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(54) Title: DEVICE FOR THERMAL AND ACOUSTIC ABSORPTION

(57) Abstract: The present teachings relate generally to an insulating device including a first and second coated glass cloth layer and a plurality of ceramic fibers. The device may further include an acoustic damping layer.



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DEVICE FOR THERMAL AND ACOUSTIC ABSORPTION

FIELD

[001] The present teachings relate to a device for management of one or more of acoustics and heat absorption.

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 insulation devices for both sound and heat absorption. Often, multiple solutions are utilized to attain the necessary heat and sound absorption for a given application. However, it would be more effective to provide one solution capable of both heat and sound absorption.

[003] It would therefore be desirable to provide a product having a shape and size that is easily modified to be adapted to a wide variety of locations (e.g., within walls or floors of buildings, within vehicle cavities, within aircraft cavities, or within other locations where heat and sound absorption are desired). It would also be desirable if the device were sufficiently flexible to be wrapped around a location. It would be further desirable if one product would be capable of absorbing both heat and sound to avoid the need for multiple products.

SUMMARY

[004] The present teachings relate generally to an insulating device including one or any combination of various glass fabric materials (e.g., aluminum and/or graphite coated glass cloth), light-weight fibers and a polymeric thread for stitching and/or otherwise sealing the edge of the device.

[005] The teachings herein provide for an insulating device comprising a first and second cloth layer including one or more of coated glass, aluminum, graphite, double sided silica, or any combination thereof and a plurality of ceramic fibers for forming one or more of a blanket, compressed fibers, a sheet, a weave, or any combination thereof. The device may include a polymeric material for sealing an edge of the device. The polymeric material may be a thread coated with a synthetic fluoropolymer. The first cloth layer may be located facing a heat source. The second cloth layer may be located facing an internal compartment of a transportation vehicle. The device may be located adjacent an engine. The device may have a thermal conductivity of at least about 0.030 W/MK and less than about 0.100 W/MK. The device may have a thermal conductivity of at least about 0.030 W/MK and less than about 0.050 W/MK. The acoustic damping layer may be flexible such that it bends under its own weight when held at one end. The device

may exhibit no damage or visual deterioration at temperatures of at least about 300°C, at least about 500°C, or even at least about 600°C. The device may be located in between a heat source and a metallic member and is in direct contact with a metallic member. The device may be wrapped around a metallic member and in between the metallic member and a heat source. The device may include an acoustic damping layer. The polymeric material may be a polytetrafluoroethylene (PTFE) thread. The device may have a thermal conductivity of at least about 0.030 W/MK and less than about 0.0375 W/MK. The device may have a thermal conductivity of at least about 0.033 W/MK and less than about 0.0375 W/MK. The device may exhibit no damage or visual deterioration at temperatures of at least about 400°C, at least about 500°C, or even at least about 600°C. The device may be located in contact or at a pre-determined distance from a heat-source. The device may be applied as a dry wrapping to a steel member or under an engine hood.

DETAILED DESCRIPTION

[006] 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.

[007] This application claims the benefit of the filing dates of U.S. Provisional Application Serial Nos. 62/395,679, filed September 16, 2016, and 62/535,283, filed July 21, 2017, the contents of these application being hereby incorporated by reference herein for all purposes.

[008] The teachings herein provide for an insulating device comprising plurality of layers. The device may include two layers, three layers, four layers, five layers, or more. The device may provide for thermal regulation (which may include heat absorption). The device may also include one or more layers to impart acoustic absorption (e.g., damping). The layers may include one or more heat resistant glass fabric material layers. One or more of the glass fabric material layers may be coated with a coating material. The coating may be applied to the fibers individually or may be applied to the layer as a whole once the layer is formed. The coating material may be any suitable coating and may be a metallic coating. The coating may be selected from aluminum, graphite and silicon / silica. At least one of the material layers may include a plurality of fibers.

The fibers may be ceramic fibers (blanket or compressed or weave). The device may include a layer of acoustic absorption (e.g., damping) material.

[0009] The layers may be selected such that at least one layer provides acoustic absorption, while a different layer provides thermal absorption. The layers may be selected such that one of the layers is capable of providing both sound and thermal absorption. Each layer may be bonded to one or more adjacent layers. Alternatively, one or more layers may be substantially free of any bonding. The layers may be bonded using physical or chemical attachment means. The layers may be bonded together using an adhesive. The layers may be heat bonded together. The layers may be stitched together.

