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(54) Title: MULTI–PURPOSE, ALUMINUM FOAM–BASED SOUNDPROOF PANEL

(57) Abstract

There is disclosed a multipurpose, aluminum foam–based soundproof panel which comprises at least one aluminum foam panel with a plurality of open pores. The open pores are formed from the closed pores within a mass of aluminum foam by rolling the aluminum foam into a panel. The aluminum foam panel with a plurality of open pores is bonded with or coated with fibrils, a perforated thin plate, a finish material, paint, a sound–absorbing member or noise insulator or a honeycomb structure on at least one surface or impressed with a pattern on one surface or has resonance hollows therein. In addition to being used as ultralight, construction finish materials with high durability and strength in the edifices or facilities which require noise insulation, the soundproof panel is superior in sound absorption performance and easy to handle. Furthermore, the panel allows a construction work to be easily executed.

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MULTI-PURPOSE, ALUMINUM FOAM-BASED SOUNDPROOF PANEL

Technical Field

The present invention relates, in general, to a multi-purpose soundproof panel and, more particularly, to an aluminum foam-based soundproof panel with irregular arrangement of a plurality of open pores different in size and shape, which can absorb sound and/or insulate noise over a wide frequency range as well as can be used as a construction finish material for various edifices.

Background Art

Originating from machinery, traffic vehicles, such as cars, trains, airplanes and the like, construction sites, audio instruments, etc., unfavorable sound, that is, noise, is a daily event. It is well known that noise is an injurious factor to personal health by causing hardness of hearing, headaches, uneasiness, etc. In addition, in industrial fields, noise and vibrations from machinery and instruments make a poor environment for workers, giving rise to a serious decrease in productivity and product quality.

Thus, it is strongly demanded that such a noise source be designed to operate as quietly as possible and that measures be taken to prevent the noise, once occurring, from propagating outside its own environment.

Now, this soundproofness is needed for almost all life environments, including working places, roadsides, railway sides, airports, construction working fields, common living spaces, such as apartments and offices, performance places, such as concert halls and theaters, gymnasiums and various resort complexes.

Conventionally, soundproof structures made from sound-controlling material or soundproofing materials capable of absorbing or insulating sound, such as noise barriers, soundproof partitions and soundproof rooms, are provided for the noise sources, in order to absorb noise and block its propagation.

General construction materials, such as wood and concrete, synthetic resins, such as polyurethane, polyethylene and polyester, inorganic fiber materials, such as glass wool and rock wool, metal materials, such as perforated metal plate, alone or in combination, are most widely used as soundproofing or sound-insulating materials.

Soundproofing or sound-insulating materials are required to show high sound absorption or insulation power over a wide frequency range and superiority in mechanical properties, such as durability, and thermal properties, such as incombustibility or flame retardancy, as well as to be low in production cost with ease in carrying out construction therewith.

Conventional soundproofing materials in current use, however, meet these requirements only partly. Considerable problems as they have, the conventional soundproofing materials are applied for the construction of soundproof or sound-insulating structures. For instance, soundproof structures made from woods or plastic resins are susceptible to heat, so that they might be problematic in the event of a fire. Glass wool or rock wool is poor in durability. What is worse, it produces pollution of the environment. Aluminum plates are satisfactory in durability and incombustibility but poor in noise-insulating or absorbing ability. In addition, the conventional soundproofing materials, except for metal materials, are almost incapable of being recycled, so they produce wastes upon discard.

Disclosure of Invention

Therefore, it is an object of the present invention to overcome the above problems encountered in prior arts and to provide a soundproof panel which is superior in soundproofing ability.

It is another object of the present invention to provide a light soundproof panel of high strength and durability, which is useful as an interior or exterior finish material for the buildings or facilities in which soundproofness is needed.

In accordance with the present invention, the above objects could be accomplished by a provision of a multi-purpose, aluminum foam-based

soundproof panel, comprising at least one aluminum foam panel with a plurality of open pores, wherein the open pores are formed from the closed pores within a mass of aluminum foam by rolling the aluminum foam into a panel, and the aluminum foam panel with a plurality of open pores is bonded with or coated with fibrils, a perforated thin plate, a finish material, paint, a sound-absorbing member or noise insulator or a honeycomb structure on at least one surface or impressed with a pattern on one surface or has resonance hollows therein.

The aluminum foam panel with a plurality of open pores, useful as a base for the soundproof panel according to the present invention, is prepared by subjecting a mass of aluminum to a conventional foaming process and by then rolling it into a plate. For instance, a mass of aluminum is molten in a mold equipped with a heater and a stirrer. After being maintained at an appreciate viscosity with the aid of a viscosity increasing agent, the molten aluminum is added with a foaming agent to produce an aluminum foam with closed pores. When rolling the aluminum foam, its closed pores break into open ones.

The term open pores as used herein, means the air bubbles which are trapped in not a closed state, but an open state in aluminum foam. Upon foaming aluminum metals, air bubbles form therein, most of which are closed, each providing a closed space. Because the aluminum panels containing such closed pores are now found to fall short of the ability to absorb sound waves, there are needed novel soundproof aluminum panels which are better in absorption of sound and/or insulation of noise. In the invention, the closed pores in aluminum foams are burst into open states by lightly rolling the aluminum foam panels.

The rolling with the aim of opening the closed pores may be carried out by pressing the aluminum foams to the extent that the thickness of the aluminum foams is reduced by, for example, about 20-30 %. Of course, the rolling reduction is determined depending on the conditions of the resulting aluminum, such as use, thickness, etc. Care should be taken not to compress the pores to flat by increasing the rolling reduction. The aluminum foam panels

thus obtained can be ultralight sound-absorbing materials with a pore volume amounting up to 90% in total.

Brief Description of the Drawings

The nature and mode of operation of preferred embodiments of the present invention will now be more fully described in the following detailed description, taken with the accompanying drawings wherein:

Figures 1 and 2 show a soundproof panel coated with fibrils in accordance with a first embodiment of the present invention, in a perspective view and in a cross sectional view, respectively;

Figures 3 and 4 show a soundproof panel provided with a perforated thin plate in accordance with a second embodiment of the present invention, in a perspective view and in a cross sectional view, respectively;

Figures 5 and 6 show examples of soundproof panels useful as construction finish materials in accordance with a third embodiment of the present invention;

Figures 7 through 9 are perspective views showing multilayer structures of soundproof panels in accordance with a fourth embodiment of the present invention;

Figures 10 and 11 are perspective views showing tactically processed soundproof panels in accordance with a fifth embodiment of the present invention;

Figures 12 and 13 show another example of a tactically processed soundproof panel in accordance with a fifth embodiment of the present invention, in a perspective view and in a cross sectional view, respectively; and

Figures 14 through 17 are perspective views showing examples of soundproof panels for use in construction of the ceiling, in accordance with a sixth embodiment of the present invention.

Best Modes for Carrying out the Invention

The application of the preferred embodiments of the present invention is best understood with reference to the accompanying drawings.

