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(54) **IMPROVED SOUND-ABSORBING PANEL**

(57) A sound-absorbing panel (100) comprising a first cardboard layer (1) provided with a set of through slots (11), a second cardboard layer (2) provided with a

set of through holes (21) and a third cardboard layer (3) not provided with through holes or slots.

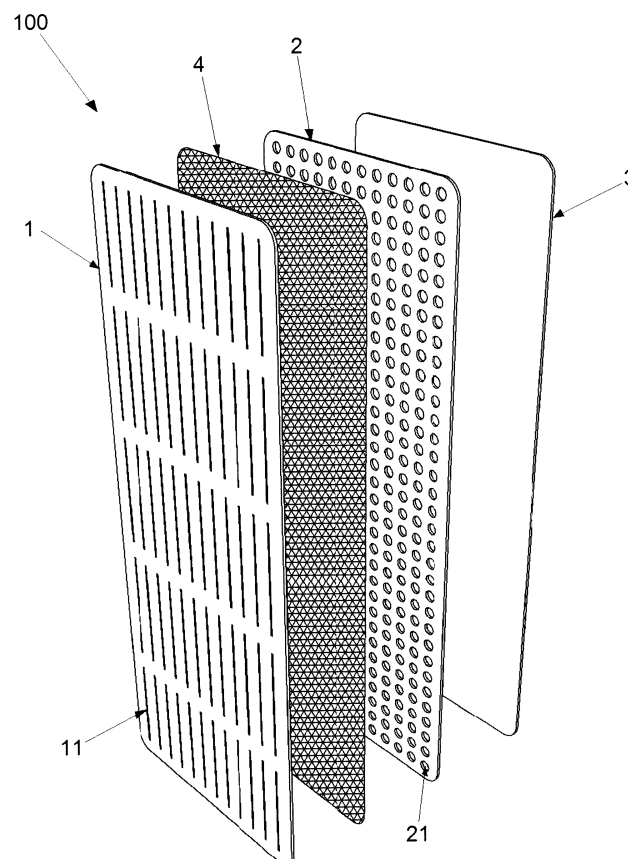


FIG. 1

Description

[0001] The present patent application for industrial invention relates to an improved sound-absorbing panel.

[0002] As it is known, the term "sound-absorption" indicates the capability of a material to absorb sound energy. In fact, when a sound wave is incident on a wall that separates two areas, the sound wave is partially reflected in the originating area, partially absorbed by the wall and partially transmitted in the adjacent area.

[0003] A material is defined as sound-absorbing when it allows for converting a good part of the sound energy that crosses the material into energy; it generally being thermal energy.

[0004] More precisely, the function of sound-absorbing materials is to reduce reverberation, i.e. the roaring sound and the echo, inside adjoining areas. Practically speaking, in closed spaces, the total noise that is perceived is determined by the reflection of the sound waves by the walls that define the area, especially when the walls are made of smooth compact materials, which are defined as reflecting.

[0005] Therefore, the main function of a sound-absorbing material is not to reflect and hinder the propagation of sound waves, but to reflect the sound energy incident on the material as least as possible in order to reduce reverberation.

[0006] In general sound-absorbing materials are porous or fibrous materials that are capable of dissipating part of the sound energy in their interstices: in fact, porous materials, such as open cell foam - i.e. melamine or polyurethane - or fibrous materials, such as wood fibers, rock or glass wool, polyester fibers, heavy fabrics and felts, have a high sound absorption coefficient. On the contrary, hard compact materials with a high specific weight, such as marble, ceramic, glass, cement and the like, have a very low sound absorption coefficient and are therefore highly reflecting.

[0007] Therefore, sound-absorbing materials are basically high-porosity materials that can be purchased in rolls in order to make customized panels according to the user requirements or finished products in the form of panels with predefined regular dimensions.

[0008] In particular, the sound-absorbing panels that are intended to be installed inside internal walls and partitions are generally made of plasterboard, which is a largely used material especially for false ceilings and light-weight partitions.

[0009] More precisely, the acoustic insulation of partition walls, between two spaces or living areas, is generally obtained by using plasterboard counter walls separated from the existing wall by means of an empty space filled with sound-absorbing material (generally glass wool).

[0010] The sound insulation power of such a wall increases when the thickness of the empty space increases, i.e. when the distance between the plasterboard counter wall and the existing wall increases so that the

empty space can receive a higher amount of sound-absorbing material.