[0010] The glass fabric materials may include a conventional fiberglass material. The glass fibers may include E-glass fibers (e.g., alumino borosilicate glass), A-glass fiber (e.g., alkali-lime glass with no boron oxide), C-glass (e.g., alkali-lime glass with boron oxide), E-CR-glass (e.g., alumino-lime silicate), D-glass (e.g., borosilicate glass), R-glass (e.g., alumino silicate glass without MgO and CaO), S-glass (e.g., alumino silicate glass with high MgO), pure silica, or any combination thereof. The glass fibers may have a length of from about 1mm to about 15mm. The glass fibers may have a length of at least about 3mm. The glass fibers may have a length of less than about 10mm, or even less than about 7mm. The diameter of the fibers may be from about 5 to about 30 microns. The diameter of the fibers may be at least about 10 microns. The diameter of the fibers may be less than about 15 microns. The fibers may be woven or non-woven. The fibers may be lofted. The fibers may be compressed. The fibers may be compressed and molded.

[0011] One or more of the glass fibers may include a coating. This coating may include one or more materials that facilitate the ability of the fiber to provide improved thermal conductivity. The coating may be a polymeric coating. The coating may be a metallic coating. The glass fibers may be coated with one or more of aluminum, graphite, silica, silicon, polyolefins (i.e., polyethylene and polypropylene), polycarbonate, polyester, polyamide, polyurethane or any combination thereof. The coating may include perfluorocycloalkene (PFCA), ethylene, vinyl fluoride (fluoroethylene) (VF1), vinylidene fluoride (1,1-difluoroethylene), tetrafluoroethylene (TFE), chlorotrifluoroethylene (CTFE), hexafluoropropylene (HFP), perfluoropropylvinylether (PPVE), [erfluoromethylvinylether (PMVE), or combinations thereof. The coating may cover substantially the entirety of the fiber. The coating may cover only a portion of the fiber. The fiber may also comprise any of the materials stated above for use as a coating. The fiber may be formed partially of one or more of the materials described above (e.g., a bi-component fiber).

[0012] The insulating device described herein may include one or more cloth layers. The cloth layers may be formed as one or any combination of a blanket, a sheet, a plurality of

compressed fibers, or a weave. These cloth layers may be woven or non-woven. These layers may be one or more of a glass cloth, a coated glass cloth, a black glass cloth, an aluminum cloth, a graphite cloth, a silica cloth or any combination thereof.

[0013] The device, and specifically at least one of the one or more cloth layers may include a plurality of ceramic fibers. Such fibers may comprise alkaline earth silicate (including a combination of CaO-, MgO-, SiO₂ and ZrO₂), aluminosilicate, polycrystalline (including Al₂O₃), or combinations thereof. Such ceramic fibers may be selected for use in a layer designed for thermal absorption. However, it is also possible that the ceramic fibers be utilized in a layer designed for sound absorption.

[0014] The device may include a polymeric material for sealing an edge of the device. The polymeric material may be a thread coated with a synthetic polymer. The synthetic polymer may be selected from perfluorocycloalkene (PFCA), ethylene, vinyl fluoride (fluoroethylene) (VF1), vinylidene fluoride (1,1-difluoroethylene), tetrafluoroethylene (TFE), chlorotrifluoroethylene (CTFE), hexafluoropropylene (HFP), perfluoropropylvinylether (PPVE), perfluoromethylvinylether (PMVE), or combinations thereof.

[0015] The device may be located adjacent an engine. The device may be in direct contact with a metallic member. The device may be arranged such that it includes a first and second cloth layer, the first cloth layer being located adjacent a heat source and the second cloth layer being located adjacent a metallic member such that the device acts to insulate the metallic member from the heat source. The device may be wrapped around a metallic member such that the first cloth layer is located on the exterior of the wrap and facing and/or adjacent to a heat source. The device may be located in between an engine and an internal passenger compartment.

[0016] The device may have a thermal conductivity of at least about 0.030 W/MK and less than about 0.100 W/MK in accordance with ASTM E1225. The device may have a thermal conductivity of at least about 0.030 W/MK and less than about 0.050 W/MK. The device may exhibit a thermal conductivity of at least about 0.033 W/MK and less than about 0.0375 W/MK.

[0017] Any of the materials described herein may also be utilized for the acoustic absorption layers. The acoustic absorption layers may utilize any materials known in the art for such purposes. The acoustic absorption layer may be flexible such that it bends under its own weight when held at one end. The device may exhibit no damage or visual deterioration at continuous temperatures of at least about 400°C, at least about 500°C, or even at least about 600°C.

[0018] Various properties of the device with the acoustic absorption layer described herein are shown below at Table A.

[0019] Table A

Operating Temperature Range	-30°C to +550°C
Hot Side Temperature range	Up to 500°C
Cold Side Temperature range	Up to 90°C
Number of Layers	2 to 4 (depending upon functional requirements / area of application)
Delta Temperature	50-75% of Input Temperature
Heat Temperature Durability at 500 & 700 Degrees Celsius	No any visual deterioration & no damage
Thermal Shock resistance at +50°C to -30°C (10 cycles)	No dimensional loss, No loss in mass & No Brittleness
Flammability	Non Flammable
Thermal Conductivity	0.035 ~ 0.038 W/MK

[0020] Various properties of the device without the acoustic absorption as layer described herein are shown below at Table B.