(First embodiment)

Referring to Figs. 1 and 2, there is schematically shown a soundproof panel 100 which comprises an aluminum foam 10 and fibrils 120. As seen, the aluminum foam 10 has a plurality of open pores 12 and at least one surface is coated with the fibrils 120 with the aid of an adhesive 110.

The soundproof panel 100 according to the first embodiment is prepared by the steps of rolling an aluminum foam panel 10 with closed pores into an aluminum foam panel with open pores 12, washing the aluminum foam panel 10, drying it, coating an adhesive 110 on at least one surface of the aluminum foam panel 10, bonding fibrils 120 on the adhesive coat 110 and curing the adhesive coat 110.

Preliminary for its subsequent steps, the washing step is to remove impurities, so as to efficiently bond the fibrils to the surface of the aluminum foam. For instance, the aluminum foam panel with open pores is immersed in a waterbath and ultrasonicated to remove impurities therefrom.

In the drying step, a heater, such as a drying furnace, may be used to desiccate the wet aluminum foam panel 10, thereby providing a condition under which the fibrils 120 should be more completely bonded to the aluminum foam panel 10.

There is no limitation to the adhesive if it is able to bond fibrils to the surface of aluminum metal. Examples of useful adhesives include natural or inorganic adhesives, such as water-soluble sodium silicate, casein and Arabic gum, rubber adhesives, such as SBR, NBR and NBR latex, polyurethane adhesives, formaldehyde adhesives, such as resol type phenol resins, and polymeric adhesives, such as polyvinyl acetate adhesives and styrene adhesives, with preference to water-soluble adhesives.

As for the bonding of the fibrils 120, it may be accomplished by taking advantage of electrostatic attraction. In detail, a static electricity of 20,000-80,000 V, for example, 34,000 V is applied on the panel 20 which has been preheated. Separately, a diluted fibril powder is charged in a static electricity-generator and applied with static electricity. While the panel 10 is moving at a

predetermined speed, the electrically charged fibril powder is sprayed on the adhesive coat 110 on the panel 10.

Useful fibrils may be made from natural fibers, such as cotton, silk and wool, or synthetic fibers, such as nylon, rayon, polypropylene fiber, acetate fiber, glass fiber, carbon fiber and polyester fiber. For use, the fibers are cut into fine powder.

The fibrils 120 can be coated to a predetermined thickness by controlling the applied electrostatic voltage and the moving velocity of the panel 10. It is necessary to select the color of the fibrils 120 according to how and where to use the soundproof panel 100 because the color of the fibrils determines that of the finally prepared soundproof panel 100.

The curing step is preferably carried out by drying the aluminum foam panel 10 coated with the fibrils 120 in a drying furnace, preheated. Thus, the soundproof panel 100 according to the first embodiment is finally prepared.

While a plurality of open pores 12, which are different in size and shape with irregular arrangement in the aluminum foam panel 10, can remarkably attenuate the noise of low frequencies, the coated fibrils 120 can absorb the noise of high frequencies without reflection. Thus, the soundproof panel 100 of the above-mentioned structure is superior in absorbing or insulating noise over a wide frequency range by virtue of the cooperative action of the open pores and the fibrils.

The soundproof panel 100 utilizing a fibril-coated aluminum foam in accordance with the first embodiment of the present invention, may be used as a construction finish material for an interior decoration wall (or ceiling or floor), partition, noise barrier and sound-controlling facility in all spaces that require soundproofness, for example, in factories, offices, residential buildings, trains, cars, ships, airplanes, soundproof rooms, auditoria, broadcasting studios, gymnasiums, roadsides, etc.

(Second Embodiment)

With reference to Figs. 3 and 4, there is schematically shown a soundproof panel 200 which comprises an aluminum foam panel 10 and a

perforated thin plate 220. As seen, the aluminum foam 10 has a plurality of open pores 12 and its at least one surface is bonded with the perforated thin plate 220 with the aid of an adhesive 210.

As in the first embodiment, the aluminum foam panel 10 has a plurality of open pores and can be made by rolling an aluminum foam having closed pores.

Before being bonded with the perforated thin plate 220, the aluminum foam panel 10 with a plurality of open pores is grinded to flat. The flat aluminum foam panel 10 thus obtained allows the perforated thin plate 220 to bond thereto as uniformly as possible, thereby eliminating any poor bonding space which may cause the perforated thin plate 220 to be released from the aluminum foam panel 10.

As for the perforated thin plate 220, it may be prepared by forming a plurality of perforations 222 in a metal plate, such as an aluminum plate or a stainless steel plate, in a regular array. Depending on how and where the soundproof panel 200 is used, proper selections are made for the material of the perforated thin plate 220, the diameter and population of the perforations 222, and the thickness of the perforated thin plate 220. For instance, if the soundproof panel 200 utilizing an aluminum foam is used as a construction finish material for an auditorium or a theater in which audio facilities are equipped, a stainless steel thin plate with elegant gloss may be selected. On the other hand, where the weight of the soundproof panel 200 is problematic, recruitment of an aluminum thin plate is helpful to reduce the weight.

There is no particular limitation to the adhesive 210 if it is able to bond a perforated metal plate to the surface of the aluminum foam plate. Examples of useful adhesives include epoxy resin adhesives of strong adhesiveness using curing agents such as polyamine, polyamide and polysulfide resins, and urethane rubber-based adhesives.

For a strong fastness between the aluminum foam panel and the perforated thin plate, the two members are preferably bonded by a heat press curing method in which the adhesive 210 is cured by heat with the pressuring of the perforated thin plate 220 upon the aluminum foam panel 10.

With the open pores 12 in the aluminum foam panel 10 being able to efficiently attenuate the noise of low frequencies, the perforated thin plate 220 serves as a resonance board to amplify the absorption ability of the aluminum foam panel 10. Thus, the soundproof panel 200 in accordance with the second embodiment of the present invention is superior in absorbing or insulating noise over a wide frequency range in addition to being good in appearance.

The soundproof panel 200 utilizing the aluminum foam in accordance with the second embodiment of the present invention, may be used as a construction finish material for an interior decoration wall (or ceiling or floor), partition, noise barrier and sound-controlling facility in all spaces that require soundproofness, for example, in factories, offices, residential buildings, trains, cars, ships, airplanes, soundproof rooms, auditoria, broadcasting studios, gymnasiums, roadsides, etc.

(Third Embodiment)

Because construction finish materials, which are usually used for the exterior and interior walls in various architectures, may be in sight of and in contact with people, they are required to be good in appearance and in quality and pleasant to the touch. Construction finish materials are also required to provide ease in carrying out a construction work, such as construction of a wall or a ceiling, therewith. Therefore, the present invention pertains to a soundproof material which is useful as a finish construction material.

With reference to Figs. 5 and 6, there are soundproof panels 300 utilizing aluminum foams, which are useful as interior finish materials.

