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(54) **SOUND ABSORBENT**

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DISPOSITIF INSONORISANT

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Description

TECHNICAL FIELD

[0001] The present invention relates to an absorbent for a dissipative absorption of sound. In particular, the invention relates to a sound attenuator incorporating the absorbent and to a method for sound reduction in a system for transport of a gaseous medium. In a first application of the invention, such a transport system comprises a ventilation system. In a second application, the gas transport system comprises an exhaust gas system and in particular an exhaust gas system for an internal-combustion engine, for example in a ship. In both applications, the device and the method relate to a channel, from the wall or outlet of which noise is generated, which may be subjected to acoustic requirements. However, the invention is also advantageously applicable to other elongated gas transport systems, such as in exhaust gas plants in, for example, vehicles with internal-combustion engines or in flue-gas cleaning devices for plants for, for example, production of electric power.

BACKGROUND ART

[0002] By sound is meant a physical phenomenon which gives rise to hearing sensations. Usually, sound is regarded as a wave motion in a gaseous medium. Sound may, however, also be transported in other media, such as fluids and solid materials. In air, the sound propagates as a longitudinal wave motion at a velocity of about 340 m/s. However, the velocity is dependent on the temperature of the medium. The audible sound comprises frequencies from about 20 Hz to about 20,000 Hz. The wavelength of the audible sound in air with a normal temperature thus varies from the order of magnitude of 3 m at low frequencies (-100 Hz), 30 cm for sound at intermediate frequencies (-1000 Hz), and 3 cm for sound at high frequencies (-10,000 Hz). In addition, the sound may vary greatly with both amplitude (sound intensity) and time.

[0003] In a traditional absorbent, sound energy is transformed into heat by flow resistance of the absorbent. Such an absorbent substantially exhibits resistive attenuation. Other words for this are dissipative or viscous attenuation. The ratio of the thickness of the absorbent to the length of the sound waves which are included in the sound has proved to be decisive for the attenuation at lower frequencies in such a traditional absorbent. A satisfactory attenuation is attained at these absorbents for sound frequencies at which the thickness of the absorbent is larger than a quarter of a wavelength of the sound. The sound attenuating properties then decrease drastically for sound with lower frequencies, which has a larger wavelength. Even at a ratio of wavelength to absorbent thickness of about 1/8, the absorption is only half as great, and at a ratio of 1/16 it is only 20 % of the absorption which is obtained at a ratio of 1/4. Since a cer-

tain absorption capacity still remains, in many cases a satisfactory absorption may be obtained by increasing the surface of the total absorbent.

[0004] Well-known materials for the manufacture of a resistive absorbent are mineral wool and glass wool. Usually, the wool is retained by an adhesive which causes a homogeneous structure in the absorbent. Under normal conditions, such an absorbent is very good from several points of view. In environments with hygienic requirements, however, these absorbents are less suited since bacteria may develop in the absorbent or fibres may loosen. A common requirement in such hygienic environments is that an absorbent shall be capable of being flushed. In this context, the known absorbent has proved to be less resistant and may retain moisture for a long period of time. After repeated flushing, the absorbent is gradually dissolved. The known wool is built up of brittle fibres, in which case a less good mechanical strength is obtained in the absorbent. In case of heavy vibrations, the structure is decomposed in course of time.

[0005] A large number of porous absorbents are available on the market and their sound-absorbing properties are known by measurements. Usually, the porous absorbents are characterized by thickness and density.

One problem in the manufacture of circular attenuators for, for example, ventilation systems is that the absorbent, which is usually made flat, must be bent to fit into the attenuator. Depending on the original thickness of the absorbent, it will have a varying density in the circular design. On the inside of the sound attenuator, the density will be high and tendencies to folding will arise. On the outside, cracks will sometimes arise as a result of the hard bending.

[0006] In environments with high gas velocities, the known absorbent is also less good. A surface-wiping gas tears with it fibres and particles from the absorbent. Successively, these end up in channels and spaces where they have a negative influence on the environment. The torn-off particles also result in the absorbent being gradually worn down and, in the end, disappearing entirely. In these contexts, it is known to coat the absorbent with a more stable layer, for example of thin plastic or a perforated sheet. These coatings involve extra operations during manufacture and thereby tend to increase the cost.

[0007] For the purpose of reducing the sound emitted from, for example, the orifice of a ventilation system or an exhaust gas system, it is known to arrange one or more sound attenuators in the gas channel of the system. The designation sound attenuator here means a device which is capable of consuming sound energy. This may occur by transforming the sound energy into some other form of energy, such as, for example, heat.

[0008] In the following text, the designation resistive attenuator refers to a device which is capable of absorbing sound in a gas channel, that is, to transform the sound energy into another form of energy. The designation attenuator, in the following text, means a device which is

capable of reducing sound, and attenuation means the property of reducing sound.

