



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 342 857 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

10.09.2003 Bulletin 2003/37

(51) Int Cl.7: **E04B 1/84**, E01F 8/00

(21) Application number: **03075569.8**

(22) Date of filing: **26.02.2003**

(84) Designated Contracting States:

**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT SE SI SK TR**

Designated Extension States:

AL LT LV MK RO

(72) Inventor: **Teobaldelli, Angelo**

62029 Tolentino (IT)

(74) Representative: **De Gregori, Antonella**

Ing. Barzano & Zanardo Milano S.p.A.

Via Borgonuovo 10

20121 Milano (IT)

(30) Priority: **28.02.2002 IT MI20020409**

(71) Applicant: **Isopol S.r.l.**

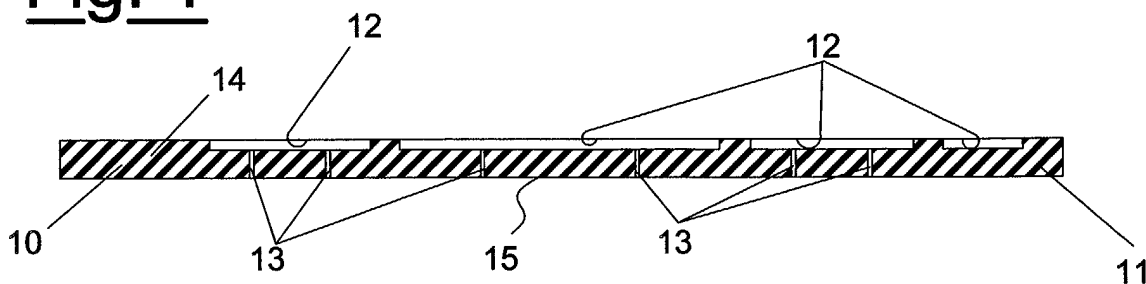
20045 Besana Brianza (Milan) (IT)

(54) **Coating element with high sound-absorbing properties**

(57) An element (10) with high sound-absorbing properties, comprising at least one layer (11) made up of thermosetting and/or thermoplastic and/or expanded polymers, which, by their intrinsic nature, do not have a

substantial sound-absorbency coefficient in the spectrum of audible frequencies; the special constructive geometry of the element (10) allow high sound-absorbency values to be attained for all of the spectrum of frequencies with a low thickness.

Fig. 1



EP 1 342 857 A2

Description

[0001] The present invention refers to elements having special sound-absorbing properties.

[0002] More specifically, the invention concerns panels consisting of thermosetting and/or thermoplastic and/or expanded polymers which, given their nature and the specific constructive geometry adopted, allow high sound-absorbency values to be obtained in a wide spectrum of audible frequencies, being able to combine with it heat insulation, coating and/or decorative functions.

[0003] Currently different types of products or materials are used which, exploiting their intrinsic characteristics, can carry out a sound-absorbing function.

[0004] Such materials, currently on the market, comprise open or closed cell polyurethane, capable of being combined with other materials, such as lead, stone/glass wool, or other materials with woven fibres, which exploit the same principle, or panels with variable surface geometry, in general realised with different parallelepipeds.

[0005] However, such materials have some drawbacks, which limit their sound-absorbency and their use.

[0006] Indeed, materials with woven fibres and polyurethane have particularly high sound-absorbency characteristics at medium and high frequencies and, moreover, to obtain good results in such a case, it is always necessary to use substantial thicknesses.

[0007] On the other hand, their possible combination with lead plates or other similar materials, so as to give greater sound-insulation properties, tends to make the entire system heavier, in some cases further forcing the use of bulky and heavy frames or veritable support structures.

[0008] Moreover, above all in certain working conditions, such as extremely moist places, there can be, in the case of absorbency of a substantial amount of moisture, an alteration of the absorbency characteristics of the entire structure, which is also made heavier internally.

