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(54) Hollow panel

(57) A hollow panel (10) includes comprise hollow portions (12) between front and rear outer sides (11) having a substantially flat plate shape. In the hollow panel (10), the surface density is partially differentiated, whereby a lack of sound insulation due to the coincidence effect at a specific frequency is prevented from occurring. The surface density or the rigidity can be made non-uniform to suppress the lack of sound insulation, by differentiating sectional areas by forming plural kinds of widths of the hollow portions (12), or by differentiating the distances between partition walls (13) or the thicknesses of the walls.

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a hollow panel, and more particularly to a hollow panel which is suitably used as a construction material such as a wall material, a floor material, and a ceiling material.

[0002] Conventionally, hollow panels having hollow portions are employed as various kinds of panels for construction. In such a hollow panel, it is possible to realize heat insulation and weight reduction. In a known hollow panel, two corrugated plates in which end faces have a corrugated shape are sandwiched between two-flatplates constituting surfaces to form one panel, and hollow portions corresponding to the corrugated shape are laterally extended (for example, see JP-A-7-214712). The hollow panel disclosed in JP-A-7-214712 has a configuration in which the two corrugated plates are stacked back to back so that projections of the plates abutted against each other are sandwiched between the flat plates. In a completed state of the panel, therefore, hollow portions of different sectional areas are internally enclosed, so that a lack of sound insulation due to the coincidence effect which may be caused at a specific frequency can be improved.

[0003] Since the hollow panel disclosed in JP-A-7-214712 is configured so that the sectional areas of the hollow portions are differentiated by using the two corrugated plates, a disadvantage that the whole thickness of the hollow panel is increased, and other disadvantages that the cost burden due to the increased number of components is inevitably imposed, and that the corrugated plates must be bonded together to increase the number of assembly steps are caused.

SUMMARY OF THE INVENTION

[0004] The invention has been conducted in view of the disadvantages. It is an object of the invention to provide a hollow panel which can effectively exhibit the sound insulation performance while suppressing the panel thickness, and in which the number of components can be reduced, so that labor in the work of forming the panel can be reduced and the production cost can be reduced.

[0005] In order to solve the aforesaid object, the invention is characterized by having the following arrangement.

Aspect 1. A hollow panel comprising:

first hollow portions arranged in a substantially same plane and having first panel resonance frequency; and

second hollow portions arranged in the substantially same plane having second panel resonance frequency different from the first panel resonance frequency.

Aspect 2. A hollow panel according to the aspect 1, wherein each of the first hollow portion include a first sectional area; and each of the second hollow portions includes a second sectional area different from the first sectional area.

Aspect 3. The hollow panel according to the aspect 2, wherein the first hollow portion and the second hollow portion are alternatively arranged in the substantially same plane.

Aspect 4. The hollow panel according to the aspect 2, wherein a solid portion forming member is inserted into a specific one of the first and second hollow portions, the solid portion forming member having a section shape which substantially corresponds to a section shape of the specific hollow portion.

Aspect 5. The hollow panel according to the aspect 2, wherein a sectional shape of the first and second hollow portions is a trapezoidal.

Aspect 6. The hollow panel according to the aspect 1, wherein each of the first hollow portions includes a first width, and each of the second hollow portions includes a second width different from the first width.

Aspect 7. The hollow panel according to the aspect 6, wherein the first width is defined between a pair of partition walls defining the first hollow portion, and the second width is defined between a pair of partition walls defining the second hollow portion.

Aspect 8. The hollow panel according to the aspect 6, wherein the first and second hollow portions are alternatively arranged in the substantially same plane.

Aspect 9. The hollow panel according to the aspect 6, wherein a solid portion forming member is inserted into a specific one of the first and second hollow portions, the solid portion forming member having a section shape which substantially corresponds to a section shape of the specific hollow portion.

Aspect 10. The hollow panel according to the aspect 6, wherein a sectional shape of the first and second hollow portions is a trapezoidal.

Aspect 11. A hollow panel comprising:

first and second partition walls defining a plurality of hollow portions arranged in a substantially same plane, wherein a thickness of the first partition walls is different from that of the

second partition walls.

Aspect 12. The hollow panel according to the aspect 11, wherein the first and second partition walls are alternatively arranged.