[0009] One typical embodiment of a resistive attenuator is a circular or square tube, the sides of which, exposed to the gas flow, are coated with an absorbent or a porous medium of small coupled cavities. A common such sound attenuator intended for a ventilation system is described in the patent document GB 2,122,256. From the patent document US 2,826,261, another resistive attenuator intended for an exhaust system is previously known. As absorbent there is used a resistive absorbent of the type described above. The absorbent may also be protected by an air-permeable surface layer, for example a perforated sheet, to attain a longer service life and better mechanical stability at high gas speeds. Such a resistive attenuator will have a sound-attenuating property which covers a wide frequency range. The attenuation is also dependent on the thickness and flow resistance of the absorbent, the exposed absorbent surface, any surface protection such as, for example, a perforated sheet and the dimensions of the attenuator, such as the length and the diameter thereof.

[0010] One problem with the traditional resistive attenuator is thus that the absorbing layer must be made very thick to be able to attenuate low frequencies. This entails a large space for housing the attenuator. Another problem is that a traditional resistive sound attenuator gives rise to a pressure drop across the attenuator itself. This results in an increased resistance to driving the gas through the system. To compensate for this pressure increase, the cross-section area of the channels in the system is often increased. In that context, it is known that the absorption decreases in the upper frequency register of the sound. In certain cases, this is compensated for by arranging a sound absorbent in a central body in the sound attenuator. This again results in the pressure drop across the attenuator increasing. The sound-attenuating properties are also dependent on where in the system the sound attenuator is placed. It often turns out that the properties which are achieved in a laboratory, especially at low frequencies, and which are described in pamphlets, are seldom achieved in practice. This often leads to oversizing in order to attain a desired sound attenuation with sufficient certainty.

[0011] Another known way of reducing the sound emission from a gas transport system is to prevent the sound from propagating in the channel. This may be achieved by arranging a reflecting obstacle in the gas channel. Such an obstacle is obtained by creating a sound which is in opposition to the sound in the channel, thus achieving extinction. One such technique is active sound attenuation. In connection with active sound attenuation, a sound is added which is directed in a direction opposite to the sound progressing in a channel. This oppositely directed sound is then created by a loudspeaker placed in the channel. However, controllable conditions are required for an active system to function well.

[0012] Still another known way of reducing the sound

emission from a gas transport system is to arrange a passive obstacle to an acoustic wave progressing in a channel. This type of sound attenuator actually consumes no energy and is usually referred to as a reactive attenuator. A reactive attenuator substantially operates according to two principles. The first type is a reflection attenuator. This comprises an increase of the cross-section area, whereby the area increase gives rise to a reflection wave which propagates in a direction opposite to the propagation of the sound. The function is a broad-band function. The second type is a resonance attenuator. Here, the function is a narrow-band function and may almost be regarded as a filter which eliminates pure tones from the sound. To obtain maximum attenuating effect, the orifice of a resonance attenuator must be placed in a pressure maximum of the sound field in the channel. The resonance attenuator is thus very sensitive to the position in the channel.

[0013] There are also a large number of devices which in various ways combine the methods mentioned above. However, the problem is usually that the various components end up in locations where they are not effective. To compensate for the unforeseeable properties, conventional sound attenuator systems are therefore often greatly oversized, which leads to expensive, heavy and space-demanding plants with high pressure drops.

[0014] Sound attenuator devices in transport systems for gas, where the gas changes temperature, implies further complications since the wavelength of the sound is changed with the temperature. If, for example, the temperature of the gas is increased from 20°C to 900°C, the sound velocity and hence the wavelength increase two-fold. An attenuator which operates well at normal temperature therefore suffers deteriorated properties, especially at low frequencies when the gas is heated. This usually results in sound attenuating devices in transport systems with hot gases becoming very bulky.

SUMMARY OF THE INVENTION

[0015] The object of the present invention is to suggest ways and means of achieving an absorbent which has good absorbing properties within a wide frequency range and which is inexpensive to manufacture. It shall be less space-demanding than prior art absorbents and be applicable to environments involving hygienic requirements. Thus, the absorbent shall be capable of being flushed and shall not release torn-off particles. From a first aspect of the invention, an absorbent for hygienic spaces is referred to. From a second aspect of the invention, a transport system for gas comprising a plurality of channel sections such as sound attenuators, in which the absorbent is included, is referred to. In such a transport system, the absorbent shall offer an efficient sound attenuation without significantly increasing the pressure increase in the channel system. The transport system shall be simpler, less space-demanding, have a small cross-section area and be less expensive to manufacture

than corresponding systems designed according to the prior art. The system shall have a smaller weight and exhibit a smaller pressure drop and less generation of aerodynamic sound than conventional systems. In particular, these properties should be maintained also at high transport speeds of the gas and at different temperatures of the gas. Especially at high velocities, the system shall involve no environmental effect or health hazard, such as emission of torn-off fibres and the like. The absorbent included in the system shall be bendable and rotatable and hence be able to be arranged as a guide vane. The system shall also be simple to maintain and comprise replaceable parts.

[0016] This is achieved according to the invention by an absorbent with the features of claim 1, by a transport system, designed for a gaseous medium, with the features of claim 8, and by a method with the features of claims 14 and 16, respectively. Advantageous embodiments are described in the dependent claims associated with the respective independent claims.