[0009] To that which has just been stated we can add that the production cycle for such materials requires chemical reactants with a high toxic content and with the formation of dangerous gases in the case of fire. Finally, an aspect as yet unresolved consists of the impossibility of recycling such materials, with the consequent problems of disposal thereof.

[0010] Coating panels with variable surface geometry currently in use, on the other hand, exploit the concept of breaking the parallelity present inside a room, producing a fractioning effect of the sound waves.

[0011] This type of system, whilst it may be advantageous from the point of view of lightness and simplicity of application of the entire structure, nevertheless has a low yield in the absorbency of sound waves according to the audible spectrum and, in particular, has serious drawbacks at low frequencies.

[0012] The purpose of the present invention is, therefore,

that of avoiding the aforementioned drawbacks and, in particular, that of realising free and/or coating elements with high sound-absorbing properties, which ensure better sound absorbency at all audible frequencies, with respect to the prior art.

[0013] Another purpose of the present invention is that of realising elements with high sound-absorbing properties, which foresees a wide spectrum of selective and adjustable action at the various frequencies, maintaining high sound-absorbency values and, at the same time, limited thickness of the structure.

[0014] A further purpose is that of realising panels and/or coating elements with high sound-absorbing properties and, in particular, a panel, associated with a sound-absorbing system, which maintains the chemical characteristics of the original materials and has an extremely light, functional, versatile and particularly reliable structure, but/and has, thanks to is special construction, improved sound-absorbency values.

[0015] The last but not least purpose of the invention is that of realising elements with high sound-absorbing properties in an extremely simple way and with relatively low costs, thanks to the advantages obtained.

[0016] These purposes according to the present invention are accomplished by realising elements, in particular panels, of different shapes and sizes, with high sound-absorbing properties, according to claim 1, to which we refer for the sake of brevity.

[0017] It should be remembered, in any case, that the following technical considerations can be applied in an equivalent manner to coating panels and/or relative sound absorbing systems in general.

[0018] The panel according to the invention is realised with thermosetting and/or thermoplastic and/or expanded polymers not necessarily having a good sound-absorbency coefficient in the audible frequency spectrum. The specific constructive geometry of such a panel allows with sound-absorbency values to be obtained, even at low frequencies, with a limited thickness of the entire structure, which thus has extremely low bulk and is light with respect to that which can be obtained according to conventional techniques, with the same performance obtained.

[0019] Advantageously, the innovations of such a panel and of the relative absorbency system allow, in particular, complete conservation of the chemical characteristics of the original materials and allow complete visibility of the sides of the panel itself, which can be treated aesthetically.

[0020] Moreover, it is possible to fix the panel to any type of wall, even those made with masonry, since, above all using materials like expanded polystyrene, very light panels are obtained with low industrial production costs.

[0021] Such characteristics, together with simplicity in recycling operations of the materials used for the production of such panels, make the product extremely useful both from a technical and aesthetic point of view.

[0022] Further characteristics and advantages of a coating element, in particular a coating panel with high sound-absorbing properties according to the present invention, shall become clearer from the following description, given as an example and not for limiting purposes, referring to the attached schematic drawings, in which:

- figure 1 shows a side section view of a preferred example embodiment of a panel with high sound-absorbing properties, according to the invention;
- figure 2 is a top plan view of the panel of figure 1;
- figure 3 is a side section view of a second preferred example embodiment of a panel with high sound-absorbing properties, according to the invention;
- figure 3A shows a cross-section of an alternative embodiment, with respect to the one illustrated in figure 3, of the coating panel according to the invention;
- figure 4 is a cross-section of an absorbcency system comprising a series of coating panels with high sound-absorbing properties according to the invention;
- figure 5 is a cross-section of a third embodiment of a sound-absorbent coating panel, according to the invention;
- figure 5A is an alternative embodiment, with respect to that of figure 5, of the coating panel according to the invention;
- figure 6 is a longitudinal section view of an embodiment of the absorbcency system, comprising the panel according to the invention;
- figure 7 shows a section view of an embodiment of the absorbcency system, comprising the panel according to the invention, which is an alternative to that which is illustrated in figures 3 and 4;
- figure 8 shows a Cartesian graph depicting a comparison between the curves, according to the frequency, of the sound-absorbency coefficients obtained experimentally on an expanded polystyrene panel and on a coating panel of the same material, but realised according to the present invention.