Aspect 13. The hollow panel according to the aspect 11, wherein a solid portion forming member is inserted into a specific one of the hollow portions, the solid portion forming member having a section shape which substantially corresponds to a section shape of the specific hollow portion.

[0006] In the invention, a configuration may be employed in which a solid portion forming member is inserted into a specific one (s) of the plural hollow portions, the solid portion forming member having a sectional area which generally corresponds to a sectional area of the specific hollow portion(s). According to the configuration, the solid portion forming member is placed in an arbitrary one (s) of the hollow portions, whereby the surface density can be partially differentiated. Therefore, the invention can be easily applied even to an existing hollow panel so as to suppress a lack of sound insulation.

[0007] The hollow panel of the invention can be formed by using any of various materials, and preferably formed by using wood elements. Examples of wood elements are wood flakes, wood fibers, wood chips, and wood particles. The wood elements may be shaped into a panel-like shape by die molding. As a binder which is useful in the molding, any one of a foamable binder resin, a nonfoamable binder resin, and a mixture of these binders may be employed.

[0008] The hollow panel can be produced by die molding in the following manner. A fixed amount of wood elements are sprayed into dies, and cores corresponding to the shapes of the hollow portions are then laterally arranged in a substantially same plane. A further fixed amount of wood elements are sprayed onto the arrangement. Under this state, . a hot pressing process is performed. The dies are opened, and the cores are then pulled out, whereby a panel in which hollow portions are integrally formed can be shaped. The hollow panel may be obtained by another shaping method in the following manner. Two front members having a thin plate-like shape, and a single hollow portion forming member which is similar in shape to a galvanized steel sheet, or in which the end faces have a corrugated shape are separately formed. The front members are bonded together by an adequate adhesive agent so as to sandwich the hollow portion forming member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a schematic perspective partial view of a hollow panel of a first embodiment.
Fig. 2 is a partial end view of the hollow panel.
Fig. 3 is a partial end view of a hollow panel which is a modification of the first embodiment.
Fig. 4 is a partial end view of a hollow panel of a second embodiment.
Fig. 5 is a partial end view of a hollow panel of a third embodiment.
Fig. 6 is a schematic plan view of the hollow panel of the third embodiment.
Fig. 7 is a schematic plan view of a hollow panel of a fourth embodiment.
Fig. 8 is a schematic plan view of a hollow panel which is a modification of the fourth embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0010] Hereinafter, embodiments of the invention will be described with reference to the accompanying drawings.

First embodiment

[0011] Fig. 1 is a schematic perspective view of a hollow panel according to a first embodiment, and Fig. 2 is an end view of a part of the hollow panel. Referring to the figures, a hollow panel 10 that can be used as a construction material such as a wall panel, a floor panel, and a ceiling panel comprises a pair of flat outer sides 11 which are substantially parallel to each other, and plural hollow portions 12 which are positioned between the outer sides 11 so as to be arranged in a substantially same plane.

[0012] Each of the hollow portions 12 has a shape which linearly extends in a direction perpendicular to the plane of the sheet of Fig. 2. The hollow portions 12 are formed so that partition walls 13 which are arranged at predetermined intervals in the lateral directions in the figure are inclined by an approximately same angle and to alternately different directions. As a result, each of the hollow portions 12 shows an approximately trapezoidal section shape. In the embodiment, first hollow portions 12A having a smaller lateral width W1, and second hollow portions having a lateral width W2 which is larger than the lateral width W1 are formed so as to be alternately positioned along the lateral direction in Fig. 2, so that the adjacent hollow portions 12A and 12B are disposed to be alternately different or nonuniform in sectional area. In the figure, the lateral widths W1 and W2 of the first and second hollow portions 12A and 12B are indicated as those at the respective middle positions in the panel thickness direction because of the following reason. Since the partition walls 13 are inclined, the thicknesses are shown with reference to the respective middle positions for the sake of convenience. Alternatively, the partition walls 13 may not be inclined, and may be modified so as to have a sinusoidal waveform, or an

approximately pulse-like waveform so that the partition walls 13 are perpendicular to the outer sides in the panel thickness direction. As shown in Fig. 3, the hollow panel 10 may further comprise third hollow portions 12C which have a more larger width.

