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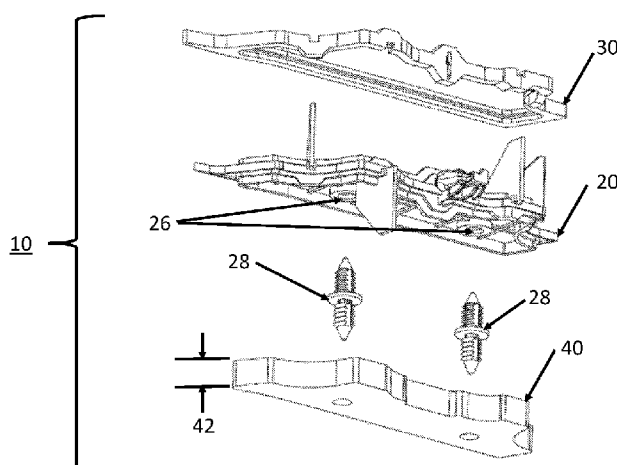


FIG. 3

(57) Abstract: The present teachings relate generally to a baffle assembly (10) for installation in a cavity (12), the assembly including at least a solid base component (20) including at least a first baffle surface and second baffle surface; an expandable adhesive agent (30) disposed on at least a portion of the solid base component; an acoustic absorber component (40) disposed on at least a portion of the first baffle surface, second baffle surface, or both; wherein the baffle assembly, when assembled in the cavity, prevents at least an average of 10 percent less transmitted sound energy across the baffle assembly versus the solid base alone over a frequency range of 80 to 6300 Htz.

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ACOUSTIC ABSORBER COMPOSITED BAFFLE ASSEMBLY

FIELD

[001] The present teachings relate to a baffle assembly with improved noise reduction properties and performance.

BACKGROUND

[002] There is an ongoing need in many industries (e.g., transportation, such as in marine craft, rail cars, automotive vehicles, aircraft, or otherwise; building construction) for improved noise reduction (e.g. sound absorption and/or transmission), particularly for reduction of noise that is within a cavity. There is also an ongoing need to structurally reinforce bodies for example body cavities in an automotive Body in White (BIW). Additionally, proper sealing of these cavities from intrusion of water, air, dust, or similar contaminants may be important.

[003] While many existing materials and components meet some of the above needs, there continues to be a need for improved component assemblies that simplify manufacture and/or use of the components, which help reduce the amount of such component and materials that are needed, or that meet some other need.

SUMMARY

[004] The present teachings relate generally to a baffle assembly with improved noise reduction properties and performance. The baffle assembly may consist of two (2) or more sub-components that may consist of dissimilar materials. For example, the baffle assembly may be a solid base structure with a flexible substrate attached thereto.

[005] The teachings herein provide for a baffle assembly for installation in a cavity, including: a solid base component including at least a first baffle surface and second baffle surface; an expandable adhesive agent disposed on at least a portion of the solid base component; and an acoustic absorber component disposed on at least a portion of the first baffle surface, second baffle surface, or both; wherein the baffle assembly, when assembled in the cavity, prevents at least an average of 10 percent less transmitted sound energy across the baffle assembly versus the solid base alone over a frequency range of at least 80 to 6300 Hz

[006] The acoustic absorber component may comprise a polyester. The acoustic absorber component may have a thickness of about 25.0mm. The acoustic absorber component may include a facing material. The facing material may include polyester, aluminum foil, or polyester/polypropylene.

[007] The acoustic absorber may comprise a non-woven material. The acoustic absorber may comprise a bicomponent fiber. The acoustic absorber may comprise a fiber having a thermoplastic component. The acoustic absorber may comprise a fibrous material including thermoplastic polymers having both high and low melting points. The assembly may be heated to a temperature at which a thermoplastic polymer of the acoustic absorber having a low melting point softens and melts. The thermoplastic polymer of the acoustic absorber may have the low melting point bonds the acoustic absorber together. The acoustic absorber may include a thermoplastic polymer having a higher melting point that remains substantially intact upon heating the assembly to a temperature that softens and melts a thermoplastic polymer of the acoustic absorber having a lower melting point.

[008] The solid base component may comprise a polymeric material, a metallic material or both. The solid base component may have a wall thickness of from about 0.01mm to about 20.0mm, or even from about 1.0mm to 5.0mm. The solid base component may include one or more rib structures and/or openings. The acoustic absorber may attached to the solid base component by an adhesive, a mechanical fastener, or a heat staking process.

[009] The teachings herein further provide for a method for providing sound attenuation to a cavity comprising: receiving fibrous material comprising thermoplastic fibers; processing the fibrous material to produce short fibers; adding the short fibers to a preformed web; heating the preformed web to form an acoustic absorber; fastening the acoustic absorber to a solid base component; and applying an activatable adhesive material to one or more of the acoustic absorber and solid base component. The method may also include locating the fastened acoustic absorber and solid base component into a cavity. The method may also include locating the fastened acoustic absorber and solid base component into a vehicle cavity.

[0010] The teachings may include use of the baffle assembly described herein for providing sound attenuation to a vehicle cavity.