As shown in Fig. 5, the soundproof panel 300a comprises an aluminum foam panel 10 with open pores 12, to at least one surface of which a finish material 320 is bonded via an adhesive 310. The sound proof panel 300b of Fig. 6 comprises an aluminum foam panel 10 with open pores 12, whose at least one surface is coated with a paint 330.

For the same reasons as in the second embodiment, the aluminum foam panel 10 is ground to flat. The flattened aluminum foam thus obtained is bonded with a finish material or painted with perlite, silica or felt, to produce the soundproof aluminum panel according to the third embodiment of the

present invention.

For the adhesive 310, there is no particular limitation if it is able to bond the finish material 320 to the surface of aluminum metal. Preferable are those that can be subjected to a heat press curing technique.

The finish material which is applied to the surface of the aluminum foam panel 10 is not particularly limited, as well, if it can show the general characteristics of finish material. For instance, various textures, figured sheets, metal plates, embossed plates, paper sheets, or paint coats may be applied. In order to maintain the incombustible property of the aluminum foam, flame-retardant finish materials, such as metal plates, are preferably bonded thereto. Where a further improvement in the sound-absorption of the aluminum foam is required, sound-relieving finish materials, such as textures, are recommended.

While a plurality of open pores 12 which are different in shape and size with irregular arrangement in the aluminum foam panel 10, give the aluminum panels 300 a superior sound-absorbing ability, the finish materials 320 and 330 applied to the surface of the aluminum foam panel 10 afford good sound-absorption performance as well as allow the aluminum panels 300 to be used as finish construction materials.

The soundproof panel 300 utilizing the aluminum foam in accordance with the third embodiment of the present invention, may be used as a construction finish material for an interior decoration wall (or ceiling or floor), partition, noise barrier and sound-controlling facility in all spaces that require soundproofness, for example, in factories, offices, residential buildings, trains, cars, ships, airplanes, soundproof rooms, auditoria, broadcasting studios, gymnasiums, roadsides, etc.

(Fourth Embodiment)

In executing a soundproofing work, it is more effective to use one construction material which can absorb sound and insulate noise at once than to use a sound-absorbing material and a noise-insulating material separately. In addition, preferable is a lighter and stronger material if it shows the same soundproofness. Thus, the construction material which is light and strong with

functions of sound-absorption and noise-insulation, can give a great contribution to making soundproof facilities as small as possible.

Meeting these conditions, multilayer structures of soundproof panels utilizing aluminum foams are shown in Figs. 7 to 9.

First, referring to Fig. 7, a soundproof panel 400a comprises two aluminum foam panels 10 sandwiching a sound-absorbing member 420 therebetween, each having a plurality of open pores, one of which is underlaid by a steel plate 430, the other being overlaid by a perforated plate 410.

When the soundproof panel of such a structure is used as a construction finish material, an assembly of the perforated plates 410 which bond to the aluminum foam panels 10 is arranged in such a way that the plates face outward to constitute the external side. Thus, the perforated plates 410 together serve as an exterior decoration finish wall, absorbing the sounds which are incident thereto.

On the other hand, when a construction work is executed with the soundproof panels 400a, the steel plates 430 bonding to the aluminum foam panels 10 face inward, that is, into the wall or the ceiling to form a rear side. These steel plates 430 insulate noise to prevent its propagation. To this end, iron plates or stainless steel plates may be used.

The sound-absorbing member 420 which is interposed between the two aluminum foam panels 10 with a bond to the panels 10 via adhesives, enhances the sound absorption ability of the two aluminum foam panels 10 which are respectively bonded with the perforated plate 410 and the steel plate 430. Available are glass wool, rock wool and polyurethane.

Then, referring to Fig. 8, there is a soundproof panel 400b which has a similar structure to that of Fig. 7, except that another steel plate 430, instead of the perforated plate 410, is recruited in order to enhance noise-insulating performance rather than sound-absorbing performance and two additional noise insulators 440, such as soft plates, hard plates or noise-barrier sheets, each is interposed between the sound-absorbing member 420 and the aluminum foam panel 10. Hence, this soundproof panel 400b is greatly improved in noise insulating performance.

Turning to Fig. 9, there is a multilayer structure of a soundproof panel 400c. As shown in Fig. 9, the soundproof panel 400c comprises two steel plates 430 sandwiching an aluminum foam panel 10 with open pores 12 therebetween. Because it recruits no sound-absorbing material, such as the member 420 in Fig. 7, the soundproof panel 400c has an advantage of being prepared more easily and thinly.

The aluminum foam panel 10, the perforated plate 410, the sound-absorbing member 420, the steel plate 430 and the noise insulator 440 are bonded to one another via adhesives. The kind of the adhesives and the bonding techniques may be referred to those which are described in the preceding embodiments.

Owing to the interaction among the aluminum foam panel 10, the perforated plate 410, the sound-absorbing member 420, the steel plate 430 and/or the noise insulator 440 in multilayer structures, the soundproof panels 400 according to the fourth embodiment of the present invention show excellency in sound-absorption and noise-insulation, both.

The multilayer-structured, soundproof panels 400 according to this embodiment may be used as construction finish materials for an interior decoration wall (or ceiling or floor), partition, noise barrier and sound-controlling facility in all spaces that require soundproofness, for example, in factories, offices, residential buildings, trains, cars, ships, airplanes, roadsides, etc.

(Fifth Embodiment)

In designing sound-relating edifices, such as odea, concert halls, auditoria, theatres, broadcasting studios, etc, one of the details to which the architects pay the most careful attention, is the sound plan including sound absorption and noise insulation. For example, echo, resounding, reflection, reverberation, distribution and diffusion of sounds should be optimally controlled to form desired sounds in the indoor of such an edifice while noises are prevented from leaking out therefrom. For this, soundproof materials with high sound absorption ability are necessary.

Figs. 10 to 13 show soundproof panels 500 using aluminum foams, which can be suitably used for this end.

First, with reference to Fig. 10, a soundproof panel 500 comprises an aluminum foam panel 10 with a plurality of open pores, two reinforcement bars 510 which are bonded to one surface of the aluminum foam panel 10 along its both edges in the lengthwise direction, and a sound-absorbing member 520 which is positioned at the space defined between the two reinforcement bars on the surface of the panel 10.

The aluminum foam panels 10 are manufactured into a standardized-size(width, length and thickness), enabling prefabrication to be applied for the walls or ceilings of the edifice relating to sound. Usually, they have a long board shape. The reinforcement bars 510, which are bonded on one surface of the aluminum panel 10 via an adhesive, each running in the lengthwise direction along the edge, may be made from steel or aluminum foam separately from the aluminum foam panel 10. Optionally, the reinforcement bars 510 may form a single body together with the aluminum panel 10 when it is manufactured.

Examples of the sound-absorbing member 520 include glass wool, rock wool, and polyurethane. After the sound-absorbing member 520 is cut to fit the space which is defined by the two reinforcement bars 510, the member may be inserted to the space and preferably with a bond to the aluminum foam panel 10 via an adhesive.