[0017] Sound propagates in a gas as a translatory movement, whereby gas particles alternately become dense and tenuous. This results in relative pressure maxima and pressure minima. It is these relative changes in pressure which are measured with a microphone or perceived by the ear. When a sound source is brought to sound in a room, a sound field arises, which is caused by the acoustic boundary conditions which characterize the room. These are, for example, the geometry of the room and the absorption properties of the surfaces. It may be said that the room gives a response to the sound source. The sound field is built up of vibrating gas particles which in certain positions move very vigorously whereas in other positions they move very little, or are even stationary. In those positions where the particles are stationary, the relative air pressure is high, and in those positions where the velocity of the particles is great, the relative air pressure is low. For each sound frequency, a pattern arises which is more or less accentuated depending on the boundary conditions of the room and how strong sound the source generates at that very frequency. In the following text, the above-mentioned pressure minima are referred to as nodes.

[0018] A decisive property of a sound absorbent is the flow resistance through the absorbent. Usually, this is determined by the specific flow resistance which is the pressure difference across the absorbent divided by the product of the speed of the penetrating gas and the thickness of the absorbent. Determining the static flow resistance is simple. At a dynamic state, the absorbent is also subjected to an oscillating movement of the gas particles. Besides resulting in the purely resistive resistance, this superimposed movement also results in a reactive resistance, which increases with the frequency. This is due to the fact that small gas inclusions, mass plugs, are formed and are brought to oscillate in the absorbent. The dynamic flow resistance is thus dependent on one resistive part and one reactive part. The resistive flow resist-

ance may be represented by a curve which substantially has the same flow resistance across the whole frequency range whereas the reactive flow resistance is represented by a curve which increases with the frequency. At a certain frequency, the reactive curve intersects the resistive curve. Below this frequency, the flow resistance is constant and above this frequency, the reactive flow resistance dominates and thus increases with the frequency.

[0019] When a sound reaches an absorbent, it penetrates into the absorbent and is subjected to a resistance which causes the sound to lose part of its energy. If the absorbent is soft, that is, exhibits little resistance, the sound passes relatively unobstructedly. If, however, the absorbent is hard, that is, exhibits great resistance, the sound rebounds. At such a reflection, the sound only loses a small part of its energy. It is thus a question of finding an absorbent which offers sufficiently great resistance but not so much that the sound is, for the most part, reflected.

[0020] By multiplying the specific flow resistance by the absorbent thickness and dividing it by the product of the density of the gas and the sound velocity in the gas, a normalized flow resistance is obtained. Experiments have shown that the normalized flow resistance for a good absorbent should lie between 1 and 2. If the flow resistance is greater than 2, part of the sound is reflected, which part is thus not subjected to any absorption. If the flow resistance is smaller than 1, the greater part of the sound passes through the absorbent, whereby only a minor part of the sound is subjected to absorption. It is thus an overriding object of the invention to manufacture an absorbent which, over a wide frequency range, has a normalized flow resistance of between one half and two. It is especially suitable for the flow resistance to be between one and two.

[0021] According to the first aspect of the invention, the present task is solved by an absorbent with a purely resistive resistance within these stated limits. According to the invention, these properties are exhibited by an absorbent which is manufactured by packed long threads of fibres of plastic, such as, for example, polyester. Such an absorbent is suitably manufactured as a mat and only has to be a few millimetres thick for the normalized flow resistance to be between 1 and 2. The long fibres cannot be torn off at high gas velocities and are smooth on the surface, so that no particles accompany the gas flow. The threads are not brittle but elastic, which provides for a durable and formable absorbent. In the event of fire, only carbon dioxide and water are formed from a polyester, so all in all this absorbent is environmentally friendly. The inventive absorbent is advantageously manufactured as a light, bendable mat.

[0022] In an advantageous embodiment, the absorbent is manufactured from a polyester wool, which is first compressed into a thin mat and is then secured into the compressed shape. This is suitably performed by heating, whereby the treads in the wool are welded together.

In this embodiment, it is suitable to shape the thin mat in accordance with the application into which it is to be inserted. The mat is suitably shaped plane, curved, bent or twisted. In an advantageous embodiment, the absorbent is arranged with a thin, covering film, which prevents particles or bacteria from penetrating into the absorbent. In an advantageous embodiment, the film is fixed to the absorbent by welding. Advantageously, the film is then fixed to the absorbent in a line or diamond pattern.

[0023] According to the second aspect of the invention, the present task is solved by a channel for transport of a gas, in which channel a thin absorbent is inserted, the normalized flow resistance of which is greater than one and smaller than two. The absorbent comprises a thin mat of long threads of a material which is resistant to deformation, such as plastic. The inventive concept also comprises threads formed of other solid materials, such as, for example, metal. The thickness of the absorbent should be smaller than about 5 % of the cross-section area of the channel. Such a small limitation of the channel area only entails a minor pressure increase. In an advantageous embodiment, the mat is reinforced with a net of, for example, metal. In another advantageous embodiment, the absorbent is arranged elongated and penetrates through a greater part of the channel system. In a further advantageous embodiment, the absorbent is shaped as a guide vane, for example at bends and descents in the channel system.