DESCRIPTION OF THE DRAWINGS

- [0011]** Figure 1 is a plan view of an exemplary baffle assembly
- [0012]** Figure 2 is a plan view of the baffle assembly of Fig. 1 in a cavity
- [0013]** Figure 3 is an exploded perspective view of the baffle assembly of Fig. 1
- [0014]** Figure 4 is a plan view of an exemplary acoustic absorber material
- [0015]** Figure 5 is a plan view of another exemplary acoustic absorber material.

DETAILED DESCRIPTION

[0016] The explanations and illustrations presented herein are intended to acquaint others skilled in the art with the invention, its principles, and its practical application. The specific embodiments of the present invention as set forth are not intended as being exhaustive or limiting of the invention. The scope of the invention should be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. The disclosures of all articles and references, including patent applications and publications, are incorporated by reference for all purposes. Other combinations are also possible as will be gleaned from the following claims, which are also hereby incorporated by reference into this written description.

[0017] This application claims the benefit of the filing date of Chinese Patent Application No. 201610912675.2, filed on October 19, 2016, the contents of that application being hereby incorporated by reference herein for all purposes.

[0018] The present teachings relate generally to a baffle assembly with improved noise reduction properties and performance (e.g. less transmitted sound energy – either via absorption, sound transmission loss, or a combination thereof). The baffle assembly may consist of two (2) or more sub-components that may consist of dissimilar materials. It is contemplated that the assembly includes at least a solid base substrate portion and a flexible substrate portion. Functionally, it is contemplated that the solid base functions mainly as to carrier for the assembly, although it can contribute to the technical solution of the present invention, also known as a baffle. Typically, it is contemplated that the baffle may include an attachment mechanism that allows it to be adhered to a cavity as part of its installation thereto. It is also contemplated that the flexible substrate portion functions mainly as an absorber component and aids in the absorption or reduction of sound energy and is connected to the solid base substrate in one or more fashion. Each physical element is described in more detail below.

[0019] It is contemplated that the full assembly comprises at least a baffle substrate, one or more attachment mechanisms, and at least one absorber component. It is preferred that the assembly 10 include a means for attaching the assembly 10 into the cavity 12. In one embodiment, as an illustrative example, the assembly includes a clip 24 that is attached to a wall 14 of the cavity 12 or some other structure associated with the cavity 12.

[0020] It is contemplated that the present invention includes a substrate 20 that functions as a carrier for the components that comprise the baffle assembly 10. The substrate 20 may be constructed of a polymeric material, a metallic material or both. It may have a variety of wall thicknesses that can range from about 0.01mm to about 20.0mm, but preferably ranges from about 1.0mm to 5.0mm of wall thickness. It may include reinforcement and locational and/or anti-

rotational structures of various sizes and shapes, for example comprising ribs 22 as shown in Fig. 1. It may also include assembly aids that allow it to be positioned in the cavity, for example comprising a clip 24 as shown in Fig. 1. Additionally, it is contemplated that additional features to aid in assembly of additional components of the assembly 10 may be included, for example comprising one or more holes 26 as shown in Fig. 3.

[0021] It is contemplated that the assembly 10 preferably includes an attachment mechanism that permanently connects the assembly 10 to the cavity. It is preferred that this mechanism be part of the assembly 10, but could be installed as a separated part or process then the assembly 10 is installed in the cavity. In a preferred embodiment, the attachment mechanism is an expandable layer 30 which can be part of the assembly 10, for example as shown in Fig. 2.

[0022] The expandable layer may include an epoxy-based or Butyl-based or Ethylene Vinyl Acetate-based foam, which may behave as a thermoset material or a thermoplastic material upon activation. Exemplary materials include a polymeric base material, such as an epoxy resin or Butyl resin or Ethylene Vinyl Acetate resin or ethylene-based polymer which, when compounded with appropriate ingredients (typically a blowing and curing agent), expands and cures in a reliable and predictable manner upon the application of heat or the occurrence of a particular ambient condition. The expandable layer may be a room-temperature cure material that may activate due to a chemical or physical stimulus. From a chemical standpoint for a thermally-activated material, the structural foam is usually initially processed as a flowable thermoplastic material before curing. It may cross-link upon curing, which makes the material incapable of further flow. If one or more expandable layers are present, the one or more expandable layers may have the same activation temperature or differing activation temperatures. Examples of suitable expandable layers can be found in U.S. Patent Nos. 7,892,396 and 7,313,865; 7,125,461; and 7,199,165 and U.S. Published Application Nos. 2004/0204551; 2007/0090560; 2007/0101679; 2008/0060742; and 2009/0269547, each incorporated by reference herein for all purposes. Additional suitable materials may be sold as L-5520 and L-2821, available from L&L Products, Inc. in Romeo, Michigan. Suitable expandable layers may also be considered suitable structural layers, sealing layers, acoustic layers, adhesive layers, reinforcement layers, fastening layers, second carrier layers, protective layers, or encapsulating layers. As an example, a layer may provide a sealing capability, but may also be an expandable material that provides some level of acoustic control. The expandable layer may cover or protect epoxy-based or Butyl-based or Ethylene Vinyl Acetate-based materials. For example, the expandable layer may protect one or more epoxy-based or Butyl-based or Ethylene Vinyl Acetate-based materials from moisture. The expandable layer may encapsulate the epoxy-based or Butyl-based or Ethylene Vinyl