[0013] In the hollow panel 10, the lateral ends 10A in Fig. 1 have a closed structure in which the hollow portions 12 are not formed. According to the configuration, the rigidity is provided so that lateral end portions of the outer sides 11 are prevented from being bent in a direction perpendicular to the panel plane, whereby the shape retention property can be maintained.

[0014] According to the thus configured first embodiment, when the whole of the single hollow panel 10 is considered, the first and second hollow portions 12A and 12B are formed so as to have different sectional areas, and hence the relationships are attained in which the surface densities of areas substantially corresponding to the hollow portions 12A and 12B are different. Therefore, a structure where the resonance frequency of the panel due to the sectional areas or sizes of the hollow portions is not uniform in the panel plane but dispersed is formed, and a lack of sound insulation caused by resonance at a specific frequency can be effectively suppressed.

[0015] Next, other embodiments of the invention will be described. In the following description, components which are identical with or equivalent to those of the first embodiment are denoted by the same reference numerals, and their description is omitted or simplified.

Second Embodiment

[0016] Fig. 4 shows a second embodiment of the invention. The embodiment is characterized in that, although the hollow portions 12 have the same sectional area, different thicknesses T1 and T2 of the partition walls 13 between the hollow portions 12 alternately appear. The thicknesses are set so as to have a relationship of T1 > T2.

[0017] In the second embodiment also, the area of the thickness T1 is higher in surface density than that of the thickness T2, or higher in rigidity. Therefore, the embodiment has a structure where the panel resonance frequency is not uniform in the plane of the hollow panel 10, and can exert the same sound insulation effect as that of the first embodiment.

Third Embodiment

[0018] Figs. 5 and 6 show a third embodiment of the invention. The embodiment is characterized in that a solid portion 15 is formed in a specific region where a hollow portion is to be originally formed. As shown in Fig. 6, the solid portion 15 may be formed linearly in a region corresponding to a single hollow portion, or alternatively formed so as to extend over plural hollow portions 12. In the illustrated example, the solid portion 15 linearly extends. However, the manner of the extension is not limited to a linear one. It is possible to say that the embodiment is realized by extremely increasing the thicknesses of specific ones of the partition walls 13.

[0019] Also the embodiment can exert the same effect as that of the afore-described embodiments.

Fourth Embodiment

[0020] Fig. 7 shows a fourth embodiment of the invention. In the embodiment, a rod-like member 16 serving as a solid portion forming member is inserted into one of the hollow portions 12. The rod-like member has a section shape which generally corresponds to a section shape of the hollow portion. Therefore, the surface density is partially differentiated, so that the above-mentioned sound insulation effect is attained. This configuration can be easily applied to a previously shaped hollow panel, so that the invention can be applied to an existing hollow panel. When the insertion position of the rod-like member 16 is changed, it is possible to arbitrary determine the region of a different surface density.

[0021] As shown in Fig. 8, the rod-like member 16 may be placed in a direction intersecting with, for example, perpendicular to the direction along which the hollow portions 12 extend.

[0022] As described above, although the best configuration, method, and the like for embodying the invention have been disclosed in the above description, the invention is not limited to them.

[0023] Namely, although the invention has been illustrated and described with respect to specific embodiments, those skilled in the art can variously modify as required the above-described embodiments with respect the shape, the position, the arrangement, or the like without departing from the technical concept and object of the invention. For example, the embodiments and modifications can be arbitrarily combined with each other. The number of the rod-like member 16 may be adequately increased or decreased as required. Various kinds of the rod-like members 16 of different masses may be used to enable the distribution of the surface density to be finely differentiated.

[0024] As described above, according to the invention, it is possible to provide a hollow panel that exerts an excellent effect in which the resonance frequency of the panel is not uniform in the panel plane but dispersed and hence a lack of sound insulation due to resonance can be suppressed, and which cannot be exerted in the conventional art. Since the hollow portions are arranged in a substantially same plane, the thickness of the hollow panel can be reduced.

[0025] In the case where the configuration in which a rod-like member is inserted into a hollow portion is employed, a portion where the surface density is partially differentiated can be arbitrarily determined to be placed, and therefore the invention can be easily applied to suppress a lack of sound insulation.