[0023] With reference to the aforementioned figures, with 10 is generically indicated a panel, according to the present invention, comprising, by themselves or in combination, thermoplastic, thermosetting or expanded materials, which do not necessarily, by their intrinsic nature, lend themselves particularly to being used in sound absorbcency, since they have a low absorbcency coefficient in the audible frequency spectrum. In particular, in non-limiting example embodiments of the attached figures, a layer of low-density expanded polystyrene, used as the material constituting the panel 10 is indicated with 11.

[0024] According to the invention, the panel 10 has at the rear, i.e. at the side surface 14, opposite the one which is visible from the outside, a series of special

shaped recesses 12, which can be open on the surface and communicating, through suitable small holes 13, with the front face 15.

[0025] Such recesses 12 can be arranged in various ways and can vary both in shape and in number and/or position, to be able to ensure adequate absorbcency of sound waves in the full range of audible frequencies. Moreover, the diameter and/or the number of the holes 13 can vary.

[0026] By using low thicknesses of the material 11 constituting the panel 10 and by suitably sizing the recesses 12, a reactive vibrational modulus which is totally innovative and effective from the technical point of view is created. It should be remembered, regarding this, that the system still has greater absorbcency, with respect to the prior art, even without the communicating holes 13.

[0027] As an alternative to that which has been described previously, the recesses 12 can be closed on the rear surface 14 sealing the panel 10 to a flat wall or using rear panels, constructed with the same material as the panel 10, which carry out a rear covering function.

[0028] Such a configuration is illustrated in detail in figure 3, where a rear covering panel, substantially having a lid function, is generically indicated with reference numeral 16.

[0029] The panel 16, made in one or more portions, can furthermore have a series of holes 17, which may or may not be made at the holes 13 of the structure 11, so as to increase the absorbcency of sound frequencies on both rear and front surfaces of the panel 10.

[0030] In alternative but not limiting embodiments, with respect to that which has been described above, the panels 10 having a structure like the one illustrated in figure 1, can also be placed on top of one another, symmetrically or asymmetrically, so as to create different absorbing recesses 12 for different frequencies (see, in particular, figure 4).

[0031] To vary the absorbcency ranges of the panels 10, it is also possible to insert inside the recesses 12 materials of varying nature, including, for example, expanded melammynes. The expanded melammne portion, generically indicated with 18 in figures 5 and 5A, can totally or partially fill the recesses 12.

[0032] In further embodiments of the coating panel 10 according to the present invention, the aforementioned panel can be used in absorbcency systems together with other materials, as in the illustrated example in figure 6, which represents a longitudinal section view of a standard buffering panel for soundproof cabin.

[0033] As clearly illustrated in figure 6, the panel object of the invention 10 is coupled at the rear with an outer shell 20 made from steel and foresees, at the front, a layer of glass wool 21, with which a final layer of perforated steel plate 22 is associated.

[0034] The coating panel 10 can finally realise an absorbing structure like the one illustrated in detail in figure 7. In such a case, two panels 10, with the same or similar geometry and structure, are joined along their rear sur-

faces 14 and have the recesses 12 facing each other, so that the holes 13 are present on one or the other side of the structure and so that the resulting panel can absorb noise on both faces/sides and the front face of one of the two panels 10 constitutes the rear surface 19 of the entire structure.

[0035] By operating with different geometries of the recesses of the holes, different thicknesses, as well as different mechanical and physical properties, such as the density of the polymers constituting the inner layer 11 of the panel 10, it has been demonstrated experimentally that such a panel 10 and the relative structures illustrated in the attached figures can be used for absorbing sound at low, medium and high frequencies in numerous civil and industrial applications.