Acetate-based materials. Suitable sealing layers may include epoxy-based or Butyl-based or Ethylene Vinyl Acetate-based materials. Epoxy or Butyl or Ethylene Vinyl Acetate resin may be used herein to mean any of the conventional dimeric, oligomeric or polymeric epoxy or Butyl or Ethylene Vinyl Acetate materials containing at least one epoxy functional group. Such materials may be epoxy containing materials having one or more oxirane rings polymerizable by a ring opening reaction. In preferred embodiments, the sealant material includes up to about 80% of an epoxy resin. More preferably, the sealant includes between about 10 % and 50% by weight of epoxy containing materials. Suitable sealant materials are disclosed in U.S. Patent Nos. 6,350,791; 6,489,023; 6,720,387; 6,742,258; and 6,747,074; US Published Application Nos. 2004/0033324; and 2004/0016564; and WIPO Publication Nos. WO 02/086003; WO 03/103921; WO 03/072677; WO 03/011954; and WO 2004/037509, all of which are incorporated by reference herein for all purposes.

[0023] It is contemplated that the assembly 10 preferably includes an acoustic absorber component that functions to reduce or eliminate some or all transmitted sound energy from one side of the cavity to the other, across the baffle assembly 10. It is contemplated that the component 40 be comprised of materials with high sound energy absorption properties, such as porous material, woven or non-woven material, including glass wool, rock fiber, cellular plastic, needle punched felt, cross-lapped felt, or the like. The component 40 also could be configured as vertical-lapped fiber or felt, for example as shown in Fig. 4 or a cross-lapped fiber for example as shown in Fig. 5. The component may also include a facing material, such as Polyester, Aluminum foil, and Polypropylene, or a combination thereof.

[0024] It is contemplated that the component 40 may have a thickness 42 of about 1.0mm to about as much as 100.0mm. In one preferred embodiment, the component has a thickness of about 10.0mm to about 40.0mm. In one preferred embodiment, the component 40 is comprised of a vertical-lapped fiber made of Polyester fibers.

[0025] It is contemplated that the component 40 in a preferred embodiment, is a non-woven textile. This component 40 may be related to a particular manufacturing method. Some embodiments relate to methods of forming nonwoven textiles from short fibers, comprising, at least in part, recycled fibers and containing a proportion of an adhesive component, and nonwoven materials formed according to such methods.

[0026] Alternatively, some embodiments relate to methods of forming nonwoven textiles from short fibers, wherein the methods use virgin staple fibers instead of recycled fibers. Furthermore, some embodiments relate to the nonwoven materials formed using such methods.

[0027] Certain embodiments relate to a method of forming a nonwoven material, the method comprising: receiving fibrous material comprising thermoplastic fibers; processing the fibrous material to produce short fibers; adding the short fibers to a preformed web; and heating the preformed web to form a nonwoven material. In some embodiments, the preformed web may be heated and compressed to form the nonwoven material. During heating, the thermoplastic from the fibers in the fibrous material may at least partially soften or melt and bond at least some short fibers together or to the preformed web to form the nonwoven material.

[0028] “Nowoven material” as used herein, includes composite materials that comprise nonwoven materials as well as other materials, including woven materials. Accordingly, the preformed web in some embodiments may be a woven textile, or similar material. In some embodiments, the nonwoven material may be a thermoformable short fiber nonwoven (TSFNW) material. Some embodiments relate to another method of forming a nonwoven material. The method comprises: receiving fibrous material comprising thermoplastic fibers; processing the fibrous material to produce short fibers; distributing the short fibers approximately evenly on a conveyor to provide a short fiber layer; and heating, and in some embodiments compressing, the short fiber layer to form a nonwoven material.

[0029] In embodiments where the short fiber layer is not compressed, a low density nonwoven acoustic material, such as a porous bulk absorber, may be produced. In embodiments where the short fiber layer is compressed, depending upon the extent of the compression, a high density nonwoven acoustic material, such as a porous limp sheet, may be produced.

[0030] Certain embodiments relate to nonwoven materials formed by the described methods. Some of these embodiments are believed to be suitable for use as sound absorption materials and relate to acoustic sheets and methods for making such sheets. Some embodiments are believed to suitable for use as filtration materials, pin boards, structural boards or separation materials.

[0031] In some embodiments, the low density nonwoven material of certain embodiments may be combined with a high density nonwoven material, which may also be in accordance with some other embodiments, to form a composite material with desirable properties. For example, some of these embodiments may provide a composite acoustic product comprising a porous limp sheet with a relatively high flow resistance, and a layer of porous bulk absorber attached to one side of the acoustic sheet and having a flow resistance substantially smaller than the sheet, wherein one or both of the porous limp sheet and the porous bulk absorber comprise short fibers and are in accordance with certain embodiments. The composite acoustic product provided by

these embodiments may exhibit locally reactive acoustic behavior and an overall flow resistance desirable for acoustic products, such as between 2800 Rayls and 8000 Rayls.

