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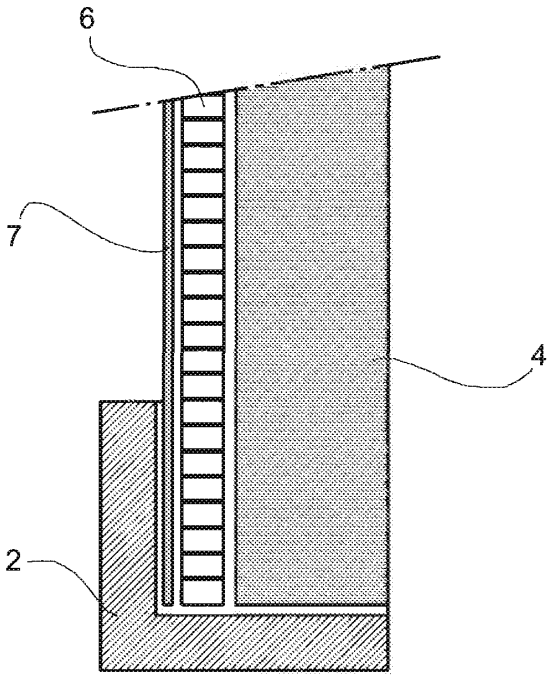
(54) Acoustically active board of textile material

(57) The board is produced mainly using textile fibres, has a high sound-damping capacity and is constructed in the form of a flat or three-dimensional decorative panel which may also be modular. It is used to improve the acoustic and furnishing properties of environments, the constructional characteristics of which may result in undesirable resonance and/or reverberation. The board consists of a fibrous mass which performs the sound-damping function. The aesthetic function is performed by the visible external surface of the fibrous mass. This surface may be flat or in three-dimensional relief, coloured or printed or patterned. The pattern may extend as far as the sides, or a frame made of other material may be provided. By way of the desired aesthetic effect, the surface may be more or less smooth, or embossed, or knurled. The board may consist of several layers, one of which, being optional, has the function of a resonator. The board is formed by means of a pressing operation at a suitable temperature with mechanical or manual shaping where required.

FIG. 3



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Description

[0001] The board according to the present invention consists of a support for bonded textile materials and is constructed in the form of a flat or three-dimensional decorative panel, with a surface which is varyingly decorated and/or worked, or also in a high relief or low relief form. The board is characterized by a marked acoustic activity since it acts as a sound-damping device. By means of modification of the set of fibres and lining layers, it is possible to achieve a sound-damping effect in all the audible frequencies or in selected bands. Its principal use is for acoustically improving environments where there is little furniture or the linear form of the walls may produce undesirable resonance. Typical environments of this kind are conference rooms and home theatres, restaurants, waiting rooms, lounges and public premises. The appearance of the board allows an improvement and/or personalization of the said premises with simultaneous improvement in their acoustic properties.

[0002] In greater detail, the present invention relates to a board having the characteristic features described in Claim 1 below. Further preferred features of the board according to the invention are contained in the dependent claims.

[0003] The board basically consists of a layer of bonded fibrous material which is made using the technology of non-woven fabrics, where the fibres used may be synthetic or artificial or natural or also a mixture thereof. Bonding of the fibres is achieved by insertion, in the fibrous mass, of fibres or granules of low-melting polymers which, after heat treatment, bond together the fibres by means of a very large number of welding points. The bonding stability is optimum at room temperature, while there is a return to a plastic behaviour by means of heating to a temperature close to that of melting of the granules or fibres which act as a binder.

[0004] The board may be made using only one layer of fibrous mass or, depending on the aesthetic appearance and sound-damping performance required, the presence of a second additional layer of textile material may be envisaged.

[0005] The choice as to the density of the fibrous mass and the fineness of the fibres is performed depending on the desired sound-damping capacity.

[0006] When it is desired that the board should perform a selective sound-damping function preferably within certain bands of the sound spectrum, a third intermediate layer is added between the fibrous mass of the first layer and the outer fabric acting as a second layer. The third layer consists of various material, preferably polymer material which has the same composition as the fibres forming the fibrous mass. The third layer has a thickness depending on the desired acoustic performance and is perforated.

[0007] By means of the openings present on it and its thickness, the third layer acts as a resonator provided with numerous necks. When a sound wave strikes the opening of the neck in a resonator, the air which is situated in the neck is made to vibrate and the air which is situated in the cavity undergoes periodic compression and rarefaction. The absorption is dependent upon the friction affecting the particles of air inside the neck. Owing to the limited volume of the neck, the air contained inside behaves in the manner of a mass which acts on a spring consisting of the air contained inside the cavity. The resonance frequency is defined by the equation

$$f = \frac{c}{2\pi}\sqrt{\frac{A}{lV}}$$

where A is the cross-section of the neck of the resonator, 1 is the length of the neck
and V is the volume of the cavity.

[0008] The typical graph of the absorption coefficient in the case of a cavity resonance consists of a Gaussian curve which is very narrow and selective within a limited frequency range.