Application of a finish material, such as paint or texture, to the external surface of the aluminum foam panel 10, may give a great contribution to the improvement in appearance and tactile sensation as well as in sound absorption.

The soundproof panel 500a as described can show sound absorption power manyfold than conventional soundproof panels if they are the same in thickness, by virtue of the sound absorption ability contributed from the open pores 12 of the aluminum foam panel 10 and from the sound-absorbing member 520, alone or in combination.

With reference to Figs. 11 to 13, there are soundproof panels 500b and 500c comprising aluminum foam panels 10 which are tactically processed to have resonance hallows 530. The aluminum foam panels 10 form certain structures with predetermined dimensions (width, length and thickness) in which the resonance hollows 530 are regularly formed in the breadthwise direction.

Formation of the resonance hollows 530 in the aluminum foam panels 10 may be accomplished by regularly positioning a plurality of reinforcement bars 540 between two separate aluminum foam panels 10 of the same size and then, bonding the bars 540 to the panels 10 via an adhesive, as shown in Fig. 11. In result, the resonance hollows 530 are defined by the reinforcement bars 540 and the two aluminum foam panels 10.

Alternatively, an aluminum foam panel 10 with a considerable thickness may be perforated so as to form spaces passing through the solid interior of the panels 10 in the breadthwise direction, as shown in Fig. 12. In this case, a slit 550 may be formed every other or every three resonance hollows in such a way that it penetrates the hallow in the breadthwise direction. Fig. 13 shows this structure in a schematic cross section view. These slits can attenuate the sounds of medium to high frequencies. When sound waves strike the surface of the aluminum foam panel 10 in such a structure, low frequency sounds are attenuated as they pass through the open pores 12 while medium and high frequency sounds are absorbed in the resonance hollows 530, which absorption is enhanced by the resonance action of the slits. Therefore, the soundproof panel of this structure is superior in noise insulation over a wide range of sound frequencies.

Application of a finish material makes it possible to use the soundproof panel 500 as a construction finish material. Depending on the required conditions for appearance, quality and tactile sensation, the finish material may be selected from, for example, textures, non-woven fabrics, metal plates, embossed plates, paper sheets, paint, perlite, silica, felt, etc. This application may be carried out by bonding or painting the finish materials to one surface of the soundproof panel 500. In the case of the soundproof panel 500a utilizing

the sound-absorbing member 520, the surface of the aluminum foam panel 10, opposite to the side of the sound-absorbing member 520, is the surface to be applied therewith. For the soundproof panels 500b and 500c having resonance hollows 530, either surface of the aluminum foam panel 10 may be applied with the finish materials.

The preparatory works necessary for the bonding of the finish material, including the pretreatment of the aluminum foam panel (surface grinding, flattening and cleaning) and the selection of adhesive and bonding technique, may be referred to those which are described in the preceding embodiments.

The tactically processed soundproof panels 500 according to this embodiment may be used as construction finish materials for the interior decoration wall (or the ceiling or the floor), partition, noise barrier and sound-controlling facility in all spaces that require soundproofness, for example, in factories, offices, residential buildings, soundproofing rooms, libraries, gymnasiums, roadsides, etc, and particularly in the edifices where sounds should be controlled in a high technical level, such as broadcasting studios, auditoria, odea, concert halls, theaters.

(Sixth Embodiment)

In order to be used for the construction of the ceiling, a soundproof panel is required to have a low weight in addition to being good in sound absorption. Preferable are those which can be used as a construction finish material without application of additional finish materials.

Referring to Figs. 14 to 17, there are shown soundproof panels 600 which can be used for the construction of the ceiling. Taking advantage of the excellent sound absorption power that an open pore-containing aluminum foam panel has in absorbing the sounds which strike the ceiling, the soundproof panels 600 for the construction of the ceiling, as shown in Figs. 14 to 17, have various patterns formed on their surfaces, so that they can be used as a construction finish material for the ceiling when they are optionally coated with a paint.

The soundproof panels 600 may be prepared by cutting a mass of open pore-containing aluminum foam into aluminum foam panels 10 with a predetermined dimension (thickness, width and length) and impressing patterns 610, 620, 630 and 640, depressed or embossed, on one surface of the aluminum foam panels with pressing and optionally by coloring the impressed surface of the aluminum foam panels 10 with paint.

As shown, the soundproof panels 600a, 600b, 600c and 600d have a stripe pattern 610, an embossed grid pattern 620, a depressed grid pattern 630 and a depressed circle pattern 640, respectively. However, the patterns which can be formed on the soundproof panels according to the present invention are not limited to these but may have any design if it is suitable for the use of the ceiling.

Because the soundproof panels 600 of the embodiment are used as construction finish materials as well as sound-absorbing materials, their surface, as it is, are exposed outside. Accordingly, it is preferable that the aluminum foam panel 10 is endowed with a decorating function by coloring the patterned surface of the aluminum foam panel 10 with paint. There is no limitation to the paint and examples of the paint include water paint, oil paint, perlite, silica, felt, etc.

A construction work may be executed by fixing the soundproof panels 600 on the ceiling via a conventional suitable hanger means.

Industrial Applicability

As described hereinbefore, the soundproof panels using aluminum foam in accordance with the present invention are superior in sound absorption performance and easy to handle, In addition, the panels allow a constuction work to be easily executed therewith as well as can be used as ultralight, construction finish materials with high durability and strength in the edifices or facilities which require noise insulation.

The present invention has been described in an illustrative manner, and it is to be understood the terminology used is intended to be in the nature of description rather than of limitation.

Many modifications and variations of the present invention are possible in light of the above teachings. Therefore, it is to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

Claims

1. An aluminum foam-based soundproof panel, comprising at least one aluminum foam panel with a plurality of open pores, wherein said open pores are formed from the closed pores within a mass of aluminum foam by rolling the aluminum foam into a panel, and said aluminum foam panel with a plurality of open pores is bonded with or coated with fibrils, a perforated thin plate, a finish material, paint, a sound-absorbing member or noise insulator or a honeycomb structure on at least one surface or impressed with a pattern on one surface or has resonance hollows therein.

2. An aluminum foam-based soundproof panel as set forth in claim 1, wherein said aluminum foam panel with a plurality of open pores is bonded with fibrils on at least one surface via an adhesive.

3. An aluminum foam-based soundproof panel as set forth in claim 1, wherein said aluminum foam panel with a plurality of open pores is bonded with a perforated thin plate on at least one surface via an adhesive.

4. An aluminum foam-based soundproof panel as set forth in claim 1, wherein said aluminum foam panel with a plurality of open pores is bonded with a finish material selected from the group consisting of a texture, a figured melamine sheet, a figured wood sheet, a metal thin plate, an embossed metal thin plate or a paper sheet on one surface via an adhesive or coated with paint on one surface.