[0032] The nonwoven material of certain embodiments may have a selected air flow resistivity. The selected air flow resistivity may be substantially higher than the air flow resistivity of a conventional nonwoven material comprising substantially only conventional staple fibers having a long length of, for example, from about 30 mm to about 100 mm. In some embodiments, the selected air flow resistivity achieved in a nonwoven material comprising short fibers of a certain diameter and composition may be about three times that of a conventional nonwoven material produced using longer fibers of the same diameter and composition. This increase in air flow resistivity with decreasing fiber length is unexpected based upon current acoustic theory.

[0033] Some embodiments relate to a nonwoven material comprising: a compressed fibrous web; and recycled fiber material in the fibrous web, the recycled fiber material comprising short fibers having an average length less than about 12 mm, the short fibers comprising between about 5% and less than 100% by weight of a nonwoven material.

[0034] The recycled fiber material may comprise thermoplastic fibers. The short fibers may be obtained by milling and sifting the recycled fiber material.

[0035] Other embodiments relate to a bulk recycled fiber material comprising short fibers formed from off-cuts of material comprising thermoplastic fibers, the short fibers being formed by milling the off-cuts and having an average length of less than about 12 mm.

[0036] Certain embodiments relate to a method of forming a nonwoven material, the method comprising: receiving fibrous material; processing the fibrous material to produce short fibers; distributing the short fibers across an area to form a precursor web; and bonding together at least some of the short fibers of the precursor web to form a nonwoven material. Further embodiments relate to nonwoven materials formed in accordance with the method above.

[0037] The area across which the short fibers are distributed may comprise a surface, such as a conveyor, that does not form part of the nonwoven material, but supports the precursor web during the bonding process. Alternatively or additionally, the area may comprise a preformed web which may be sacrificial or integral with the nonwoven material. In such embodiments, the short fibers may be distributed within and/or on top of the preformed web. Accordingly, the short fibers may be used to modify the air flow resistance of the preformed web to achieve a nonwoven material having desirable properties.

[0038] The fibrous material may often include thermoplastic fibers or bicomponent fibers having an adhesive thermoplastic component. Accordingly, the bonding of at least some of the short fibers may be effected by heating the precursor web to a temperature at which the

thermoplastic polymer in the short fibers will at least partially soften or melt. The softened or molten thermoplastic can be used to bond together at least some of the short fibers and form the nonwoven material. Thus, bonding includes adhering the short fibers to the softened thermoplastic so that the fibers become fused to the thermoplastic as the heated material cools.

[0039] In some embodiments, the fibrous material may comprise thermoplastic polymers having high and low melting points. In such embodiments, the fibrous material may be heated only to a temperature at which the thermoplastic polymer having a low melting point softens and melts. Thus, the thermoplastic polymer having the low melting point may be used to bond together the nonwoven material, while the thermoplastic polymer having a higher melting point remains substantially intact. In some embodiments, the low melting point thermoplastic polymer may be present in a different fiber to the higher melting point thermoplastic polymer. In some other embodiments, the high and low melting point polymers may form different components of a bicomponent fiber.

[0040] Alternatively, at least some of the short fibers may be bonded together using an adhesive component. A variety of materials may be used as the adhesive component in accordance with embodiments of the nonwoven material. The adhesive component may be a thermoplastic or thermoset resin or binder, which may be in the form of a powder. In some other embodiments, the adhesive component comprises thermoplastic fibers, such as thermoplastic staple fibers, that are combined with the short fibers prior to forming the precursor web. The adhesive component may comprise a preformed web of thermoplastic fibers onto and/or into which the short fibers are distributed to form the precursor web.

[0041] A combination of the above embodiments of the adhesive component may be used in the nonwoven material. For example, the adhesive component may comprise a thermoplastic resin powder in combination with thermoplastic fibers. Furthermore, the adhesive component may be used in combination with short thermoplastic fibers or short bicomponent fibers having an adhesive thermoplastic component formed from the fibrous material in order to bond together at least some of the short fibers of the precursor web.

[0042] The fibrous material may be processed to produce short fibers by milling the fibrous material, such as by knife milling.

[0043] It is contemplated that the component 40 may be attached to the substrate 20 mechanically (e.g. via push pins 28 as shown in Fig. 3), via adhesive means (e.g. pressure sensitive adhesives), or via welding (e.g. heat stake or ultrasonic welding), or any other known method of joining generally planar surfaces.