[0036] In particular, experimental tests have been carried out at certified and recognised laboratories on low-density expanded polystyrene coating panels 10, with predetermined recesses 12, shaped according to predetermined shapes calculated based upon the technical specifications to be satisfied. The experimental tests were conducted placing the sample on the floor of a reverberation room and subjecting it to sound radiation emitted within current regulations.

[0037] A graph relative to the data on the sound-absorbency coefficient of such a structure was thus obtained. A comparison between the experimental sound-absorbency coefficient of the expanded polystyrene sample of the coating panel 10 (curve A of figure 8) and the experimental sound-absorbency coefficient of a normal expanded polystyrene panel of the same thickness (20 mm) and size as the panel (curve B), with all other things being equal, clearly demonstrated that, for the whole spectrum of audible frequencies, the panel 10 has a series of absorbency coefficients which are greater than those detected, at the same frequency, in the measurements carried out on the conventional expanded polystyrene panel.

[0038] From the industrial point of view, the coating panel 10 can thus be used, for example, to increase the sound-absorbency at medium frequencies of the spectrum of typical sound-absorbing panels realised with a steel, glass wool, and perforated containment plate shell, normally used in barriers and/or in buffering of soundproof cabins for industrial machinery and/or for domestic appliances where, indeed, to obtain effective sound-absorbency at the lowest frequencies, a thicker and thus bulkier panel is needed.

[0039] The coating panel 10 is in this case positioned inside the shell of the soundproofing buffering panel (see figure 6) to ensure greater absorbency of sound waves in the whole spectrum of audible frequencies, at the same time maintaining the compactness and lightness of the conventional structure.

[0040] The coating panel 10 can also be used as an inner coating of washing machine or dishwasher casings, so as to increase the sound-absorbency and, in any case, to avoid mode biasing of the housing. More-

over, it can also be applied in inner coatings of automobiles (roof of the passenger compartment, sun visors) or in engine compartments or under the engine and on bonnets.

[0041] Finally, the panel 10 can be applied directly or indirectly on soundproof screens or road barriers and can be used as an inner coating for ducts or piping of air conditioning units, since it has negligible negative effects upon pressure drops.

[0042] As far as civil applications are concerned, the panel 10 can be used as an inner coating for the surfaces of rooms of residential buildings (bedroom, living room, office) and as soundproof coating for recording studios, listening rooms, auditoriums, cinemas, etc.

[0043] In any case, the fact that the panel 10 has a smooth front surface 15, besides good sound-absorbency, makes it useful in all applications in which good sound diffusion must be obtained in rooms.

[0044] From the description which has been carried out the characteristics of the element with high sound-absorbing properties, object of the present invention, are clear, just as the advantages are also clear.

[0045] Finally, it is clear that numerous variants can be brought to the elements in question, without for this reason departing from the novelty principles inherent to the inventive idea, just as it is clear that, in the practical embodiment of the invention, the materials, the shapes and the sizes of the illustrated details can be whatever according to the requirements and they can be replaced with others which are technically equivalent.

Claims

1. Coating element and/or panel with high sound-absorbing properties, of the type comprising at least one panel (10) made up of at least one layer (11) of expanded and non-expanded thermoplastic or thermosetting material, in particular polystyrene and expanded polypropylene, said materials being present individually or in combination, **characterised in that** at least one surface (14) of said panel (10) has a series of shaped recesses (12) of various shapes and sizes present in predetermined areas of the surface (14).
2. Coating element and/or panel according to claim 1, **characterised in that** said surface (14) with shaped recesses (12) is arranged at the rear of the panel (10), on the opposite side with respect to a front surface (15) which can be seen from the outside, said front surface (15) having a substantially smooth and flat configuration or else worked decoratively.
3. Element according to claim 2, **characterised in that** said shaped recesses (12) are open on the surface and communicate, through suitable holes (13)

made inside said layer (11), with the front surface (15).

of residential buildings and as a soundproof coating of recording studios, listening rooms, auditoriums, cinemas, etc.