[0024] In still another advantageous embodiment, the absorbent according to the invention is also adapted to be placed in a resistive attenuator. In yet another advantageous embodiment, such an attenuator is arranged in combination with one or more reactive attenuators. In this embodiment, the sound field in the channel may be locally controlled and optimized attenuating properties be obtained.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The invention will be explained in greater detail by description of embodiments with reference to the accompanying drawings, wherein

Figure 1 shows the specific flow resistance versus the frequency of an absorbent according to the invention,

Figure 2 shows a cross section of an absorbent according to the invention,

Figure 3 shows the absorption versus the frequency of a few embodiments of an absorbent according to the present invention,

Figure 4 shows a cross section in the longitudinal direction of part of a system for transport of a gaseous medium according to the invention, and

Figure 5 shows alternative cross section shapes of part of a system for transport of a gaseous medium according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0026] The dynamic flow resistance, as previously mentioned, has one resistive part and one reactive part. The resistive part of the resistance is a viscous attenuation which is independent of the frequency of the sound. The reactive part is mass-dependent and exhibits a resistance which increases with the frequency. For the majority of known absorbents, the reactive resistance dominates in the frequency range of interest, that is, the frequency range where a good absorption is desired. For these absorbents, it is thus the frequency-dependent reactive flow resistance which determines the absorption properties. Since the absorption decreases with increased flow resistance, the absorption in the frequency range of interest decreases. Experiments have shown that a majority of known porous absorbents have a great reactive resistance in the frequency range where absorption is desired. The known absorbents thus do not fulfil the condition that the normalized flow resistance is limited between one and two within a wide frequency range.

[0027] Figure 1 shows the specific flow resistance versus the frequency of a porous absorbent. In the diagram, the resistive flow resistance is designated z_{res} and the reactive flow resistance is designated z_{mass} . At lower frequencies, the resistive flow resistance predominates. At higher frequencies, the reactive flow resistance predominates. This implies that it is very difficult to correctly balance an absorbent which has good absorption properties within a wide frequency range. In known absorbents, the transition from a resistive to a reactive flow resistance normally takes place below or within the frequency range f_{intr} where a good absorption is desired.

[0028] A porous absorbent may be regarded as a large number of interconnected channels with a characteristic length and a characteristic diameter. These channels run in all directions in the absorbent and their characteristic is influenced by the density, thickness and fibrous structure of the absorbent. The resistive flow resistance is proportional to the viscosity of the gas and inversely proportional to the characteristic diameter squared. The reactive flow resistance is instead proportional to the frequency, the characteristic length and the density of the gas. When manufacturing an absorbent with good properties within the frequency range of interest, the resistive flow resistance must thus be increased according to arrow A in Figure 1, the reactive resistance be reduced according to arrow B, and the resistive flow resistance be limited between one half and two, advantageously between one and two.

[0029] An absorbent with the desired properties is obtained according to the invention from a wool which is compressed and secured in its compressed shape. The material may be plastic, metal or the like. Preferably, the

wool is a polyester which is secured in its compressed shape by welding or fusing the wool threads together. In an advantageous embodiment, the wool is pressed between two gas-permeable, stiff layers, such as, for example, perforated sheet. In a cylindrical embodiment, the wool is arranged on an inner stiff, perforated sheet and is compressed by an outer perforated sheet with an adjustable diameter. The properties of the absorbent thus manufactured are adjustable and optimizable for a desired purpose.

[0030] When heating a gas, the gas particles move away from each other while at the same time the thermal movement increases, whereby the density decreases and the viscosity increases. This results in an increase of the resistive part of the flow resistance and a decrease of the reactive part. In the diagram of Figure 1, this is represented by the arrows A and B. An absorbent which, at normal temperature, has less good absorption properties will thus receive much better properties at higher temperatures. One absorbent which has this property is perforated sheet. Such an absorbent is suitably manufactured from a sheet with a thickness of 1 mm or less, with a degree of perforation which is less than 10 % and with holes which are about 1 mm or less. For a normal temperature, the holes would need to be smaller than one-tenth of a millimetre. Such a perforated sheet is difficult and costly to manufacture.

[0031] Figure 2 shows a typical absorbent according to the invention. It consists of a thin mat 1 of long elastic fibres, which cross each other in all directions in an irregular pattern. In the shown example, the threads are manufactured of a plastic such as, for example, polyester. An advantage of this material is that, in case of fire, it is decomposed into water and carbon dioxide. However, other materials of elongated bendable threads or fibres are also possible. The figure also shows an advantageous embodiment of the absorbent in which a thin foil 2 is attached as protection in front of the thin mat. In the shown example, the foil is fused to the mat in a line pattern 3. The foil primarily consists of a polyethylene film but may also be another plastic material or a metal foil.