[0044] Table 1 (one) represents sound absorption characteristics (in decibels) of the baffle substrate alone ("Baffle") versus the assembly ("Baffle + Acoustic Absorber") as tested using the two different acoustic absorber configurations. In this example, the baffle substrate is comprised of an aluminum sheet with a thickness of about 10.0mm. The first acoustic absorber component (DECI-TEX®: D-VO, 25mm, 600gsm), with a thickness of about 25.0mm. The second acoustic absorber component (DECI-TEX®: D-VP, 25mm, 600gsm), with a thickness of about 25.0mm. The Test procedure for sound absorption is via Impedance Tube testing in accordance with ISO 10534-2:1998. Samples were prepared with 100mm diameter shape for sound frequency from 80 – 1600Hz, and 30mm diameter shape for sound frequency from 1000 - 6300Hz. Results are shown below in Table 1 (one).

Table 1

Sound Absorption			
Frequency (Htz)	Baffle	Baffle + D-VO	Baffle +D-VP
80	0.03	0.05	0.03
100	0.04	0.06	0.08
125	0.04	0.07	0.06
160	0.07	0.06	0.10
200	0.06	0.09	0.12
250	0.06	0.11	0.11
315	0.06	0.12	0.12
400	0.17	0.12	0.15
500	0.16	0.16	0.26
630	0.41	0.20	0.37
800	0.42	0.28	0.45
1000	0.28	0.36	0.54
1250	0.23	0.41	0.66
1600	0.47	0.60	0.90
2000	0.59	0.87	0.96
2500	0.43	0.85	0.94
3150	0.35	0.66	0.97
4000	0.30	0.61	0.95

5000	0.35	0.64	0.86
6300	0.48	0.66	0.77

[0045] Table 2 (two) represents sound transmission loss characteristics (in decibels) of the baffle substrate alone (“Baffle”) versus the assembly (“Baffle + Acoustic Absorber”) as tested using the two different acoustic absorber configurations. In this example, the baffle substrate is comprised of an aluminum sheet with a thickness of about 10.0mm. The first absorber component (DECI-TEX®: D-VO, 25mm, 600gsm), with a thickness of 25.0mm. The second absorber component (DECI-TEX®: D-VP, 25mm, 600gsm), with a thickness of 25.0mm. The Test procedure for sound transmission loss is via Impedance Tube testing in accordance with ASTM E2611. Samples were prepared with 100mm diameter shape for sound frequency from 80 – 1600Hz, and 30mm diameter shape for sound frequency from 1000 - 6300Hz. Results are shown below in Table 2 (two).

Table 2

Sound Transmission Loss (dB)			
Frequency (Htz)	Baffle	Baffle + D-VO	Baffle + D-VP
80	10.80	17.71	21.02
100	11.30	18.03	21.02
125	11.98	18.76	21.31
160	12.95	19.50	22.03
200	13.99	20.29	22.71
250	15.53	19.67	23.53
315	17.60	13.40	23.78
400	15.10	12.26	18.29
500	13.33	16.31	18.32
630	11.69	17.20	21.89
800	14.98	17.83	24.41
1000	16.47	19.31	22.92
1250	17.89	21.36	24.01
1600	19.43	22.47	25.49
2000	20.53	23.34	27.03
2500	22.19	25.41	29.89

3150	22.80	26.82	32.22
4000	23.88	27.16	32.53
5000	24.15	27.48	32.58
6300	24.16	27.79	32.27

[0046] The above examples shown in the tables use acoustic absorber configurations with a thickness of 25mm and a density of 600gsm (Grams Per Square Meter). It is contemplated that a larger range of thicknesses and densities also can produce the desired results. Thicknesses may range from about 10mm to as much as about 75mm and densities from about 300gsm to as much as about 1200gsm. Additionally, the above examples shown in the tables are tested over a frequency range from about 80 to about 6300 Htz. It is contemplated that the desired performance of the present invention also occurs over a wider frequency range, particularly a range of about 20 to about 20 kHz.

[0047] The following comments pertain generally to all teachings. Unless otherwise stated, any numerical values recited herein include all values from the lower value to the upper value in increments of one unit provided that there is a separation of at least 2 units between any lower value and any higher value. As an example, if it is stated that the amount of a component, a property, or a value of a process variable such as, for example, temperature, pressure, time and the like is, for example, from 1 to 90, preferably from 20 to 80, more preferably from 30 to 70, it is intended that intermediate range values such as (for example, 15 to 85, 22 to 68, 43 to 51, 30 to 32 etc.) are within the teachings of this specification. Likewise, individual intermediate values are also within the present teachings. For values which are less than one, one unit is considered to be 0.0001, 0.001, 0.01 or 0.1 as appropriate. These are only examples of what is specifically intended and all possible combinations of numerical values between the lowest value and the highest value enumerated are to be considered to be expressly stated in this application in a similar manner. As can be seen, the teaching of amounts expressed as "parts by weight" herein also contemplates the same ranges expressed in terms of percent by weight. Thus, an expression in the Detailed Description of the Invention of a range in terms of at "x" parts by weight of the resulting composition" also contemplates a teaching of ranges of same recited amount of "x" in percent by weight of the resulting composition.

[0048] Unless otherwise stated, any test method standard referenced herein is for the version existing as of the earliest filing date in which the standard is recited.