[0021] Table B

Operating Temperature Range	-30°C to +700°C
Hot Side Temperature range	Up to 700°C
Cold Side Temperature range	Up to 150°C
Number of Layers	2 to 3
Delta Temperature	50 - 75% of Input Temperature
Heat Temperature Durability at 500 & 700 Degrees Celsius	No any visual deterioration & no damage
Thermal Shock resistance at +50°C to -30°C (10 cycles)	No dimensional loss, No loss in mass & No Brittleness
Flammability	Non Flammable
Thermal Conductivity	0.035 ~ 0.038 W/MK

[0022] As identified in the results above, the thermal regulation device without the use of an acoustic absorption layer, may attain improved heat resistance qualities as compared to devices with the acoustic absorption layer. It is possible that in areas of extreme heat (e.g., locations experiencing temperatures in excess of 550 °C), the device without the sound absorption layer may be preferred. In areas with comparably lower temperatures (especially where acoustics are an issue and sound attenuation is desired) the device with the sound absorption layer may be selected).

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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. An insulating device comprising:
- a. a first and second cloth layer including one or more of coated glass, aluminum, graphite, double sided silica, or any combination thereof;
 - b. a plurality of ceramic fibers for forming one or more of a blanket, compressed fibers, a sheet, a weave, or any combination thereof.
- Claim 2. The insulating device of claim 1, including a polymeric material for sealing an edge of the device.
- Claim 3. The insulating device of claim 2, wherein the polymeric material is a thread coated with a synthetic fluoropolymer.
- Claim 4. The insulating device of any of the preceding claims, wherein the first cloth layer is located facing a heat source
- Claim 5. The insulating device of any of the preceding claims, wherein the second cloth layer is located facing an internal compartment of a transportation vehicle.
- Claim 6. The insulating device of any of the preceding claims, wherein the device is located adjacent an engine.
- Claim 7. The insulating device of any of the preceding claims, wherein the device has a thermal conductivity of at least about 0.030 W/MK and less than about 0.100 W/MK.
- Claim 8. The insulating device of any of the preceding claims, wherein the device has a thermal conductivity of at least about 0.030 W/MK and less than about 0.050 W/MK.
- Claim 9. The insulating device of any of the preceding claims, wherein the acoustic damping layer is flexible such that it bends under its own weight when held at one end.
- Claim 10. The insulating device of any of the preceding claims, wherein the device exhibits no damage or visual deterioration at temperatures of at least about 300°C, at least about 500°C, or even at least about 600°C.
- Claim 11. The insulating device of any of the preceding claims, wherein the device is located in between a heat source and a metallic member and is in direct contact with a metallic member.
- Claim 12. The insulating device of any of the preceding claims, wherein the device is wrapped around a metallic member and in between the metallic member and a heat source.
- Claim 13. The insulating device of claim 1, including an acoustic damping layer.
- Claim 14. The insulating device of claim 2, wherein the polymeric material is a polytetrafluoroethylene (PTFE) thread.

Claim 15: The insulating device of any of the preceding claims, wherein the device has a thermal conductivity of at least about 0.030 W/MK and less than about 0.0375 W/MK.

Claim 16: The insulating device of any of the preceding claims, wherein the device has a thermal conductivity of at least about 0.033 W/MK and less than about 0.0375 W/MK.

Claim 17: The insulating device of any of the preceding claims, wherein the device exhibits no damage or visual deterioration at temperatures of at least about 400°C, at least about 500°C, or even at least about 600°C.

Claim 18: The insulating device of any of the preceding claims, wherein the device is located in contact or at a pre-determined distance from a heat-source.

Claim 19: The insulating device of any of the preceding claims, wherein the device is applied as a dry wrapping to a steel member or under an engine hood.

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2017/051949

A. CLASSIFICATION OF SUBJECT MATTER
 INV. B32B5/22
 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)
 B32B

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)

EPO-Internal, WPI Data, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 83/03796 A1 (HEXCEL CORP [US]) 10 November 1983 (1983-11-10) claims 1,2,5,8 page 2, line 17 - line 21 page 4, line 17 - line 28 -----	1-19
X	DATABASE WPI Week 201627 Thomson Scientific, London, GB; AN 2016-225103 XP002776393, & WO 2016/056939 A1 (KARPEVICH A N) 14 April 2016 (2016-04-14) abstract -----	1-19



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

5 December 2017

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14/12/2017

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 8303796	A1	10-11-1983	DE 3372732 D1 03-09-1987
			EP 0107727 A1 09-05-1984
			US 4522673 A 11-06-1985
			WO 8303796 A1 10-11-1983

WO 2016056939	A1	14-04-2016	NONE