4. Element according to claim 1, **characterised in that** said shaped recesses (12) are open on said rear surface (14). 5
5. Element according to claim 1, **characterised in that** said shaped recesses (12) are closed on said rear surface (14) by means of at least one flat wall or at least one second rear panel (16), suitable for carrying out the covering function. 10
6. Element according to claim 5, **characterised in that** said second rear panel (16) has a series of holes (17), which can be made at the holes (13) of said layer (11), so as to increase the absorbency of sound frequencies on both rear and front surfaces (14, 15), of said panel (10) . 15
20
7. Element according to claim 1, **characterised in that** at least two of said panels (10) are placed on top of each other, symmetrically or asymmetrically, so as to create different sizes of said shaped recesses (12), in order to obtain adequate absorbency for different frequencies. 25
8. Element according to claim 1, **characterised in that** said shaped recesses (12) are filled, at least partially, with portions (18) of polymeric material. 30
9. Element according to claim 1, **characterised in that** it is used in standard buffering panels for soundproof cabins, said panel (10) being coupled at the rear with an outer shell (20) and foreseeing, at the front, the insertion of a layer of glass wool (21), or other similar materials, with which a final layer of perforated steel plate (22) is associated. 35
10. Element according to claim 3, **characterised in that** two of said panels (10) are joined along their rear surfaces (14) and have said recesses (12) closed inside two outer surfaces (14, 15). 40
11. Element according to claim 10, **characterised in that** on one side and on the other of said two panels (10) a series of holes (13) are foreseen, which are made inside said layer (11). 45
12. Element according to claim 1, **characterised in that** it can be used as an inner sound absorber for casings of washing machines or dishwashers, of automobiles, inside the passenger compartment, in the engine compartment, under the engine and on bonnets, on soundproof screens or road barriers and as an inner coating for ducts or tubing of air conditioning units, said element also capable of being used as an inner coating of surfaces of rooms 50
55

