aspect of the invention the sound attenuator consists of foamed material, particularly of an open-cell expanded plastics material such as expanded polyurethane or melamine resin material.

In accordance with another aspect of the invention the thickness of the spacer element is approximately 100 mm.

One advantageous embodiment of the invention incorporates a side envelope being provided for the spacer element. Advantageously this envelope is of sheet metal.

In accordance with yet a further aspect of the invention the porous absorber consists of a foamed material, particularly of an open-cell expanded plastics material such as expanded polyurethane or melamine resin material.

In accordance with still a further particularly advantageous aspect of the invention a perforated film is provided on the surface of the porous absorber facing the sound. Due to such a film the absorption characteristics of the sound attenuator for high frequencies are not detrimented, it thereby being advantageous when the perforation surface area percentage of the perforated film is 20 to 80%, a perforation surface area percentage of 30 to 50% being particularly advantageous.

In accordance with yet a further aspect of the invention the porous absorber is essentially cuboidal and has a thickness of approximately 130 mm.

The invention will now be described and explained in more detail in the following by way of an example embodiment as shown in the drawings in which:

Fig. 1 is a schematic illustration not true-to-scale of a cross-section through a sound attenuator according to the invention disposed on a surface defining a room area, and

Fig. 2 is a bar chart representing the degree of sound absorption achieved by the sound attenuator according to the invention as a function of frequency.

Fig. 1 shows a sound attenuator 1 which is applied to a surface 6 (wall or ceiling) defining a room area. The sound attenuator 1 comprises two attenuator elements.

The first attenuator element for low sound frequencies comprises a frame-shaped spacer element 2 and a plate absorber 3 disposed on the spacer element 2. The spacer element 2 is applied to the surface 6 defining a room area for example by bonding. Due to the frame-shaped spacer element 2 and the plate absorber 3 disposed thereon (for example by bonding) a cavity 5 filled with air is enclosed by the surface 6 defining a room area. The spacer element 2 consists of a foamed material, particularly of an open-cell foamed material, such as for example expanded polyurethane or melamine resin material. The plate absorber 3 consists of a flexible material, preferably of a plastics film to advantage. By this aspect of the first attenuator element according to the invention sound frequencies below approximately 500 Hz are attenuated by the flexible spacer element 2 and the cavity 5 located on the side of the surface 6 defining a room area. As shown in the Figure, the spacer element 2 may be surrounded on the side by an envelope 7. Due to this envelope 7, which may be a thin strip of metal or sheet metal or the like, the absorption quality of the first attenuator element is further enhanced, and a definition is provided with respect to adjoining, further sound attenuators.

The second attenuator element of the sound attenuator 1 according to the invention is applied directly to the plate absorber 3, for example by bonding, and includes substantially a porous absorber 4 of foamed material, particularly of an open-cell expanded plastics material such as expanded polyurethane or melamine resin material. On its surface facing the sound the porous absorber 4 may comprise, as shown, a film 8 having perforations 9. The perforated surface area percentage of this perforated film 8 is 20 to 80%, a perforated surface area percentage of 30 to 50% having proved to be particularly advantageous.

In the second attenuator element of the sound attenuator according to the invention sound frequencies above 500 Hz are attenuated by friction and other energy losses in the porous absorber 4.

The thickness of the spacer element 2 is approximately 100 mm, that of the porous absorber 4 roughly 130 mm. Since the plastics film serving as the plate absorber 3 is only 200 μm at the most, preferably only 50 μm thick, the entire sound attenuator has a thickness of only roughly 230 mm. Thus, as compared to the component structures otherwise having a usual length of approx. 1 m, a significant gain in space-saving is achieved so that the acoustic rooms to be attenuated by being fitted with sound attenuators according to the invention offer more space or may be constructed smaller right from the start. An application of the sound attenuator according to the invention in wind tunnel systems is feasible since, due to the flat surface running parallel to the surface defining the room area, the flow losses are maintained low.