[0032] Figure 3 shows the influence of a covering foil on the absorbent. Depending on the thickness or weight of the foil, an absorption - decreasing with the frequency - is obtained at high frequencies. The figure shows a typical basic absorption of a porous absorbent and the effect of three different thicknesses, 5, 10 and 20 μm , of such a foil. It should be mentioned in this context that the foil, across the greater part of the absorbent surface, should lie loosely adjacent to the mat. In the shown case, this problem is solved in that the foil is fixed to the mat in lines only. In the case of direct contact, such as by gluing or if the foil is pressed against the absorbent of, for example, perforated sheet, the absorption is deteriorated at high frequencies. A foil prevents particles from penetrating into the absorbent. It is thus suitable for use in environments involving environmental requirements. The foil-clad absorbent will also have better long-term

properties since particles do not penetrate into and stop up the porous channels.

[0033] Figures 4 and 5 show a transport system designed for a gaseous medium with a first 4, a second 5 and a third 6 channel section containing an absorbent 1 according to the invention. Since the absorbent is thin, it has very little influence on the cross-section area and thus gives rise to an extremely small pressure drop across the channel section. Because of its plasticity, the absorbent is suited to be arranged as a guide vane in the system, as shown in the example. The length of the absorbent is not, as in known sound attenuators, limited to the length of the attenuator itself but may be arranged optionally along the channel system. Figure 5 shows a few examples of how the absorbent is intended to be arranged in the transverse direction of the channel. In the channel 7, which may be of optional shape, the absorbent 1 is arranged in a laminated pattern 8, in a cross pattern 9, and in a circular pattern 10. Other shapes are also possible within the scope of the invention.

[0034] The absorbent according to the invention is exceedingly suited to be arranged as a resistive attenuator together with a reflection or reaction attenuator in a channel system. By suitably dimensioning the properties of such attenuators, a very efficient attenuation may be obtained over a frequency interval such as, for example, a third octave band.

[0035] Although advantageous, the channel system is not limited to comprise a channel system with a circular-cylindrical cross section. The invention may, with an equivalent result, be applied to systems with a multi-edge cross section as well as to systems with longitudinally bent sections.

Claims

1. A sound absorbent for hygienic spaces comprising a single layer porous mat, **characterized in that** the normalized flow resistance of the mat is in the interval of 0.5-2.
2. A sound absorbent according to claim 1, **characterized in that** the mat comprises a plurality of long threads compressed into a thin sheet.
3. A sound absorbent according to claim 2, **characterized in that** the threads are manufactured from a plastic material.
4. A sound absorbent according to claim 3, **characterized in that** the plastic material is a polyester.
5. A sound absorbent according to any of the preceding claims, **characterized in that** the sheet is reinforced by a net of a shape-permanent material.
6. A sound absorbent according to any of the preceding

claims, **characterized in that** the absorbent comprises a foil making free contact with the mat.

7. A sound absorbent according to claim 1, **characterized in that** the absorbent comprises a perforated sheet when it is used at high gas temperatures. 5
8. A transport system for a gaseous medium comprising a plurality of channel sections, whereby at least a first channel section comprises an absorbent having a single layer porous mat, **characterized in that** the mat is thin and its normalized flow resistance is in the interval of 0.5-2. 10
9. A transport system according to claim 8, **characterized in that** the cross-sectional area of the absorbent is smaller than 5% of the cross-sectional area of the channel section. 15
10. A transport system according to claim 8, **characterized in that** absorbent comprises a mat of compressed long threads of polyester. 20
11. A transport system according to any of claims 8-10, **characterized in that** absorbent is reinforced by a net of a shape-permanent material. 25
12. A transport system according to any of claims 8-11, **characterized in that** absorbent is placed at a distance along the walls of the channel. 30
13. A transport system according to any of claims 8-12, **characterized in that** absorbent forms guide vanes in the channel section. 35
14. A method for manufacturing an absorbent for hygienic spaces comprising a single layer porous mat, **characterized by** arranging the normalized flow resistance of the mat in the interval of 1-2. 40
15. A method according to claim 14, **characterized by** arranging the single layer mat from a plurality of long threads which are compressed into a thin sheet. 45
16. A method for manufacturing a single layer absorbent comprising a plurality of channels with a characteristic diameter influencing a resistive part of the normalized flow resistance and a characteristic length influencing a reactive part of the normalized flow resistance, **characterized by** compressing plurality of long threads into a single layer thin sheet having the resistive part of the normalized flow resistance within the interval of 0.5 to 2 and the reactive part of the normalized flow resistance limited by the resistive part. 50
17. Use of an absorbent according to claim 1 comprising a single layer porous mat having normalized flow 55

resistance of the mat in the interval of 0.5-2 in a ventilation plant.

18. Use of a transport system according to claim 8 comprising a plurality of channel sections, whereby at least a first channel section comprises a single layer thin absorbent having normalized flow resistance is in the interval of 0.5-2 in a ventilation plant.