[0009] In the case of the board according to the present invention, the presence of fibrous sound-damping material within the cavity (but not in the neck) results in less selective absorption, but still with an increase in the sound-damping effect within a relatively limited frequency band. By choosing in the desired manner the dimensions of the holes or openings and the thickness of the layer it is possible to obtain a board with an increased sound-damping capacity in specific zones of the sound spectrum.

[0010] The fibrous body of the board does not perform only a sound-damping function, but also contributes greatly to the mechanical solidity and dimensional stability of the article.

[0011] An aesthetic function is instead performed by the visible surface of the board. This surface may be simply coloured, with a surface which may or may not be worked, or more specifically hand decorated or painted, or printed with drawings or with photographs, or also consist of various suitably assembled textile materials.

[0012] A further variant consists in the surface with a corroded appearance, where a more or less pronounced incision or corrosion of the surface produces the coloured design (sinking colour effect).

[0013] The board, in all the variants, may be formed as a board on its own or as part of a larger size design, so as to be able to cover even entire walls or ceilings. In this case it is constructed with invisible (flush) frames so as to be able to move the individual components towards each other, minimizing the distance between the various parts of the overall board/design/sculpture.

[0014] The walls or ceilings which are covered with the board divided into different decorative panels may be prepared in a stable manner, with the panels fixed to a fixed framework, or in a temporary manner, by means of spe-

cial structures provided with hooks removable by means of simple repeated pressure or magnetic fasteners or also Velcro fasteners.

[0015] In the case of the board being decorated manually, the fibrous mass of the first layer and any further layers are reduced to the desired density and thickness by means of a preliminary hot-pressing operation. In this way the surface remains smooth for continuation of the manual decoration.

[0016] In the case of the board decorated with prints, photographs or with a rough or sculptured surface, the operation of applying the print or the operation of modifying the surface is performed by means of a hot-pressing operation which has the simultaneous function of achieving the desired density and thickness requisites of the fibrous mass.

[0017] The layers in addition to the first layer of fibrous mass are also fixed together by the same pressing operation, with the arrangement of low-melting fibres or granules between the layers.

[0018] The surface appearance is determined by the pressing conditions or by the dyeing or colouring or joining or decorating conditions to which the board is subject, as well as by the surface of any mould.

[0019] Further advantages and characteristic features of the present invention will become clear from the detailed description which follows, provided by way of a non-limiting example with reference to the accompanying plate of drawings in which:

Figure 1 is a front view of a board according to the invention, from which the decorative design has been omitted for the sake of greater clarity;
Figure 2 is a cross-sectional view along the line II-II of Figure 1; and
Figure 3 is a view, on a larger scale, of a detail according to Figure 2.

[0020] In these figures, 1 denotes a board viewed from the front, omitting the decorative design thereof, 2 denotes a frame of the board, 4 denotes a first layer of sound-damping fibrous mass, 7 denotes a decorative fabric or second layer and 6 denotes a perforated or third layer. The second layer 7 and the third layer 6 are visible only in Figure 3, the scale of which has been conveniently enlarged with respect to that of Figure 2.

[0021] The board 1 was made using a heat-bonded polyester fibre panel with a density of 50 kg/m^3 and thickness of 35 mm. A third layer 6 was combined with the first layer 4 formed by said panel, said third layer consisting of a sheet of plasticized polyester with a thickness of 6 mm in which holes with a diameter of 4 mm were formed. The surface area of the holes forms 45% of the entire area. The second layer 7 was combined on top of the third layer 6, said second layer being formed by a non-woven fabric, again made of polyester, water-punched with a weight of 180 g/m^2 and thickness of 1.2 mm previously printed with dispersed dies and reproducing a patterned design. Joining together of the various layers 4, 6, 7 was performed by passing the board 1 briefly through a hot press with a very light pressure so as to reduce the overall thickness to 40 mm. By way of a glue between the three layers 4, 6, 7 two strata of low-melting polyester fibre were used. The composite board 1 thus obtained was then finished with a wooden frame 2. The board 1 thus made, tested in accordance with the standard ASTM 1050-90, has a good sound-damping capacity over the whole sound spectrum and a greater sound-damping capacity in the range of 150 to 600 Hz.

[0022] Obviously, without modifying the principle of the invention, the constructional details and the embodiments may vary greatly with respect to that described purely by way of example, without thereby departing from its scope. In particular, the use of the board according to the invention is not subject to particular limitations and may thus also be used as a wall panel and for the construction of false ceilings.

Claims

1. Board (1) produced mainly using textile fibres, having a high sound-damping capacity and constructed in the form of a flat or three-dimensional panel, said board (1) comprising a first layer (4) consisting of a fibrous mass which performs the sound-damping function and having a visible external surface which performs an aesthetic function.

2. Board (1) according to Claim 1, in which said visible external surface is flat or in three-dimensional relief, coloured or printed or patterned, smooth or embossed, or knurled, or also modelled in various forms.

3. Board (1) according to Claim 1 or 2, in which said aesthetic function is performed by the visible external surface of the fibrous mass of the first layer (4).