5. An aluminum foam-based soundproof panel as set forth in claim 1, which comprises two aluminum foam panels with a plurality of open pores and a sound-absorbing member sandwiched therebetween, the exposed surfaces of said aluminum foam panels being covered with a perforated thin plate and a steel thin plate, respectively, with a bond via an adhesive.

6. An aluminum foam-based soundproof panel as set forth in claim 1, which comprises two aluminum foam panels with a plurality of open pores and a sound-absorbing member sandwiched therebetween, the exposed surfaces of said aluminum foam panels being each covered with a steel thin plate with a bond via an adhesive.

7. An aluminum foam-based soundproof panel as set forth in claim 6, further comprising two noise-insulators, each being interposed between said aluminum foam panel and said sound-absorbing member with a bond via an adhesive.

8. An aluminum foam-based soundproof panel as set forth in claim 1, wherein said aluminum foam panel with a plurality of open pores is bonded with a steel plate on either side thereof.

9. An aluminum foam-based soundproof panel as set forth in claim 1, further comprising two reinforcement bars, each running on said aluminum foam panel along either edge in the breadthwise direction, and a sound-absorbing member which is positioned on said aluminum foam panel at the space defined by said two reinforcement bars.

10. An aluminum foam-based soundproof panel as set forth in claim 9, wherein said aluminum foam panel is bonded with a finish material selected from the group consisting of texture, a metal plate, an embossed metal plate and a paper sheet on the surface opposite to said sound absorbing member.

11. An aluminum foam-based soundproof panel as set forth in claim 1, wherein said aluminum foam panel with a plurality of open pores contain hollows which are regularly arranged in the breadthwise direction.

12. An aluminum foam-based soundproof panel as set forth in claim 11, wherein a slit is formed every other or every three resonance hollows in such a

way that said slit penetrates the hallow in the breadthwise direction.

13. An aluminum foam-based soundproof panel as set forth in claim 1, wherein said aluminum foam panel with a plurality of open pores has an embossed or depressed pattern on one surface.

14. An aluminum foam-based soundproof panel as set forth in claim 13, wherein said aluminum foam panel with a plurality of open pores is coated with paint on the patterned surface.