Patentansprüche

1. Schallabsorptionsmaterial für Hygieneräume mit einer einschichtigen porösen Matte, **dadurch gekennzeichnet, daß** der normierte Strömungswiderstand der Matte im Bereich von 0,5 bis 2 liegt.
2. Schallabsorptionsmaterial nach Anspruch 1, **dadurch gekennzeichnet, daß** die Matte mehrere lange Fäden aufweist, die zu einer dünnen Bahn verdichtet sind.
3. Schallabsorptionsmaterial nach Anspruch 2, **dadurch gekennzeichnet, daß** die Fäden aus einem Kunststoffmaterial hergestellt sind.
4. Schallabsorptionsmaterial nach Anspruch 3, **dadurch gekennzeichnet, daß** das Kunststoffmaterial ein Polyester ist.
5. Schallabsorptionsmaterial nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, daß** die Bahn durch ein Netz aus einem formbeständigen Material verstärkt ist.
6. Schallabsorptionsmaterial nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, daß** das Absorptionsmaterial eine Folie aufweist, die freien Kontakt mit der Matte herstellt.
7. Schallabsorptionsmaterial nach Anspruch 1, **dadurch gekennzeichnet, daß** das Absorptionsmaterial eine perforierte Bahn aufweist, wenn es bei hohen Gastemperaturen verwendet wird.
8. Transportsystem für ein gasförmiges Medium mit mehreren Kanalteilstücken, wobei mindestens ein erstes Kanalteilstück ein Absorptionsmaterial mit einer einschichtigen porösen Matte aufweist, **dadurch gekennzeichnet, daß** die Matte dünn ist und ihr normierter Strömungswiderstand im Bereich von 0,5 bis 2 liegt.
9. Transportsystem nach Anspruch 8, **dadurch gekennzeichnet, daß** die Querschnittfläche des Absorptionsmaterials unter 5 % der Querschnittfläche des Kanalteilstücks liegt.

10. Transportsystem nach Anspruch 8, **dadurch gekennzeichnet, daß** das Absorptionsmaterial eine Matte aus verdichteten langen Polyesterfäden aufweist.
11. Transportsystem nach einem der Ansprüche 8 bis 10, **dadurch gekennzeichnet, daß** das Absorptionsmaterial durch ein Netz aus einem formbeständigen Material verstärkt ist.
12. Transportsystem nach einem der Ansprüche 8 bis 11, **dadurch gekennzeichnet, daß** das Absorptionsmaterial in einem Abstand entlang den Wänden des Kanals plaziert ist.
13. Transportsystem nach einem der Ansprüche 8 bis 12, **dadurch gekennzeichnet, daß** das Absorptionsmaterial Leitschaukeln im Kanalteilstück bildet.
14. Verfahren zur Herstellung eines Absorptionsmaterials für Hygienräume mit einer einschichtigen porösen Matte, **gekennzeichnet durch** Einstellen des normierten Strömungswiderstands der Matte im Bereich von 1 bis 2.
15. Verfahren nach Anspruch 14, **gekennzeichnet durch** Ausbilden der einschichtigen Matte aus mehreren langen Fäden, die zu einer dünnen Bahn verdichtet werden.
16. Verfahren zur Herstellung eines einschichtigen Absorptionsmaterials mit mehreren Kanälen mit einem charakteristischen Durchmesser, der einen resistiven Teil des normierten Strömungswiderstands beeinflusst, und einer charakteristischen Länge, die einen reaktiven Teil des normierten Strömungswiderstands beeinflusst, **gekennzeichnet durch** Verdichten mehrerer langer Fäden zu einer einschichtigen dünnen Bahn, bei der der resistive Teil des normierten Strömungswiderstands im Bereich von 0,5 bis 2 liegt und der reaktive Teil des normierten Strömungswiderstands **durch** den resistiven Teil begrenzt ist.
17. Verwendung eines Absorptionsmaterials nach Anspruch 1 mit einer einschichtigen porösen Matte, die einen normierten Strömungswiderstand der Matte im Bereich von 0,5 bis 2 hat, in einer Lüftungsanlage.
18. Verwendung eines Transportsystems nach Anspruch 8 mit mehreren Kanalteilstücken, wobei mindestens ein erstes Kanalteilstück ein einschichtiges dünnes Absorptionsmaterial mit einem normierten Strömungswiderstand im Bereich von 0,5 bis 2 aufweist, in einer Lüftungsanlage.