4. Board (1) according to any one of Claims 1 to 3, in which said first layer (4) is formed by means of a pressing operation if necessary followed by a mechanical or manual shaping operation.

5. Board (1) according to Claim 1 or 2, comprising a second layer (7) having a visible surface which performs said aesthetic function.

6. Board (1) according to Claim 5, in which said second layer (7) is of the fibrous type and consists of a shuttle-woven or knitted fabric or a punched or heat-bonded non-woven fabric.

7. Board (1) according to Claim 5 or 6, in which said second layer (7) has a visible coloured or printed, patterned or embroidered surface.

8. Board (1) according to any one of the preceding Claims 5 to 7, in which said second layer (7) is joined to said first layer (4) by means of heat-meltable powders, granules or fibres or by means of resins which are distributed so as to prevent the formation of closed films able to alter the air-permeability characteristics, or also by means of stitching.

9. Board (1) according to any one of Claims 5 to 7, in which a third perforated layer (6) with a resonator function is inserted between said first layer (4) and second layer (7) and is able to select a part of the sound spectrum in which the greatest sound-damping effect may be achieved.

10. Board (1) according to Claim 9, in which said third layer (6) is joined to the first layer (4) and to the second layer (7) by means of heat-meltable powders, granules or fibres or by means of resins which are distributed so as to prevent the formation of closed films which are able to alter the air-permeability characteristics, or also by means of stitching.

11. Board (1) according to any one of the preceding claims, in which the surface with an aesthetic function is coloured or patterned by means of preliminary dyeing of the fibres, or by means of printing, or by means of paints.

12. Board (1) according to any one of the preceding claims, having a frame (2) to which decoration of the surface with an aesthetic function may also be applied.

13. Board (1) according to any one of the preceding claims, having an overall structure divided into smaller modules in order to facilitate the mounting thereof on large surfaces.

FIG. 1

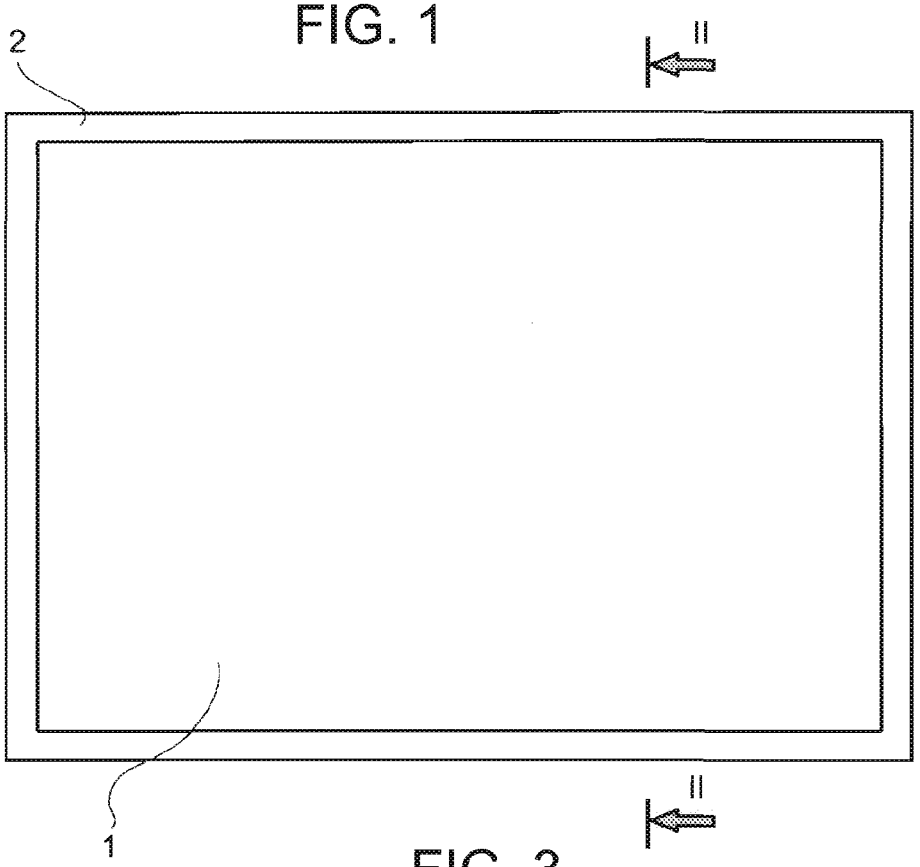

FIG. 2

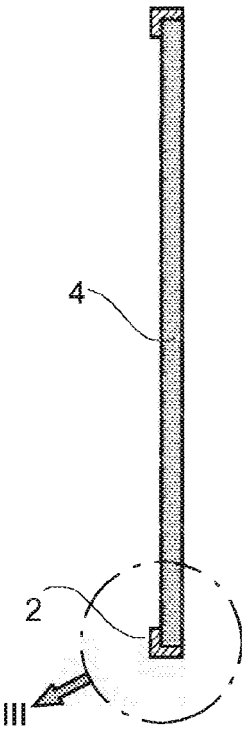

FIG. 3