FIG. 1

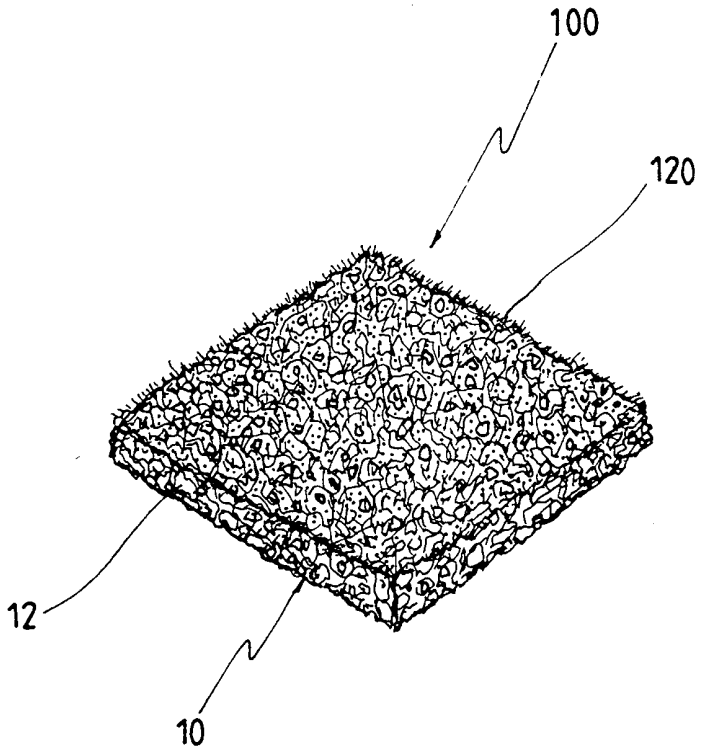


FIG. 2

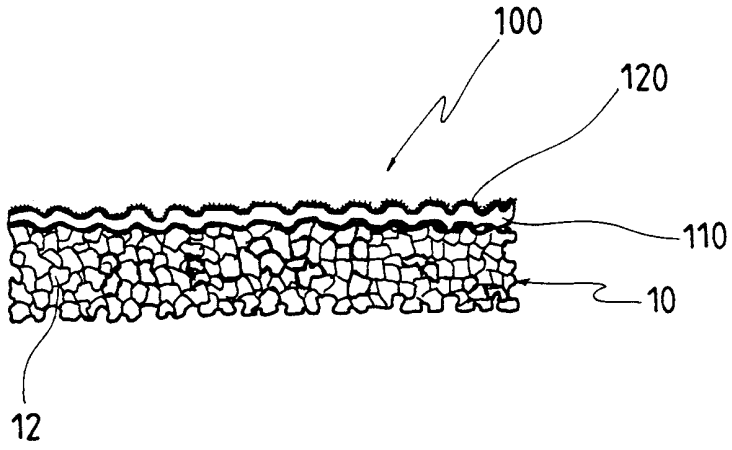


FIG.3

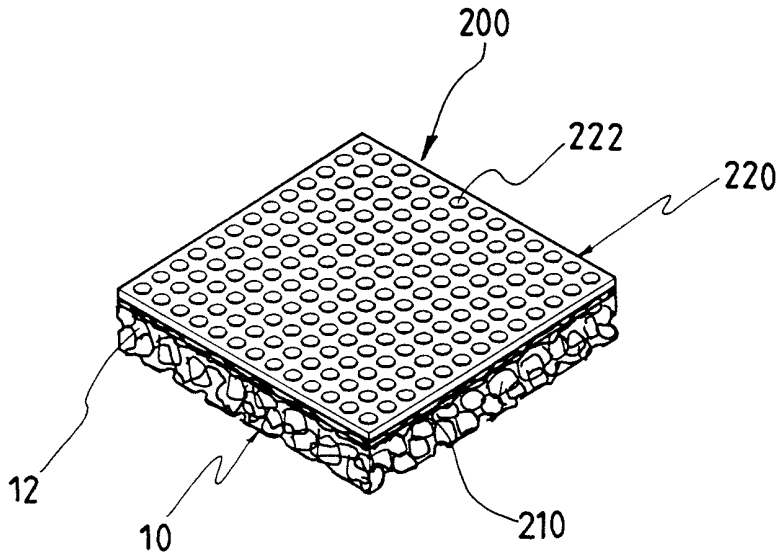


FIG.4

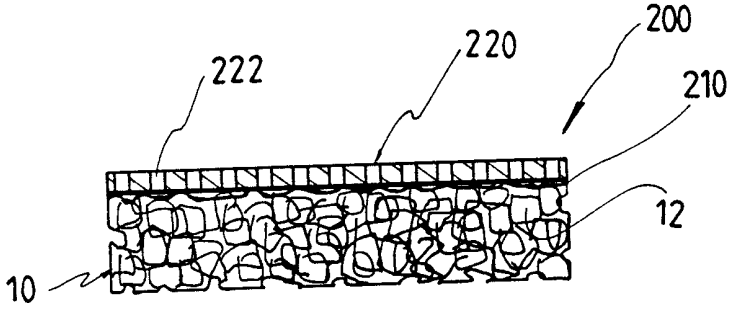


FIG.5

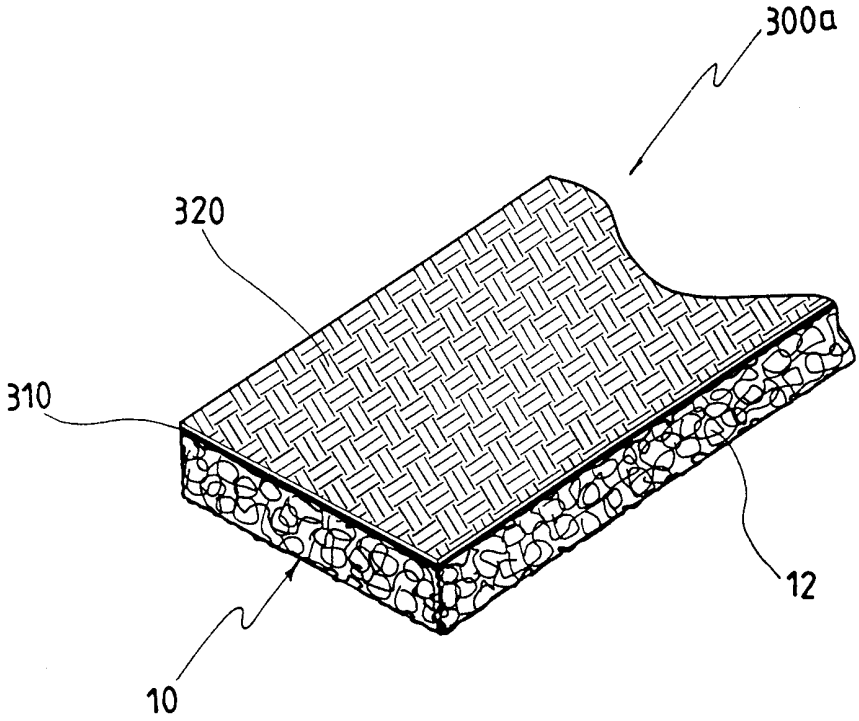


FIG.6