The sound attenuator according to the invention attenuates noise in a wideband range of frequencies in accordance with the results of a series of tests given in the following. In this series of tests the degree of sound absorption

according to DIN 52212 was determined. The thickness of the porous absorber 4 of Basotect was 130 mm, the thickness of the plate absorber 3 was 50 μm and the thickness of the enclosed cavity 5 was 100 mm. The test surface area was 9.8 m^2 , the bay involved had a volume of 210 m^3 . The degree of sound absorption α_s as a function of the frequency f in Hz was tested.

f in Hz	100	125	160	200	250	315
α_s	0.64	0.86	0.93	1.31	1.34	1.29

f in Hz	400	500	630	800	1000	1250
α_s	1.21	1.91	1.10	1.09	1.04	1.01

f in Hz	1600	2000	2500	3150	4000	5000
α_s	1.03	1.04	1.05	1.09	1.12	1.15

As evident from these test results the degree of sound absorption α_s is continuously greater than 1 over a wide frequency range of 200 Hz to 5000 Hz, it not being until below 180 Hz that the degree of sound absorption falls below 1. These results are illustrated graphically in the bar chart in Fig. 2 in which the frequency in Hz is entered on the abscissa and the the degree of sound absorption α_s on the ordinate.



Sound Attenuator

Claims

1. A sound attenuator, particularly for application to surfaces defining a room area, comprising a first attenuator element for low sound frequencies and a second attenuator element for high sound frequencies, said first attenuator element including a plate absorber (3) disposed spaced away from a surface (6) defining a room area by a spacer element (2) and said second attenuator element including a porous absorber (4) disposed on said plate absorber (3).
2. The sound attenuator as set forth in claim 1, characterized in that said spacer element (2) is configured frame-shaped and said plate absorber (3) disposed on said spacer element (2) encloses, together with said surface (6) defining a room area, a cavity (5).
3. The sound attenuator as set forth in claim 1 or 2, characterized in that said plate absorber (3) consists of a flexible material.
4. The sound attenuator as set forth in claim 3, characterized in that said plate absorber (3) is a closed-cell film of plastics material
5. The sound attenuator as set forth in claim 4, characterized in that said plastics film is a film of polyurethane.
6. The sound attenuator as set forth in any of the preceding claims, characterized in that the thickness of said plate absorber (3) is between 20 μm and 200 μm .
7. The sound attenuator as set forth in claim 6, characterized in that the thickness of said plate absorber (3) is between 25 μm and 50 μm .



8. The sound attenuator as set forth in any of the preceding claims, characterized in that said spacer element (2) consists of foamed material.
9. The sound attenuator as set forth in claim 8, characterized in that said spacer element (2) consists of an open-cell expanded plastics material, particularly of expanded polyurethane or melamine resin material.
10. The sound attenuator as set forth in any of the preceding claims, characterized in that the thickness of said spacer element (2) is roughly 100 mm.
11. The sound attenuator as set forth in any of the preceding claims, characterized in that an envelope (7) surrounding the sides of said spacer element (2) is provided.
12. The sound attenuator as set forth in claim 11, characterized in that said envelope (7) is made of sheet metal.
13. The sound attenuator as set forth in any of the preceding claims, characterized in that said porous absorber (4) consists of foamed material.
14. The sound attenuator as set forth in claim 13, characterized in that said porous absorber (4) consists of an open-cell expanded plastics material, particularly of expanded polyurethane or melamine resin material.
15. The sound attenuator as set forth in any of the preceding claims, characterized in that a perforated film (8) is provided on the surface of said porous absorber (4) facing the sound.



16. The sound attenuator as set forth in claim 15,
characterized in that the perforation surface area
percentage of said perforated film (8) is 20 to 80%
17. The sound attenuator as set forth in claim 16,
characterized in that the perforation surface area
percentage is 30 to 50%.
18. The sound attenuator as set forth in any of the preceding
claims, characterized in that said porous absorber (4) is
essentially cuboidal.
19. The sound attenuator as set forth in any of the preceding
claims, characterized in that the thickness of said porous
absorber (4) is approximately 130 mm.