Revendications

1. Dispositif d'insonorisation destiné à des espaces sanitaires comprenant un tapis poreux monocouche, **caractérisé en ce que** la résistance à l'écoulement normalisée du tapis est de l'ordre de 0,5 à 2.
2. Dispositif d'insonorisation selon la revendication 1, **caractérisé en ce que** le tapis comprend une pluralité de fils longs comprimés dans une feuille fine.
3. Dispositif d'insonorisation selon la revendication 2, **caractérisé en ce que** les fils sont fabriqués à partir d'une matière plastique.
4. Dispositif d'insonorisation selon la revendication 3, **caractérisé en ce que** la matière plastique est un polyester.
5. Dispositif d'insonorisation selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la feuille est renforcée par un filet d'un matériau à forme permanente.
6. Dispositif d'insonorisation selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le dispositif d'insonorisation comprend une feuille en contact libre avec le tapis.
7. Dispositif d'insonorisation selon la revendication 1, **caractérisé en ce que** le dispositif d'insonorisation comprend une feuille perforée lorsqu'il est utilisé à des températures élevées de gaz.
8. Système de transport pour un milieu gazeux comprenant plusieurs sections de canal, moyennant quoi au moins une première section de canal comprend un dispositif d'insonorisation ayant un tapis poreux monocouche, **caractérisé en ce que** le tapis est fin et sa résistance à l'écoulement normalisée est de l'ordre de 0,5 à 2.
9. Système de transport selon la revendication 8, **caractérisé en ce que** la surface transversale du dispositif d'insonorisation est inférieure à 5% de la surface transversale de la section de canal.
10. Système de transport selon la revendication 8, **caractérisé en ce que** le dispositif d'insonorisation comprend un tapis de fils longs comprimés en polyester.
11. Système de transport selon l'une quelconque des revendications 8 à 10, **caractérisé en ce que** le dispositif d'insonorisation est renforcé par un filet en matériau à forme permanente.
12. Système de transport selon l'une quelconque des

revendications 8 à 11, **caractérisé en ce que** le dispositif d'insonorisation est placé à une certaine distance le long des parois du canal.

13. Système de transport selon l'une quelconque des revendications 8 à 12, **caractérisé en ce que** le dispositif d'insonorisation forme des aubes de guidage dans la section de canal. 5

14. Procédé de fabrication d'un dispositif d'insonorisation destiné à des espaces sanitaires comprenant un tapis poreux monocouche, **caractérisé en ce qu'il** comprend l'étape consistant à agencer la résistance à l'écoulement normalisée du tapis à un intervalle de 1 - 2. 10
15

15. Procédé selon la revendication 14, **caractérisé par** l'étape consistant à agencer le tapis monocouche à partir d'une pluralité de fils longs qui sont comprimés dans une feuille fine. 20

16. Procédé de fabrication d'un dispositif d'insonorisation monocouche comprenant une pluralité de canaux avec un diamètre caractéristique qui influence une partie résistive de la résistance à l'écoulement normalisée et une longueur caractéristique qui influence une partie réactive de la résistance à l'écoulement normalisée, **caractérisé par** l'étape consistant à comprimer la pluralité de fils longs dans une feuille fine monocouche ayant la partie résistive de la résistance à l'écoulement normalisée dans les limites d'un intervalle de 0,5 à 2 et la partie réactive de la résistance à l'écoulement normalisée limitée par la partie résistive. 25
30
35

17. Utilisation d'un dispositif d'insonorisation selon la revendication 1 comprenant un tapis poreux monocouche ayant la résistance à l'écoulement normalisée du tapis dans l'intervalle de 0,5 à 2 dans une installation de ventilation. 40

18. Utilisation d'un système de transport selon la revendication 8, comprenant une pluralité de sections de canal, moyennant quoi au moins une première section de canal comprend un dispositif d'insonorisation fin monocouche ayant la résistance à l'écoulement normalisée qui est dans l'intervalle de 0,5 à 2 dans une installation de ventilation. 45
50
55