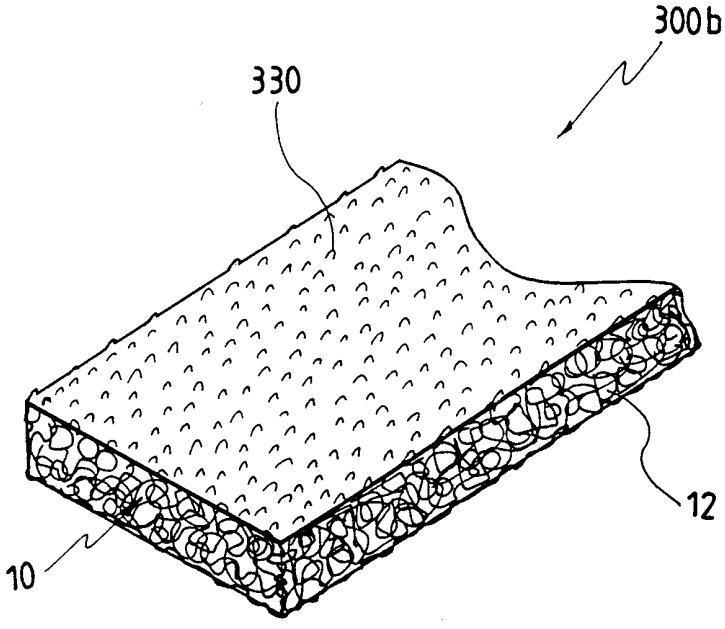


FIG.7

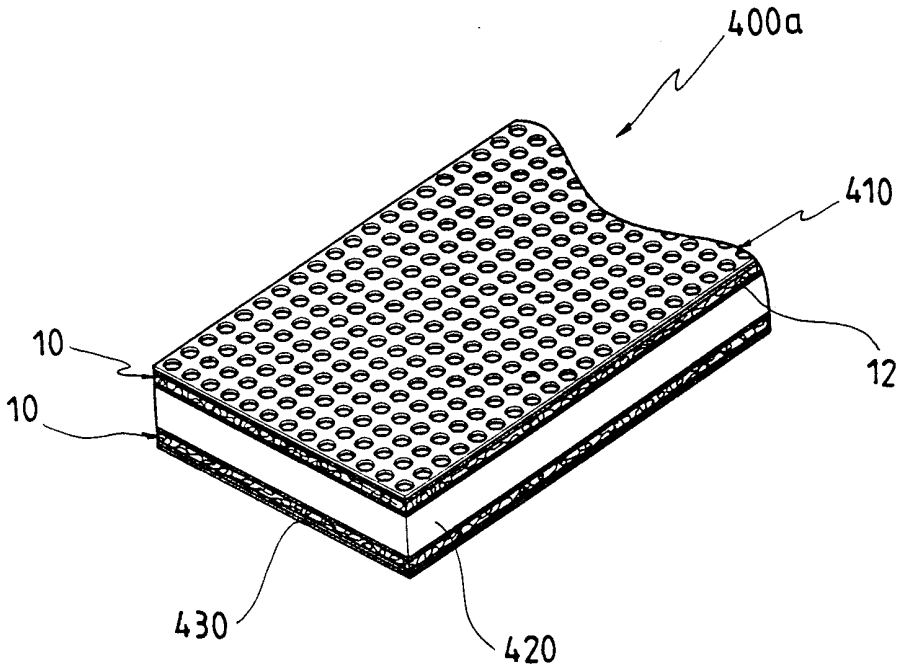


FIG.8

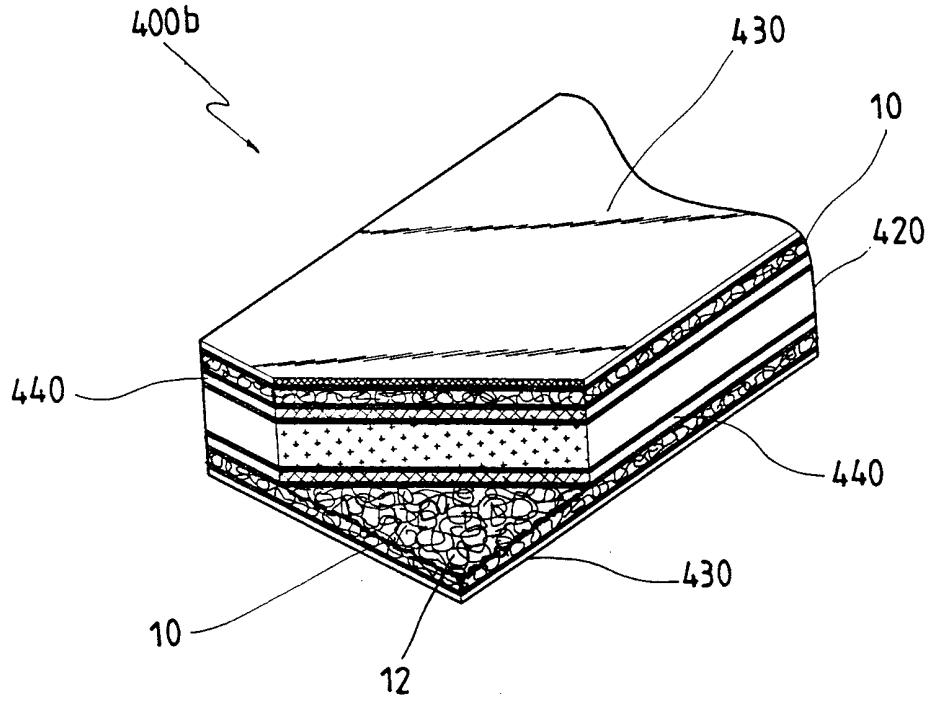


FIG.9

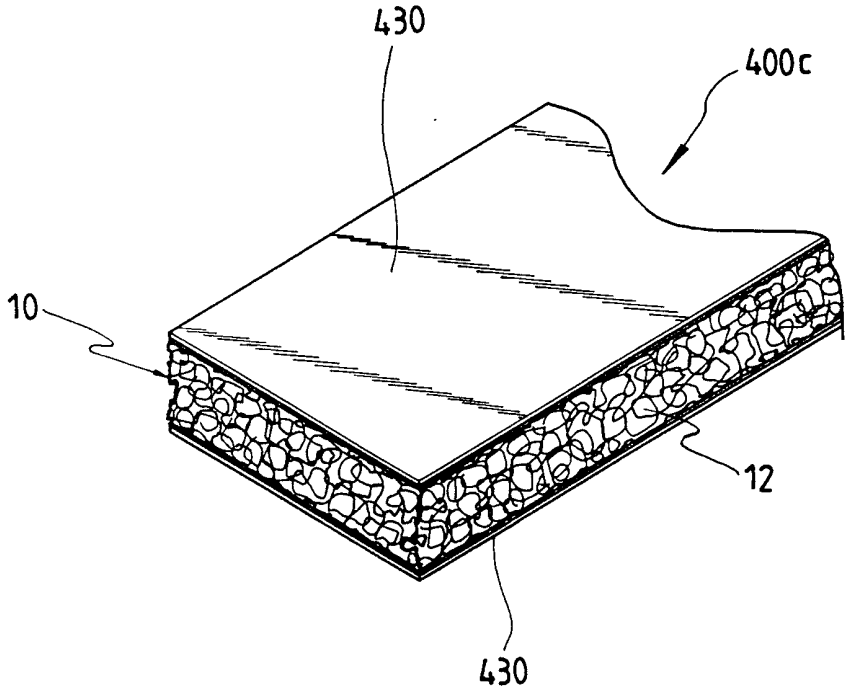


FIG.10

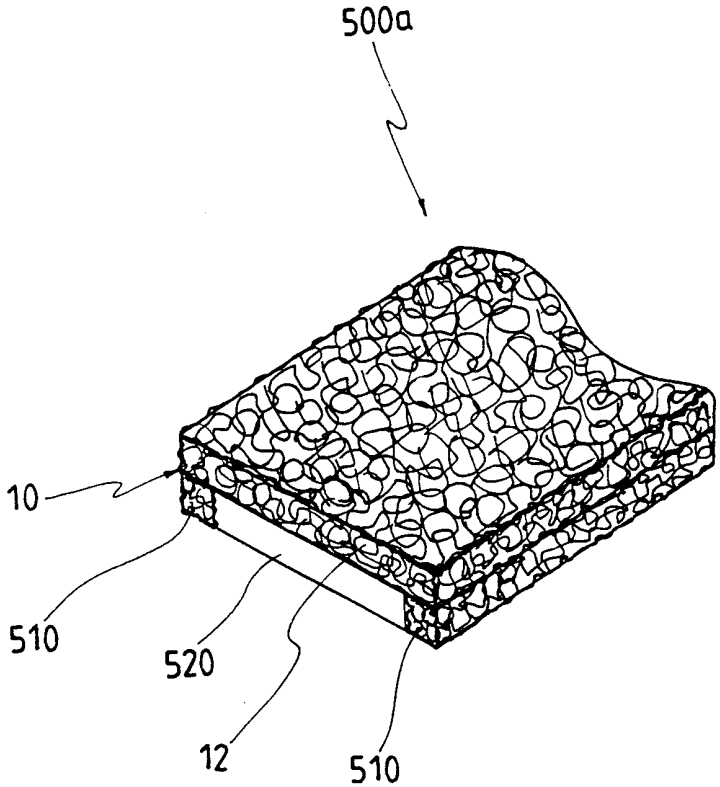


FIG. 11

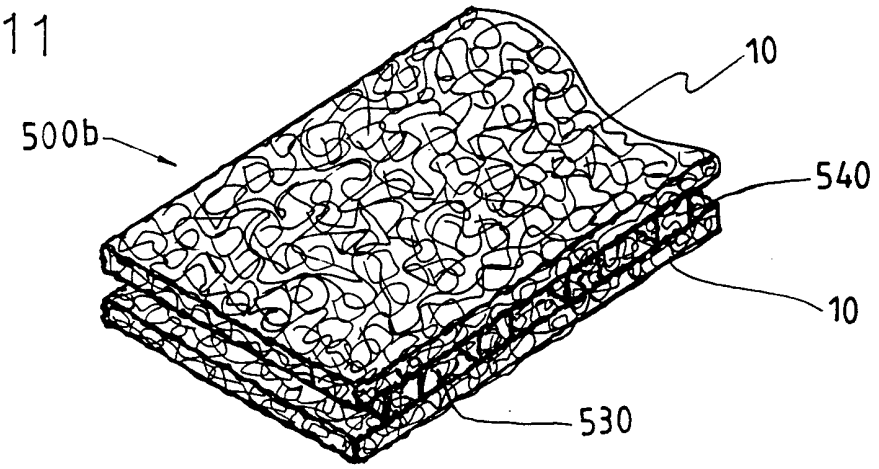