Claims

1. A hollow panel comprising:

   first hollow portions arranged in a substantially same plane and having first panel resonance frequency; and
   second hollow portions arranged in the substantially same plane having second panel resonance frequency different from the first panel resonance frequency.

2. A hollow panel according to claim 1, wherein each of the first hollow portion include a first sectional area; and each of the second hollow portions includes a second sectional area different from the first sectional area.

3. The hollow panel according to claim 2, wherein the first hollow portion and the second hollow portion are alternatively arranged in the substantially same plane.

4. The hollow panel according to claim 2, wherein a solid portion forming member is inserted into a specific one of the first and second hollow portions, the solid portion forming member having a section shape which substantially corresponds to a section shape of the specific hollow portion.

5. The hollow panel according to claim 2, wherein a sectional shape of the first and second hollow portions is a trapezoidal.

6. The hollow panel according to claim 1, wherein each of the first hollow portions includes a first width, and each of the second hollow portions includes a second width different from the first width.

7. The hollow panel according to claim 6, wherein the first width is defined between a pair of partition walls defining the first hollow portion, and the second width is defined between a pair of partition walls defining the second hollow portion.

8. The hollow panel according to claim 6, wherein the first and second hollow portions are alternatively arranged in the substantially same plane.

9. The hollow panel according to claim 6, wherein a solid portion forming member is inserted into a specific one of the first and second hollow portions, the solid portion forming member having a section shape which substantially corresponds to a section shape of the specific hollow portion.

10. The hollow panel according to claim 6, wherein a sectional shape of the first and second hollow portions is a trapezoidal.

11. A hollow panel comprising:

    first and second partition walls defining a plurality of hollow portions arranged in a substantially same plane, wherein a thickness of the first partition walls is different from that of the second partition walls.

12. The hollow panel according to claim 11, wherein the first and second partition walls are alternatively arranged.

13. The hollow panel according to claim 11, wherein a solid portion forming member is inserted into a specific one of the hollow portions, the solid portion forming member having a section shape which substantially corresponds to a section shape of the specific hollow portion.