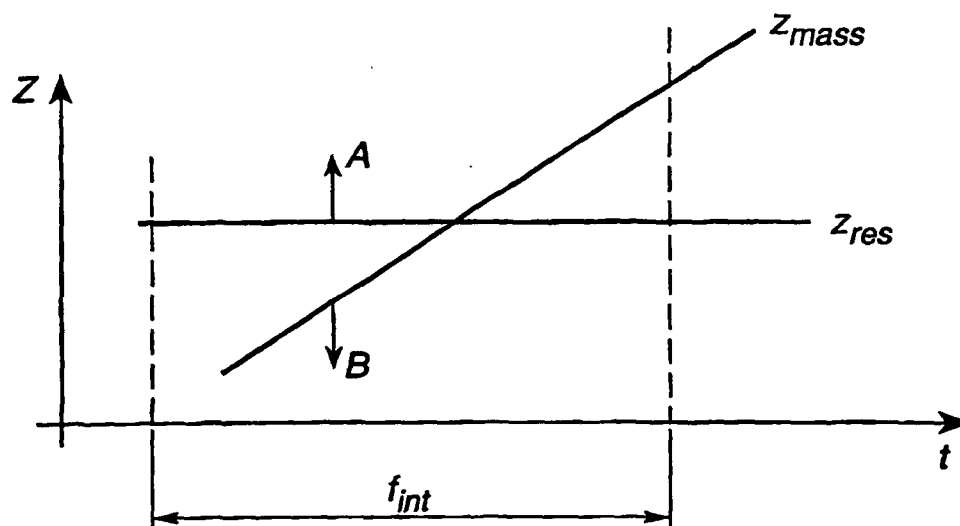


Fig. 1

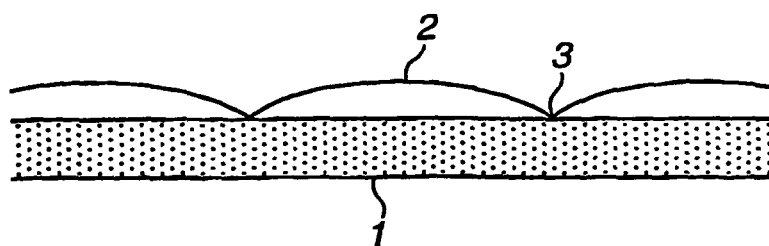


Fig. 2

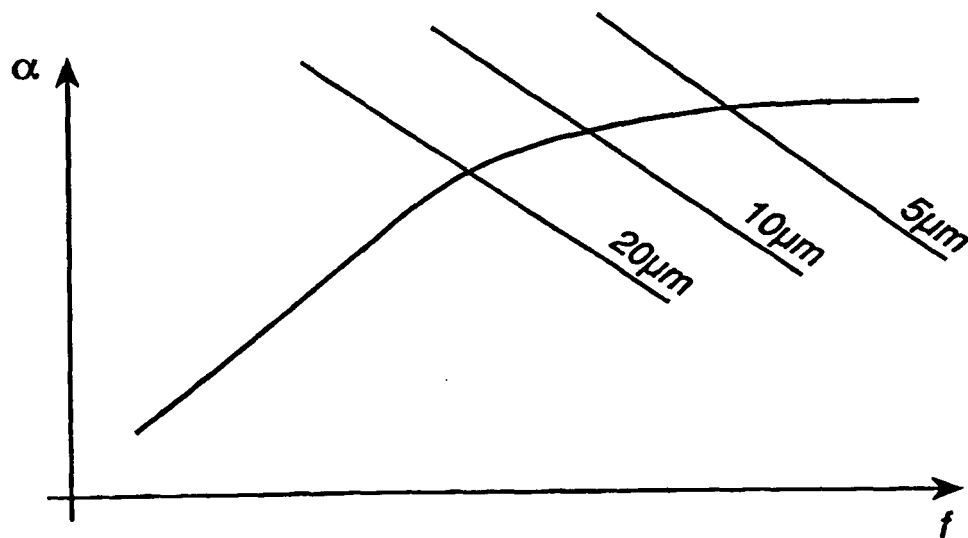


Fig. 3

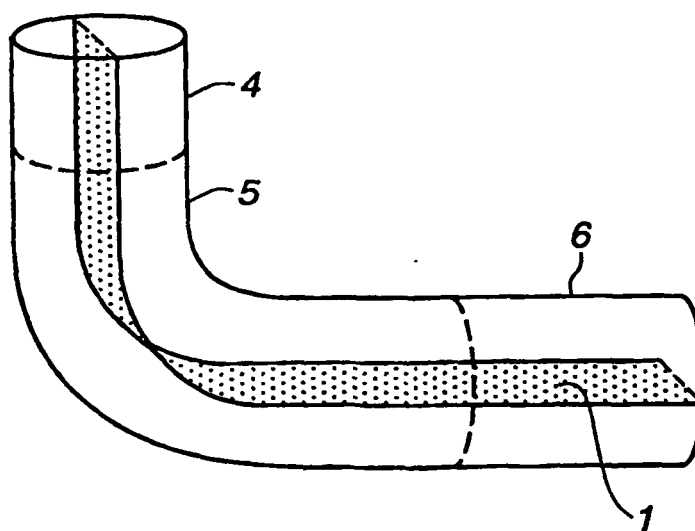


Fig. 4

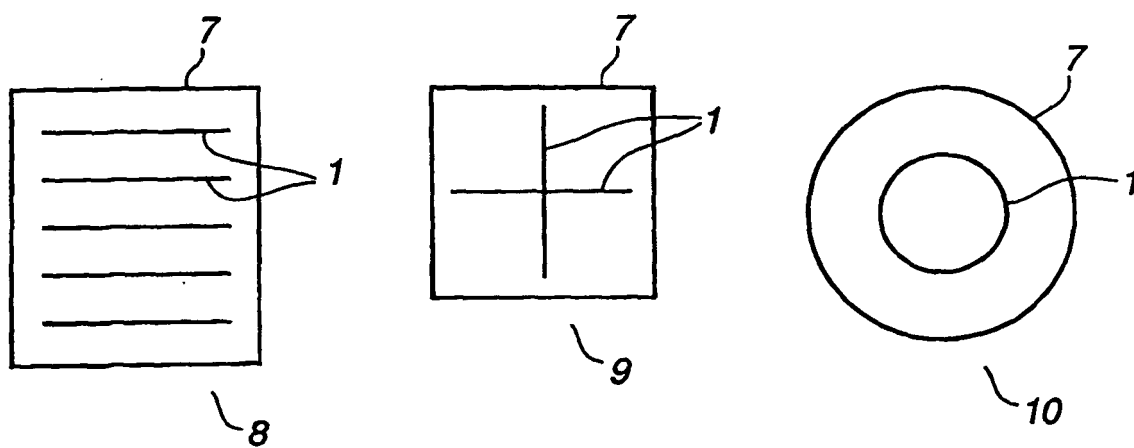


Fig. 5