FIG. 12

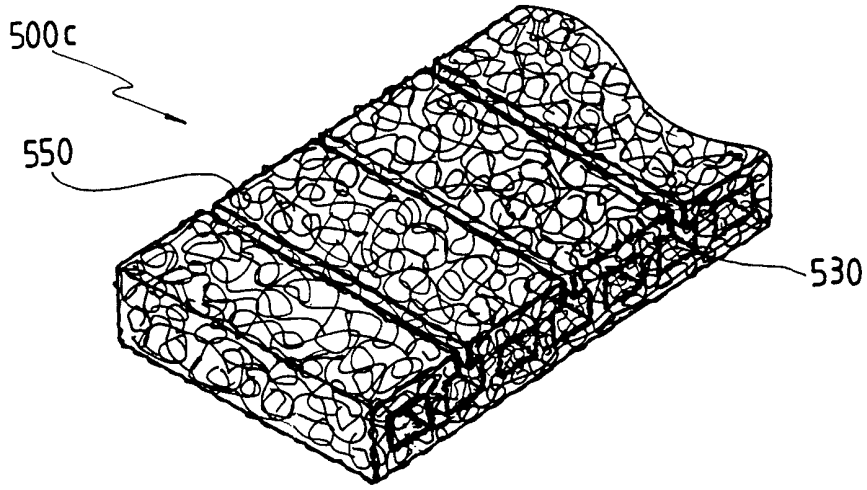


FIG. 13

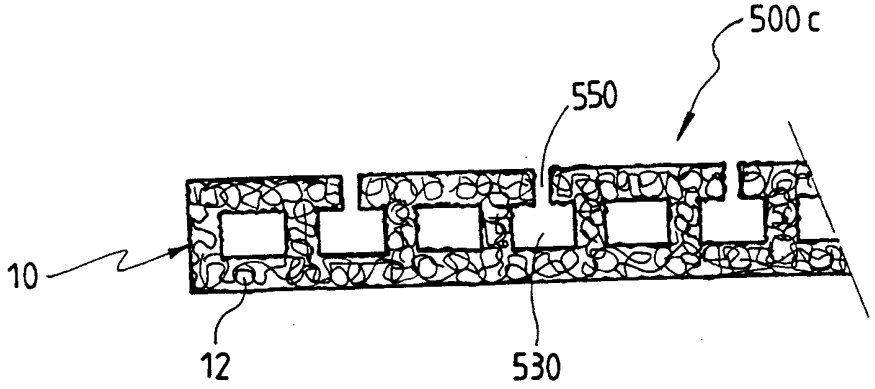


FIG. 14

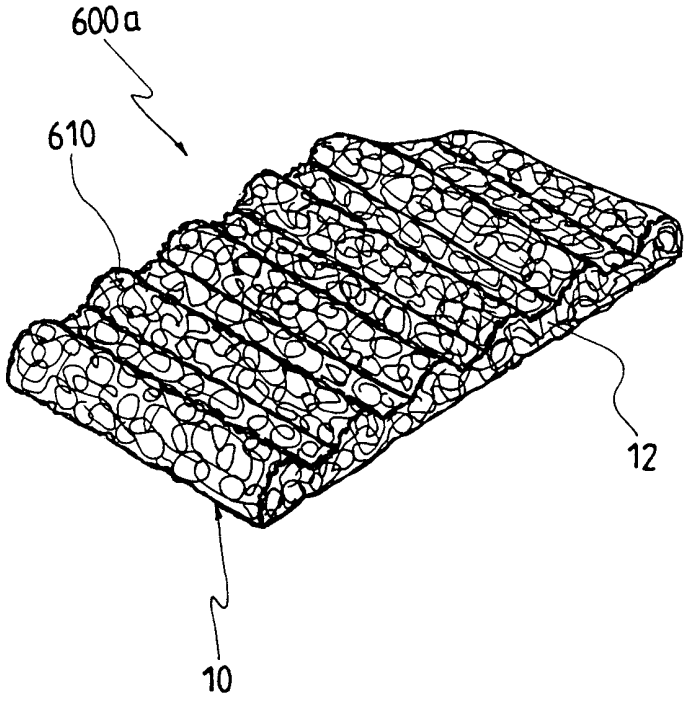


FIG. 15

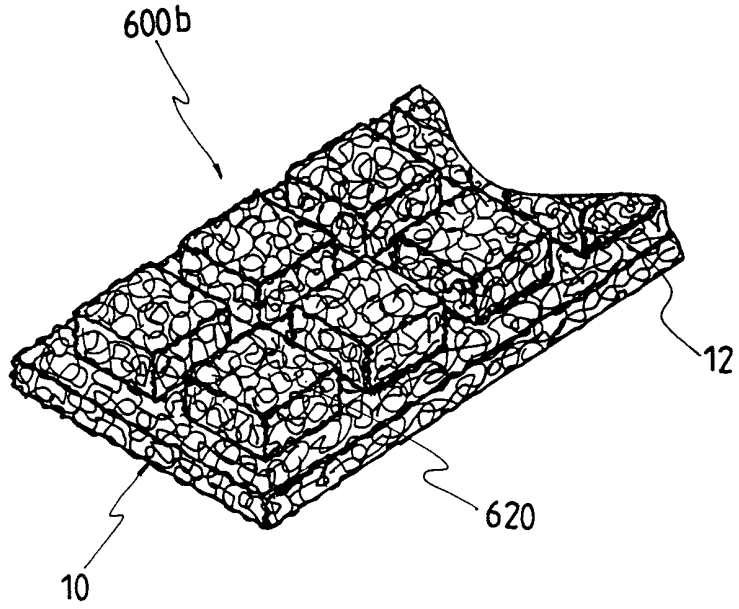


FIG. 16

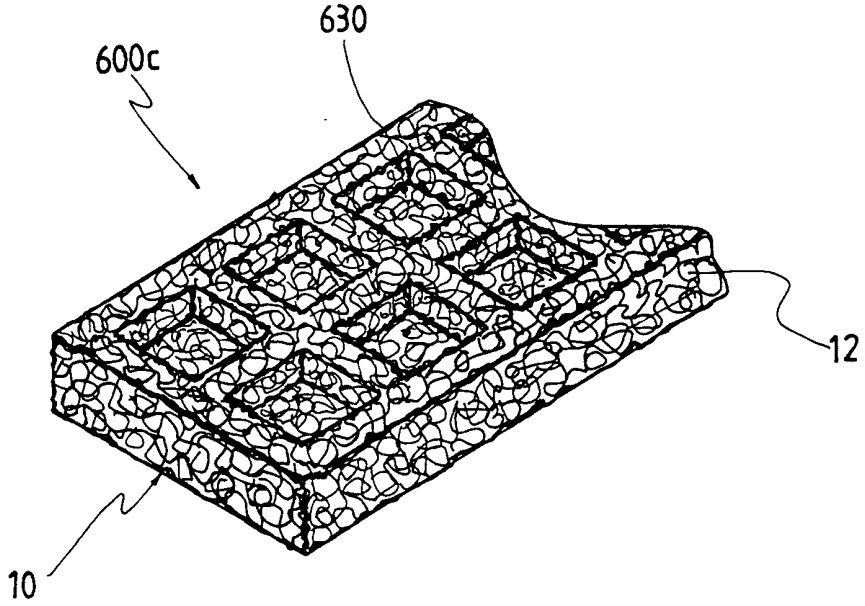


FIG. 17