Fig. 1

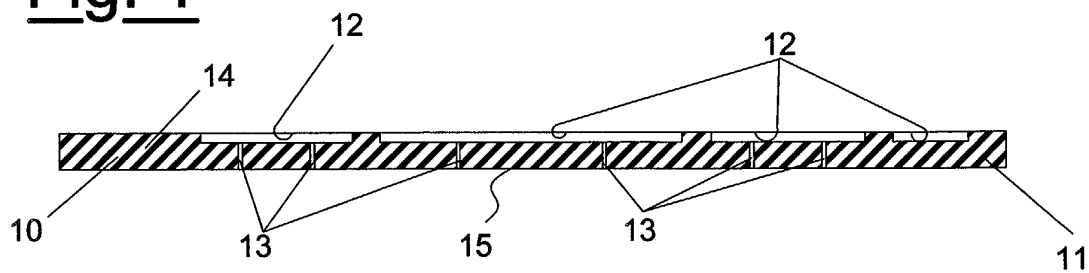


Fig. 2

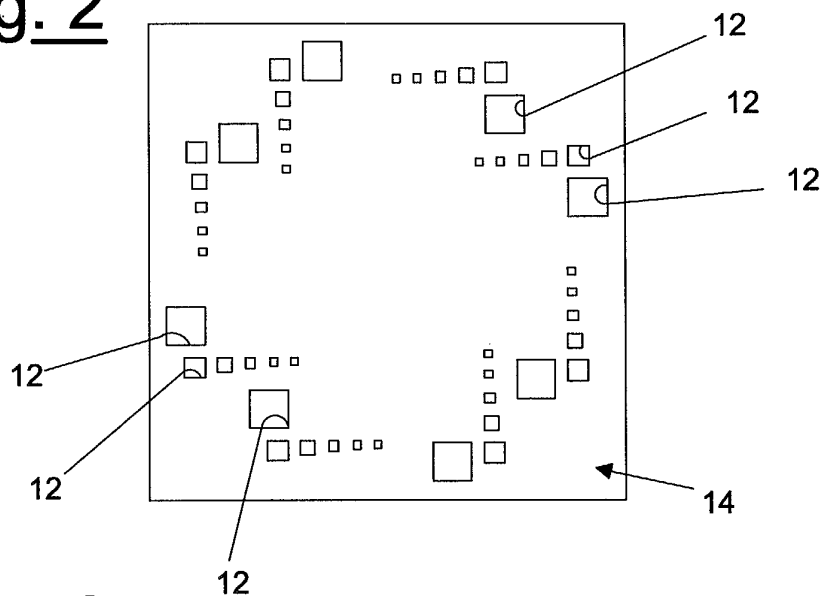


Fig. 3

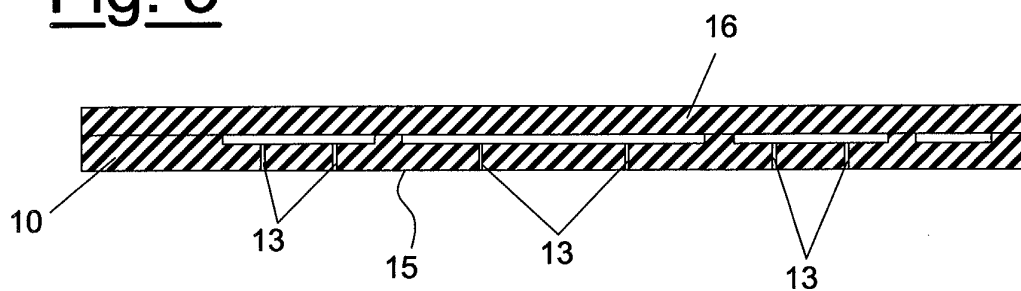


Fig. 3A

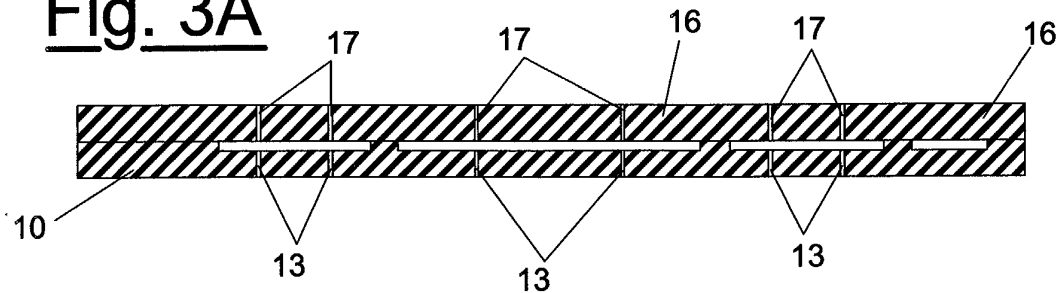


Fig. 4