[0011] In view of the above, it must be noted that the sound absorption of a porous material is very high for medium-high frequency waves. Vice versa, in order to achieve a good absorption of low-frequency sound waves, it is necessary to increase the thickness of the porous sound-absorbing material considerably. Therefore, the sound-absorbing panels for indoor use, which are largely used in living and working spaces, as well as in booths and fairs, must have a good thickness-efficacy ratio in order to minimize the volume while guaranteeing a good sound absorption.

[0012] In fact, the sound-absorbing panels that are intended to be used in closed spaces, such as fair booths and the like:

- must be light-weighted in order to be easy to transport;
- must be sufficiently resistant in order to be coupled from time to time according to the user requirements;
- must advantageously have a high sound-absorbing power in order to reduce the background noise that is typical of fair booths.

[0013] Consequently, the need to meet these conflicting requirements often impairs the reverberation reduction capability of the said sound-absorbing panels.

[0014] The purpose of the present invention is to remedy the aforementioned drawbacks of the prior art by devising a sound-absorbing panel that is efficacious, versatile, light-weighted, simple and easy to install.

[0015] The sound-absorbing panel of the invention comprises at least three layers, of which:

- a first cardboard layer provided with a series of through slots;
- a second cardboard layer provided with a series of through holes;
- a third cardboard layer devoid of holes or through slots.

[0016] In particular, the use of environmental-friendly materials, such as for example cardboard, in a larger and larger scale suggested the opportunity of evaluating the sound-absorbing properties of similar materials in such manner to use environmental-friendly materials also to improve the acoustic comfort of households, working and/or sales spaces.

[0017] In view of the above the cardboard sound-absorbing panel of the invention is light-weighted, completely recyclable and produced with a low-cost technology.

[0018] For the purpose of clarity the description of the sound-absorbing panel according to the invention continues with reference to the attached drawings, which have an illustrative, but not limiting value, wherein:

[0019] Fig. 1 is an axonometric exploded view of the

sound-absorbing panel of the invention.

[0020] With reference to Fig. 1, the sound-absorbing panel according to the invention is disclosed, which is generally indicated with reference number (100).

[0021] The sound-absorbing panel (100) of the invention comprises a first layer (1), a third layer (3) and a second layer (2) advantageously interposed between the said first layer (1) and the said third layer (3).

[0022] The said first (1), second (2) and third layer (3) have a thickness comprise between 5 mm and 30 mm and are made of corrugated, alveolar or honeycomb cardboard.

[0023] The first layer (1) is provided with through slots (11), which are identical and regularly spaced, advantageously having a length comprised between 20 cm and 30 cm and a width comprised between 4 mm and 2 cm.

[0024] The second layer (2) is provided with a series of through holes (21) which are identical and regularly distributed, having a diameter comprised between 2 cm and 5 cm.

[0025] Advantageously, the sound-absorbing panel (100) of the invention also comprises a fourth layer (4) made of woven-non-woven fabric, which is interposed between the said first layer (1) and the said second layer (2).

[0026] In particular, the said fourth layer (4) preferably has a weight/m² comprised between 200 g and 600 g.

[0027] It must be stated that specific tests were made in order to increment the sound-absorbing power of a cardboard panel.

[0028] In particular, the said tests were made in order to obtain an improved sound-absorbing panel with high sound-absorbing power, which is capable of considerably reducing the echo effect and the interference caused by it in closed areas that are typically very noisy, such as for example restaurants, fairs, classrooms, canteens and the like.

[0029] The other evaluation of the tests referred to the resistance of the cardboard sound-absorbing panel, in view of the various applications as indicated above.

[0030] In particular, the evaluation was made with reference to the possibility of creating self-standing structures defined as "islands" in large closed areas, in which users can communicate without any background noise. Specifically, the coupling of the cardboard sound-absorbing panel of the invention, for example, allows for creating fair booths, convention rooms and meeting rooms in trade show areas.

[0031] Moreover, specific tests were made to devise a cardboard sound-absorbing panel with higher absorption power for a selected frequency range. In particular, tests were made in order to favor the absorption by the cardboard sound-absorbing panel of the invention of the frequencies comprised between 400 Hz and 3,000 Hz, i.e. the most important frequencies for the diffusion of the human voice. In view of the above, the cardboard sound-absorbing panel will contribute to reduce the acoustic pollution in working areas, such as call centers and open-

space offices in general.