FIG. 1

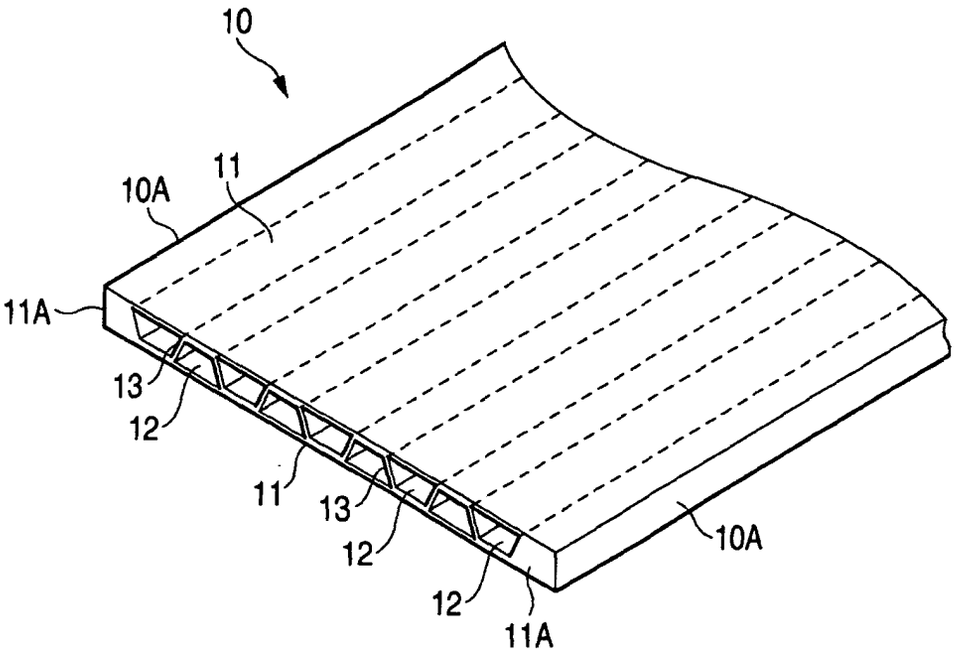

10
10A
11
11A
13
12
11
13
12
12
10A
11A

FIG. 2

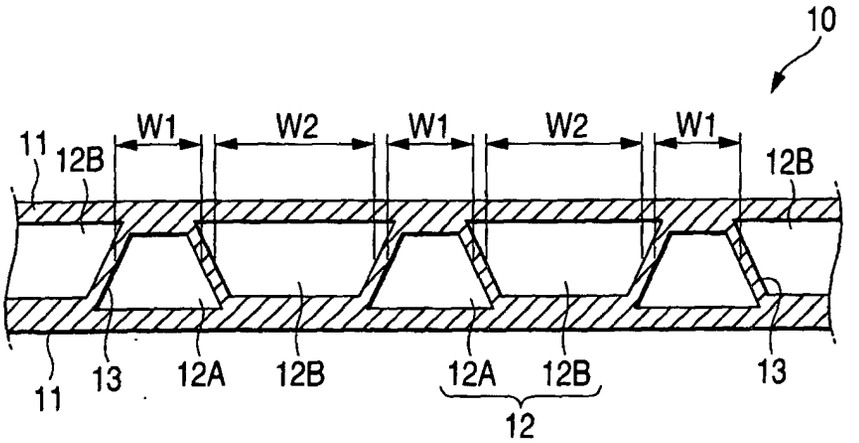
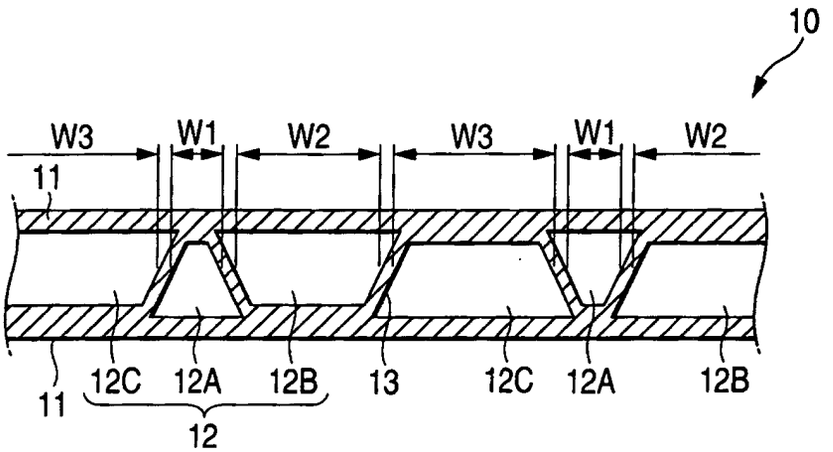

10
W1
W2
W1
W2
W1
11
12B
12B
11
13
12A
12B
12A
12B
13
12

FIG. 3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W3
W1
W2
W3
W1
W2
11
11
12C
12A
12B
13
12C
12A
12B
12