[0049] Unless otherwise stated, all ranges include both endpoints and all numbers between the endpoints. The use of "about" or "approximately" in connection with a range applies

to both ends of the range. Thus, “about 20 to 30” is intended to cover “about 20 to about 30”, inclusive of at least the specified endpoints.

[0050] The disclosures of all articles and references, including patent applications and publications, are incorporated by reference for all purposes. The term “consisting essentially of” to describe a combination shall include the elements, ingredients, components or steps identified, and such other elements ingredients, components or steps that do not materially affect the basic and novel characteristics of the combination. The use of the terms “comprising” or “including” to describe combinations of elements, ingredients, components or steps herein also contemplates embodiments that consist essentially of, or even consist of the elements, ingredients, components or steps. Plural elements, ingredients, components or steps can be provided by a single integrated element, ingredient, component or step. Alternatively, a single integrated element, ingredient, component or step might be divided into separate plural elements, ingredients, components or steps. The disclosure of “a” or “one” to describe an element, ingredient, component or step is not intended to foreclose additional elements, ingredients, components or steps. Moreover, unless expressly set forth, the recitation of “first”, “second”, or the like does not preclude additional ingredients, steps, or other elements. All references herein to elements or metals belonging to a certain Group refer to the Periodic Table of the Elements published and copyrighted by CRC Press, Inc., 1989. Any reference to the Group or Groups shall be to the Group or Groups as reflected in this Periodic Table of the Elements using the IUPAC system for numbering groups. It is understood that the above description is intended to be illustrative and not restrictive.

[0051] Many embodiments as well as many applications besides the examples provided will be apparent to those of skill in the art upon reading the above description. The scope of the invention should, therefore, be determined not with reference to the above description, but should instead be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. The disclosures of all articles and references, including patent applications and publications, are incorporated by reference for all purposes. The omission in the following claims of any aspect of subject matter that is disclosed herein is not a disclaimer of such subject matter, nor should it be regarded that the inventors did not consider such subject matter to be part of the disclosed inventive subject matter.

CLAIMS

What is claimed is:

Claim 1. A baffle assembly for installation in a cavity, comprising:

- a. a solid base component including at least a first baffle surface and second baffle surface;
- b. an expandable adhesive agent disposed on at least a portion of the solid base component; and
- c. an acoustic absorber component disposed on at least a portion of the first baffle surface, second baffle surface, or both;

wherein the baffle assembly, when assembled in the cavity, prevents at least an average of 10 percent less transmitted sound energy across the baffle assembly versus the solid base alone over a frequency range of 80 to 6300 Hz.

Claim 2. The baffle assembly of claim 1, wherein the acoustic absorber component is comprised of a Polyester.

Claim 3. The baffle assembly of claim 1 or claim 2, wherein the acoustic absorber component has a thickness of 25.0mm.

Claim 4. The baffle assembly of any of the preceding claims, wherein the acoustic absorber component includes a facing material.

Claim 5. The baffle assembly of claim 4, wherein the facing material includes Polyester, Aluminum foil, or Polyester/Polypropylene.

Claim 6. The baffle assembly of any of any of the preceding claims, wherein the acoustic absorber comprises a non-woven material.

Claim 7. The baffle assembly of any of the preceding claims, wherein the acoustic absorber comprises a bicomponent fiber.

Claim 8. The baffle assembly of any of the preceding claims, wherein the acoustic absorber comprises a fiber having a thermoplastic component.

Claim 9. The baffle assembly of any of the preceding claims, wherein the acoustic absorber comprises a fibrous material including thermoplastic polymers having both high and low melting points.

Claim 10. The baffle assembly of any of the preceding claims, wherein the assembly is heated to a temperature at which a thermoplastic polymer of the acoustic absorber having a low melting point softens and melts.

Claim 11. The baffle assembly of claim 10, wherein the thermoplastic polymer of the acoustic absorber having the low melting point bonds the acoustic absorber together.

Claim 12. The baffle assembly of any of the preceding claims, wherein the acoustic absorber includes a thermoplastic polymer having a higher melting point that remains substantially intact upon heating the assembly to a temperature that softens and melts a thermoplastic polymer of the acoustic absorber having a lower melting point.

Claim 13. The baffle assembly of any of the preceding claims, wherein the solid base component comprises a polymeric material, a metallic material or both.

Claim 14. The baffle assembly of any of the preceding claims, wherein the solid base component has a wall thickness of from about 0.01mm to about 20.0mm, or even from about 1.0mm to 5.0mm.

Claim 15. The baffle assembly of any of the preceding claims, wherein the solid base component includes one or more rib structures and/or openings.

Claim 16. The baffle assembly of any of the preceding claims, wherein the acoustic absorber is attached to the solid base component by an adhesive, a mechanical fastener, or a heat staking process.

Claim 17. A method for providing sound attenuation to a cavity comprising:
receiving fibrous material comprising thermoplastic fibers;
processing the fibrous material to produce short fibers;
adding the short fibers to a preformed web;

heating the preformed web to form an acoustic absorber;
fastening the acoustic absorber to a solid base component;
applying an activatable adhesive material to one or more of the acoustic absorber and solid base component.