[0032] It must be noted that noise attenuation tests were made in suitable test areas that allowed for objectively measuring the environmental impact of the introduction of a cardboard sound-absorbing panel according to well-defined dimensional specifications.

[0033] In particular, in compliance with the UNI EN ISO 354 regulations, the tests used to evaluate the noise attenuation are based on the evaluation of the reverberation time variations in a test area known as reverberation chamber.

[0034] More precisely, the reverberation chamber was used to measure the reverberation time variation determined by the introduction of a cardboard sound-absorbing panel.

[0035] It must be noted that the reverberation time coincides with the number of seconds that are necessary for the sound to decay by 60 dB (decibels) under the intensity level of the original sound.

[0036] By applying normative formulas, the characterization of the reverberation time allowed to define the alpha coefficient that refers to the cardboard absorption properties.

[0037] Upon changing the frequency, the evaluation of cardboard panels with different shapes allowed to identify the most appropriate shapes and dimensions of the cardboard panels.

[0038] Moreover, the large amount of data allowed for identifying the shapes of the less performing cardboard panels in terms of absorption in order to evaluate a possible use of the said panels in not particularly noisy areas.

[0039] In particular, the tests have given the best results with the sound-absorbing panel (100) according to the invention, according to the embodiment shown in Fig. 1.

[0040] In any case, it must be noted that the sound-absorbing panel (100) according to the invention can have any shape and be customized and coated with any material or fabric, while maintaining a high absorbing power.

Claims

1. Sound-absorbing panel (100) comprising at least three layers (1, 2, 3), of which:
 - a first cardboard layer (1) provided with a set of through slots (11);
 - a second cardboard layer (2) provided with a set of through holes (21);
 - a third cardboard layer (3) devoid of through holes or slots.
2. The sound-absorbing panel (100) of claim 1, wherein the said first layer (1), second layer (2) and third layer (3) have a thickness comprised between 5 mm and 30 mm.

3. The sound-absorbing panel (100) of claim 1 or 2, wherein the said slots (11) of the first layer (1) are identical and regularly distributed.
4. The sound-absorbing panel (100) of claim 3, wherein the slots (11) of the first layer (1) have a length comprised between 20 cm and 30 and a width comprised between 4 mm and 2 cm. 5
5. The sound-absorbing panel (100) of any one of the preceding claims, wherein said holes (21) of the second layer (2) are identical and regularly distributed. 10
6. The sound-absorbing panel (100) of claim 5, wherein the said holes (21) of the second layer (2) have a diameter comprised between 2 cm and 5 cm. 15
7. The sound-absorbing panel (100) of any one of the preceding claims, wherein the said second layer (2) is disposed between the said first layer (1) and third layer (3). 20
8. The sound-absorbing panel (100) of any one of the preceding claims, comprising a fourth layer (4) made of woven-non-woven fabric. 25
9. The sound-absorbing panel (100) of claim 8, wherein the said fourth layer (4) is interposed between the said first layer (1) and second layer (2). 30
10. The sound-absorbing panel (100) of claim 8 or 9, wherein the said fourth layer (4) has a weight/m² comprised between 200 g and 600 g.
11. The sound-absorbing panel (100) of any one of the preceding claims, wherein the said first (1), second (2) and third layer (3) are made of corrugated, alveolar or honeycomb cardboard. 35