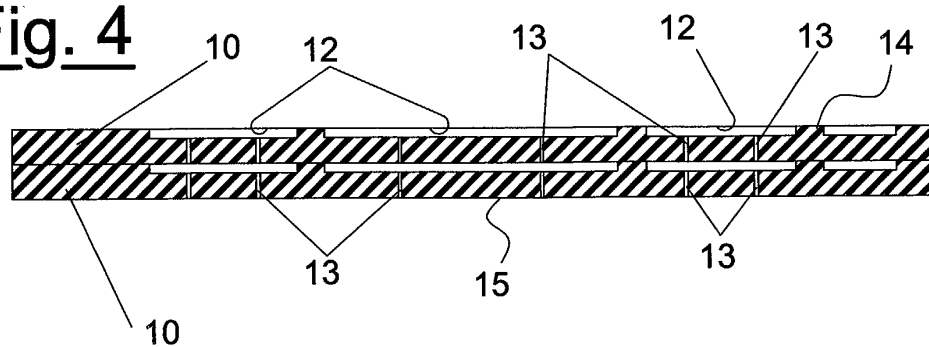


Fig. 5

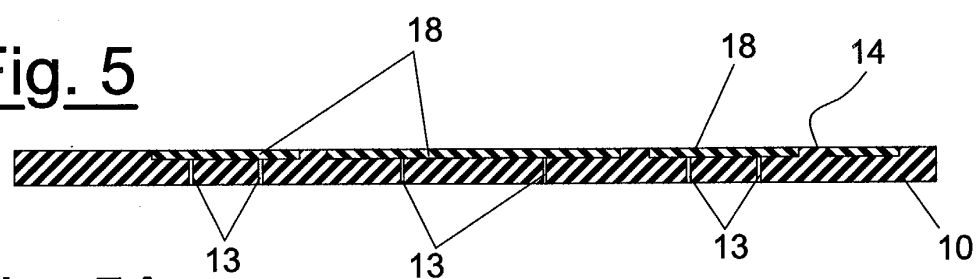


Fig. 5A

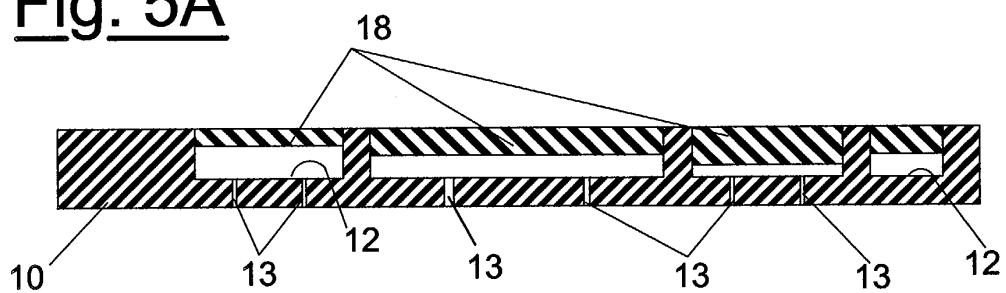


Fig. 6

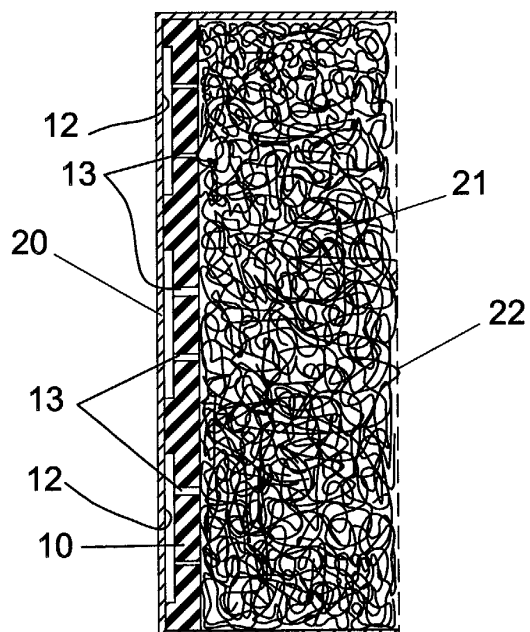


Fig. 7

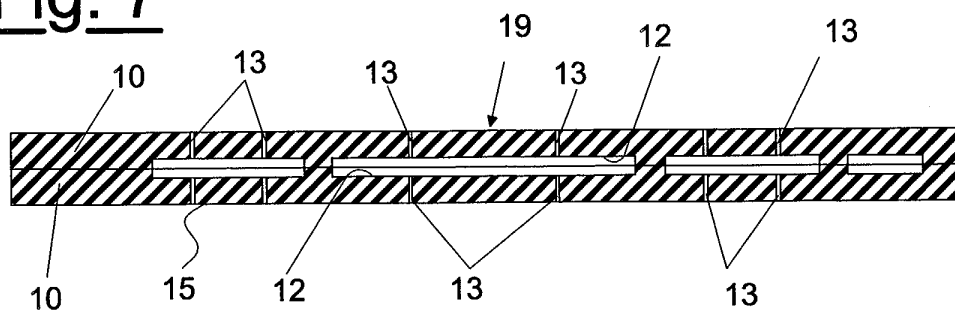


Fig. 8