FIG. 4

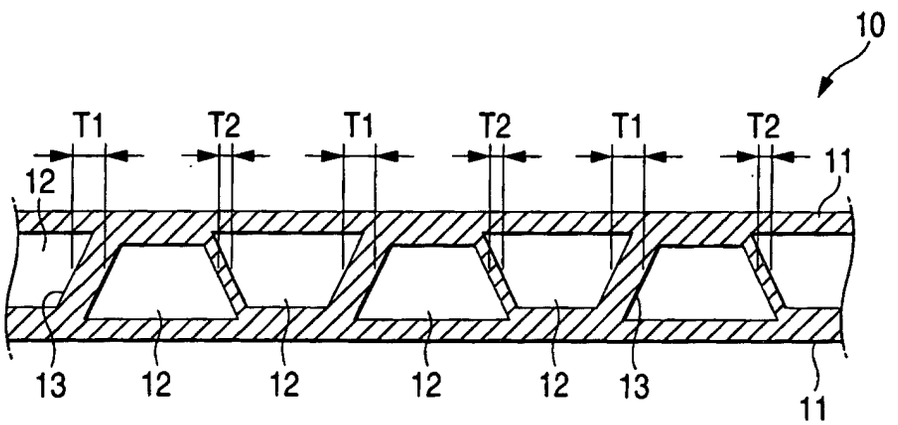

10
T1
T2
T1
T2
T1
T2
12
11
13
12
12
12
12
13
11

FIG. 5

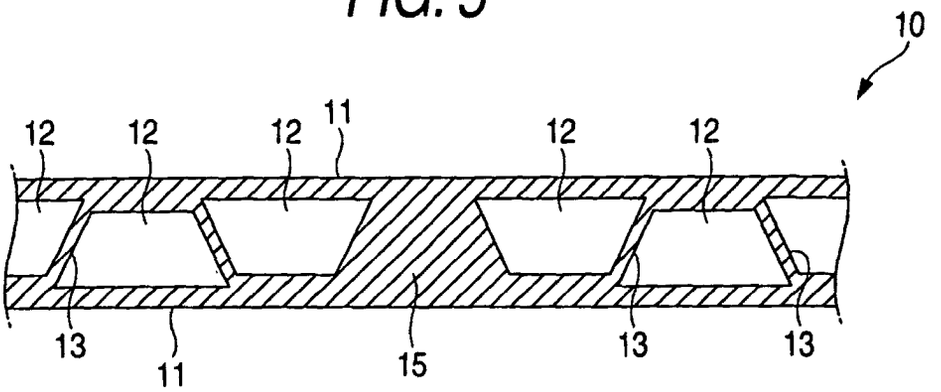


FIG. 6

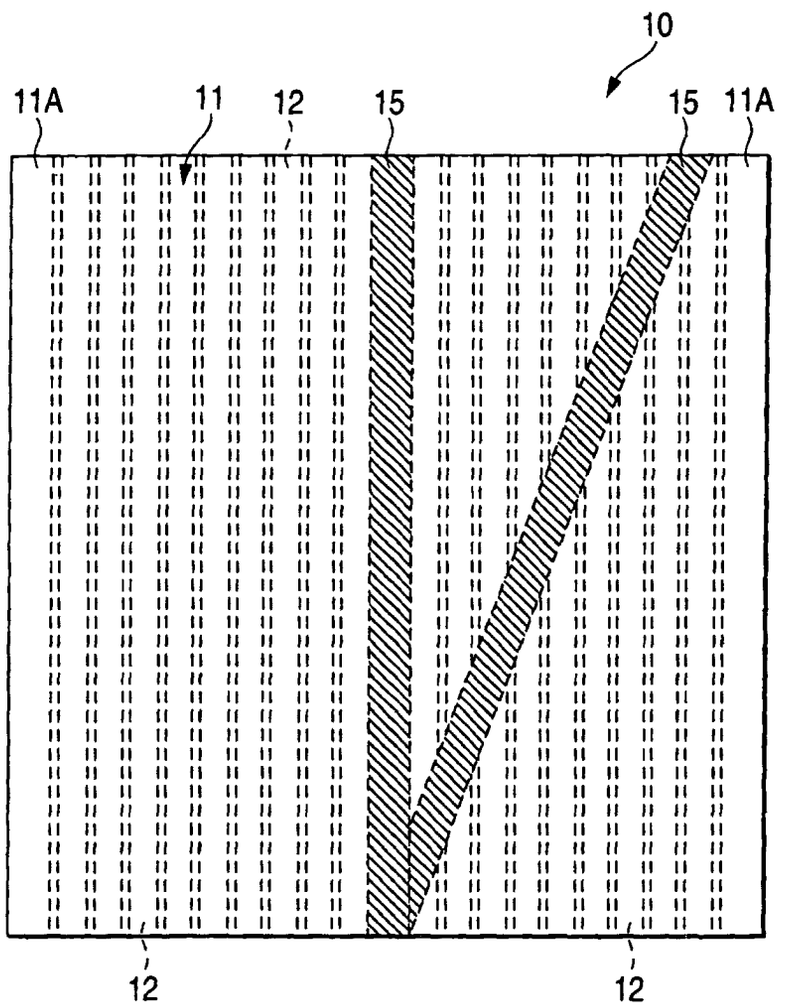


FIG. 7

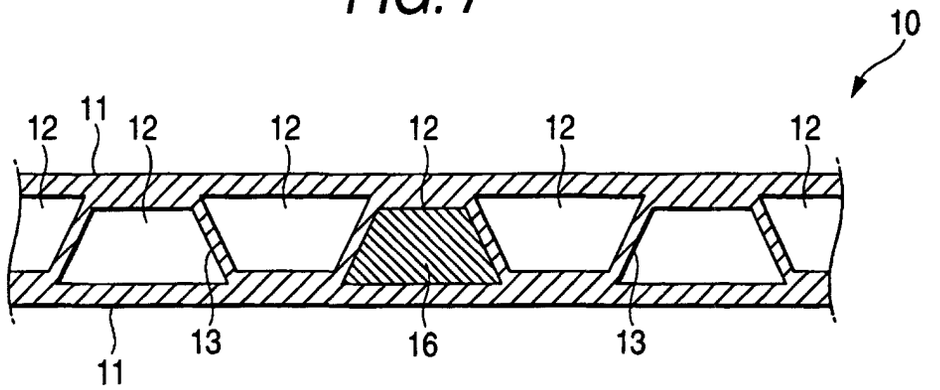
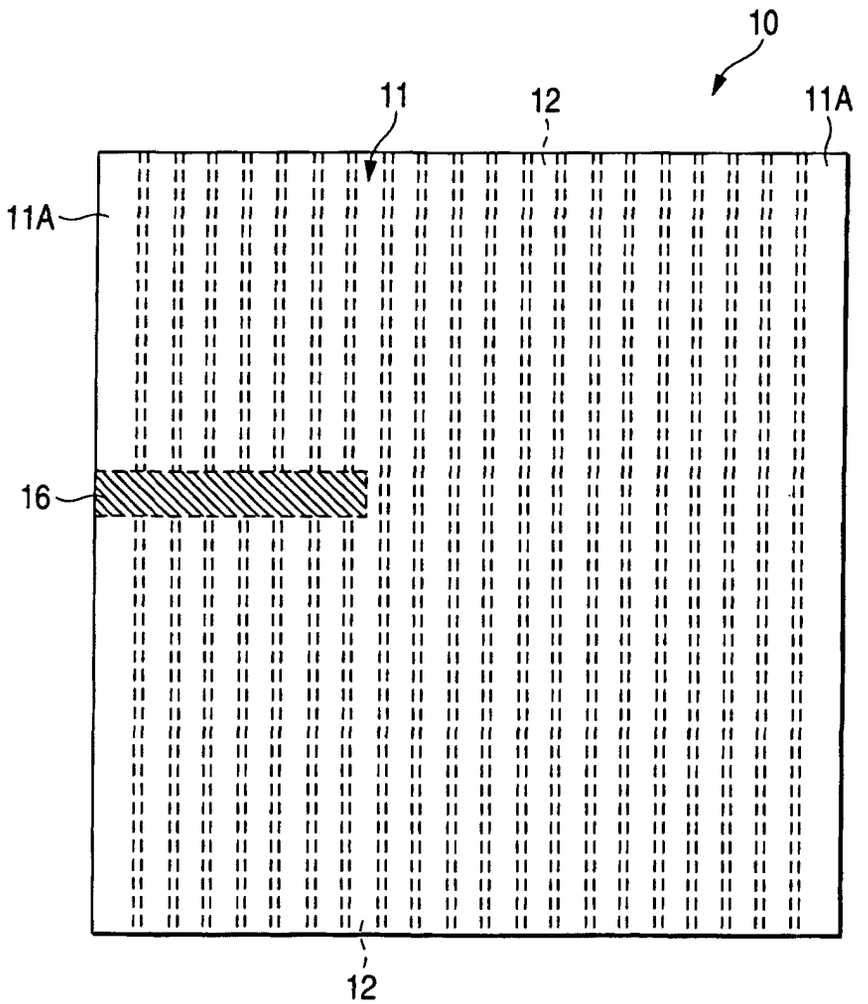


FIG. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 03 02 1112

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Y	* paragraphs [0057], [0060], [0068] - [0070]; claims 1,3-5; figures 1,3,5,9,10A-I,11A,11B; examples *	13	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 January 2004	Seiberlich, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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22-01-2004

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