Claim 18. The method of claim 17, including locating the fastened acoustic absorber and solid base component into a cavity.

Claim 19. The method of claim 17 or claim 18, including locating the fastened acoustic absorber and solid base component into a vehicle cavity

Claim 20. Use of the baffle assembly of any of claims 1 through 16, for providing sound attenuation to a vehicle cavity.

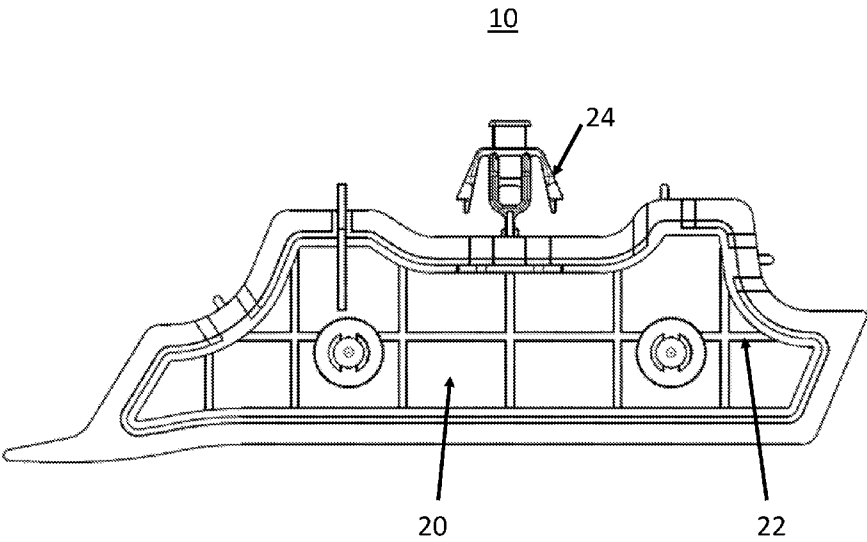


FIG. 1

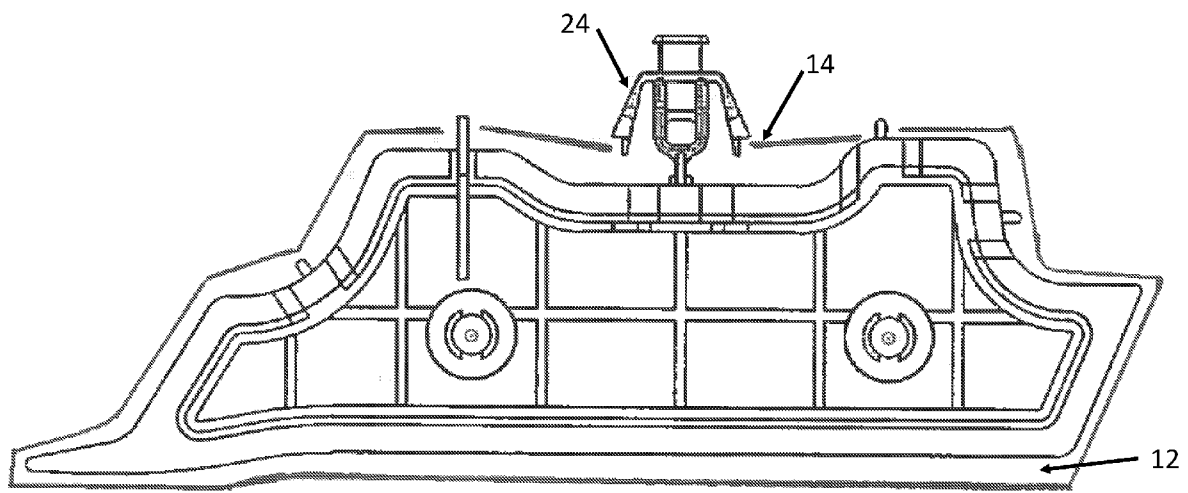


FIG. 2

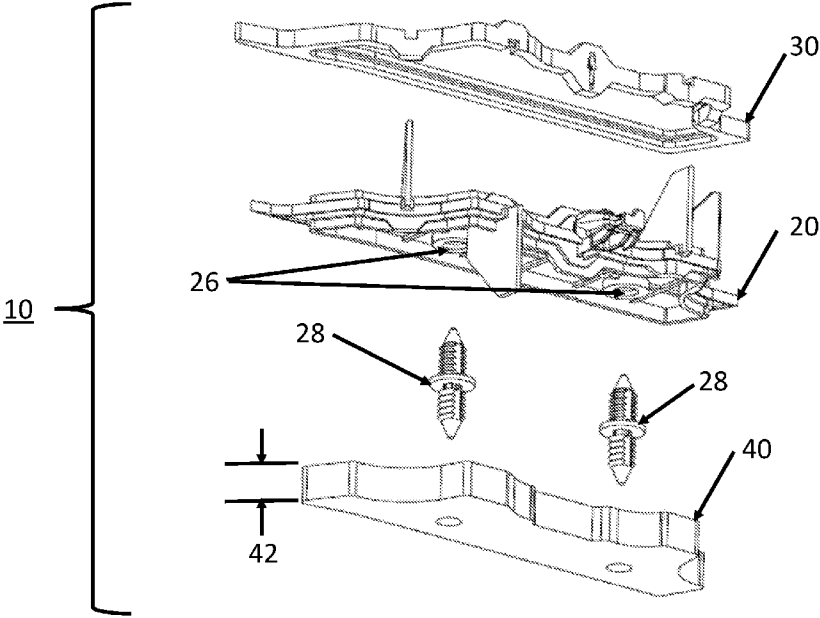


FIG. 3

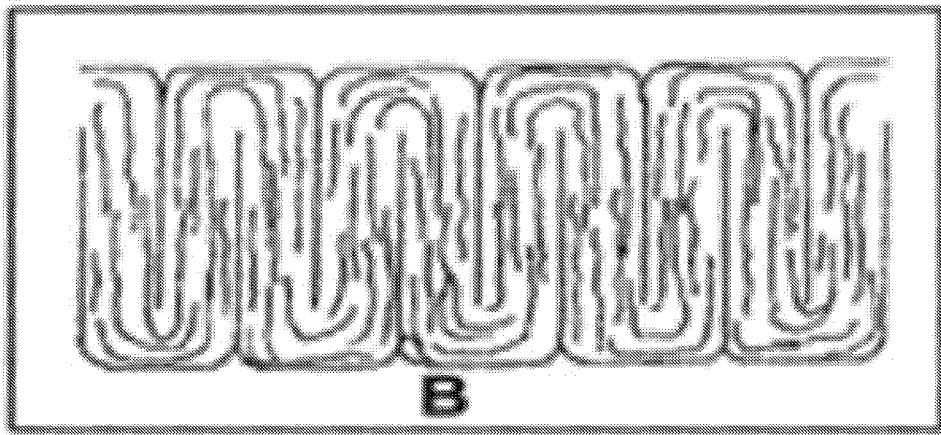


FIG. 4

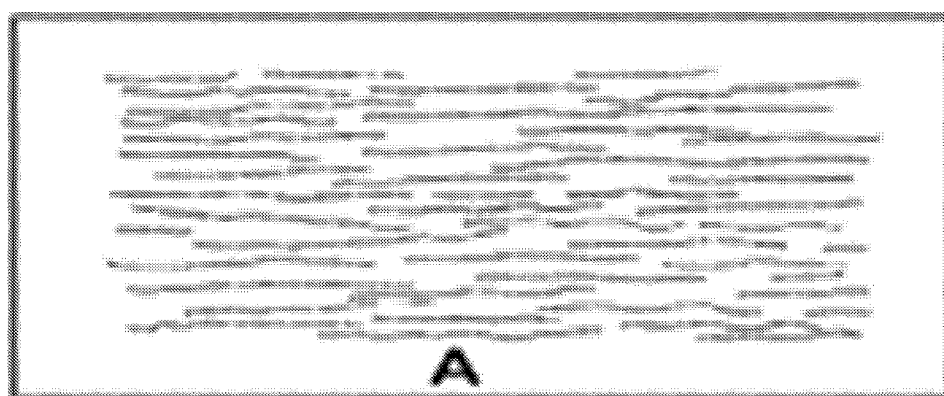


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/057324

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of Item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-5, 13-16, 20

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/057324

A. CLASSIFICATION OF SUBJECT MATTER
INV. G10K11/168
ADD.

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)
G10K

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 practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/295093 A1 (BELPAIRE VINCENT [BE] ET AL) 22 November 2012 (2012-11-22) figure 5 paragraphs [0001], [0029], [0035], [0036]	1,13,15, 16,20
X	US 6 955 845 B1 (POOLE PAUL WARREN [US] ET AL) 18 October 2005 (2005-10-18) figures 1,2 column 1, lines 1-10 columns 4-6	1,2,4,5, 13-16,20
X	DE 92 04 402 U1 (GERHARDI & CIE) 25 June 1992 (1992-06-25) figure 2 pages 2,3 claims 1-5	1,13,14, 16,20
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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

10 January 2018

Date of mailing of the international search report

22/03/2018

Name and mailing address of the ISA/

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Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/057324

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	WO 2015/185757 A1 (FAIST CHEMTEC GMBH [DE]) 10 December 2015 (2015-12-10) figures 1,2 pages 8-12 -----	1,13,14, 16,20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2017/057324

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		US 2017221467 A1	03-08-2017
		WO 2015185757 A1	10-12-2015

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-5, 13-16, 20

Absorber material thickness, use of a facing material, properties, dimensions and structural reinforcements of the solid base component, etc. (objective technical problem: optimizing the particular geometric dimensions and facing coverage of the absorber component and the particular structural properties of the base component).

2. claims: 6-12, 17-19

Fibrous material comprising thermoplastic fibers, short fibers on a preformed web, an activatable adhesive material applied to the acoustic absorber, etc (objective technical problem: obtaining non-woven textiles from short fibers).