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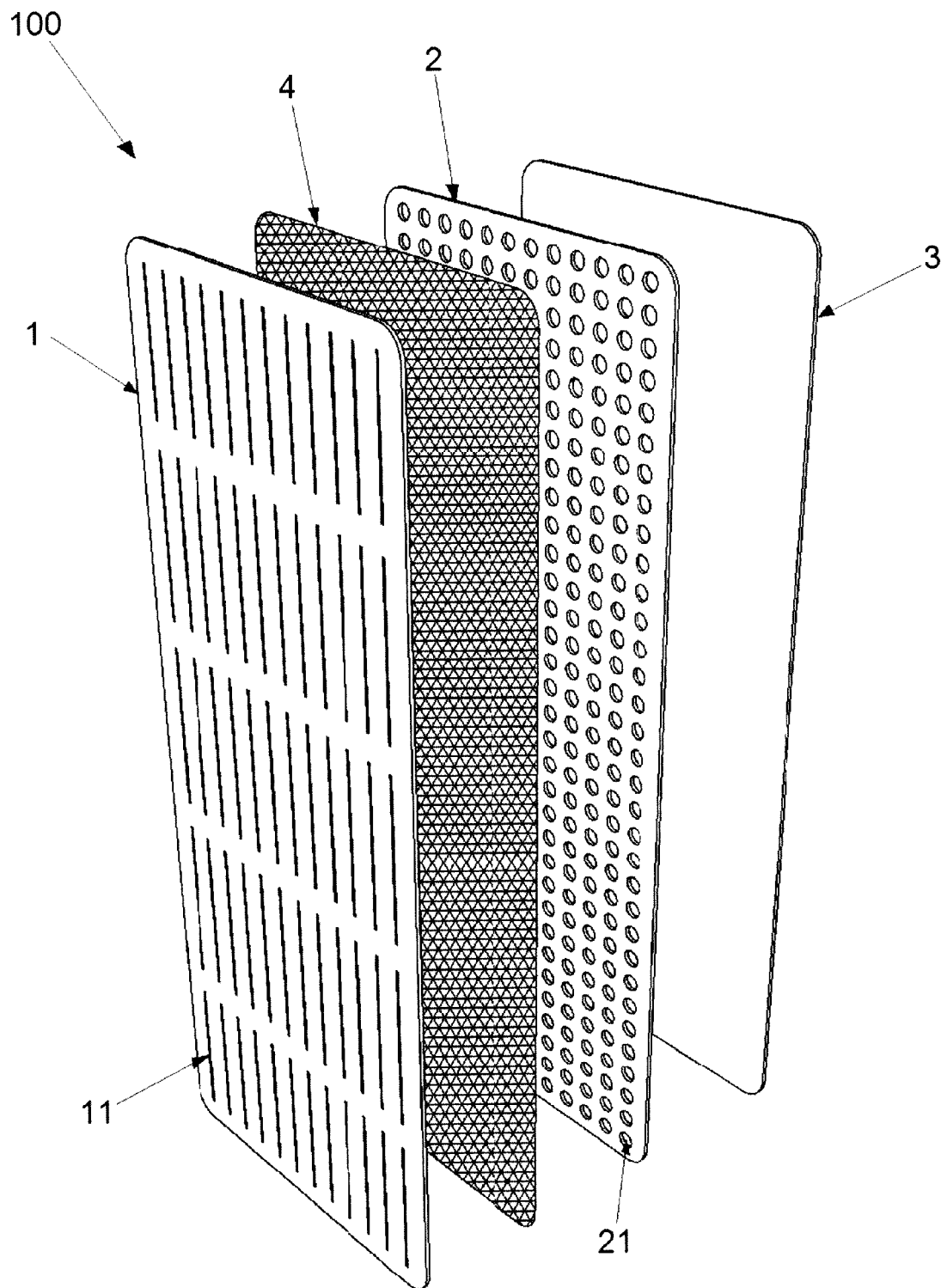


FIG. 1



EUROPEAN SEARCH REPORT

Application Number
EP 15 42 5021

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 8 251 175 B1 (ENGLERT MARK [US] ET AL) 28 August 2012 (2012-08-28) * column 4, line 25 - line 33; figure 4 * -----	1-5,7-11	INV. E04B1/86 E04B1/74 E04B1/84
A	DE 79 20 434 U1 (WIKA ISOLIER- UND DÄMMTECHNIK GMBH) 11 October 1979 (1979-10-11) * page 2, line 11 - line 14 * * page 4, line 14 - line 21; figures 1,2 * -----	1-11	
			TECHNICAL FIELDS SEARCHED (IPC)
			E04B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 25 August 2015	Examiner Delzor, François
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 42 5021

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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25-08-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 8251175	B1	28-08-2012	AU 2012240553 A1 31-10-2013
			CA 2830732 A1 11-10-2012
			CN 103443372 A 11-12-2013
			EP 2694750 A1 12-02-2014
			JP 2014513223 A 29-05-2014
			KR 20140027175 A 06-03-2014
			NZ 616728 A 24-12-2014
			RU 2013147750 A 10-05-2015
			US 8251175 B1 28-08-2012
			WO 2012138466 A1 11-10-2012

DE 7920434	U1	11-10-1979	NONE
