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(54) **Hollow panel**

Hohlkammerplatte

Panneau creux

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(73) Proprietor: **YAMAHA CORPORATION**
Naka-ku
Hamamatsu-shi
Shizuoka-ken (JP)

(72) Inventors:
- **Tanase, Rento**
  Hamamatsu-shi
  Shizuoka-ken (JP)
- **Kobayashi, Tetsu**
  Hamamatsu-shi
  Shizuoka-ken (JP)

(74) Representative: **Emde, Eric et al**
Wagner & Geyer
Gewürzmühlstrasse 5
80538 München (DE)

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EP-A- 1 321 593
DE-A- 1 805 115
DE-A- 2 506 472
GB-A- 1 384 577
US-A- 4 167 598
US-A- 6 021 612

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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 twoflatplates 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.

[0004] EP-A-1 321 593 discloses a panel for rebound wall element or acoustical element plate used as an impact-protection plate or an acoustic plate in sports and multipurpose halls, comprising two outer layers, and a middle layer containing hollow chambers.

[0005] US-A-6 021 612 discloses a sound absorbing hollow core panel of structural material based on Helmholtz resonator properties consisting of two exterior skins connected by spacers or structural connections and bounded by perimeter skins or structural connections with internal cavity or cavities that communicate with the exterior sound field through a plurality of orifices in one or both exterior skins as well as the perimeter of the panel and that have a plurality of Helmoltz resonators of different shapes and sizes tuned to specific frequencies that control the sound absorption characteristics of the hollow core panel. The internal cavity or cavities are defined by external skins and perimeters as well as internal structural elements acting as interior dividers, interior sub-volumes and perimeter structures, each of which may contain a plurality of orifices for sound communication forming a sequence of first order Helmholtz acoustical resonators with respective natural frequencies for sound absorption. Panels may be assembled with or without selected interior elements or perimeter structures as a basis for infinite flexibility in building sound absorbing walls of selectable sound absorbing characteristics and size. The numbers and geometries of the orifices as well as the sizes of the internal cavities may be varied generally, thus adding to the flexibility of the invention. Sound dissipating material may also be incorporated in the cavities of the panel.

[0006] EP-A-1 199 141 discloses a manufacturing method for hollow panels wherein highly rigid, lighter and various shapes of hollow panels constructed by layering board material made from fibers, wood elements, or wood strands can be obtained economically, wood strands on which a binder is added are layered with a plurality of cores, a thermal compression molding is performed on this layered material uniformly, cores are extracted after the thermal compression molding, and thus ribs and holes are formed in the panel. Also in the core is a bar which may be of irregular shape, and the core can be a combination of bars having the same or different cross sections. The cores are joined by joining boards in a direction of the short dimension of the core.

[0007] US-A-4 167 598 discloses a heat and sound insulating panel assembly for wall, ceiling or floor construction, consisting of a plurality of interlocking vacuum-chambered panel elements fabricated from a relatively hard, low thermally-conductive, fire-resistant or fireproof material with heat-reflective, moisture-restraining coatings on its inner and outer surfaces. Abutting surfaces may be provided with sound-cushioning pads, and vacuum-chambered spacer column elements may be employed, interlocked between panel elements, for uniform increased panel wall thickness.

[0008] DE 18 05 115 A discloses a sound insulating board, but fails to disclose a second hollow portion and a smooth surface. A space defined between trapezoidal hollow portions surrounded by a plate communicates with the exterior and does not constitute hollow portion, and a slit is formed.

[0009] GB-A-1 384 577 discloses a flat-supplied sheet material, especially for the packaging industry, which sheet material is pre-formed to facilitate adaptation to corrugated sheet substitute, but fails to disclose that a shape of the first hollow portion is unrelated to that of the second hollow portion.

[0010] Finally, DE 25 06 472 A discloses a sound absorbing panel effective in two frequency domains, combining the action of a Helmholtz resonator with that of laminar honeycomb absorber.

SUMMARY OF THE INVENTION

[0011] According to the present invention, a hollow panel is provided as set forth in claim 1. Preferred embodiments of the present invention may be gathered from the dependent claims.

[0012] In the invention, a configuration may be em-

ployed 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.

[0013] 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 non-foamable binder resin, and a mixture of these binders may be employed.

[0014] 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

[0015]

Fig. 1 is a schematic perspective partial view of a hollow panel.

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 hollow panel of Fig. 1.

Fig. 4 is a partial end view of another hollow panel.

Fig. 5 is a partial end view of still another hollow panel.

Fig. 6 is a schematic plan view of the hollow panel of Fig. 5.

Fig. 7 is a schematic plan view of a hollow panel of the present invention.

Fig. 8 is a schematic plan view of a hollow panel which is a modification of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0016] Hereinafter, embodiments of the invention will be described with reference to the accompanying drawings.

[0017] Fig. 1 is a schematic perspective view of a hollow panel not in accordance with the present invention, 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.

[0018] 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. 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.

[0019] 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.

[0020] 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.

[0021] In the following description, components which are identical with or equivalent to those of the above hollow panel are denoted by the same reference numerals, and their description is omitted or simplified.

[0022] Fig. 4 shows another hollow panel wherein, 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.

[0023] The area of the thickness T1 is higher in surface density than that of the thickness T2, or higher in rigidity. Therefore, the hollow panel 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 hollow panel.

[0024] Figs. 5 and 6 show a third example of the hollow panel. 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 hollow panel is realized by extremely increasing the thicknesses of specific ones of the partition walls 13.

[0025] Also the hollow panel of Figs. 5 and 6 can exert the same effect as that of the afore-described embodiments.

[0026] Fig. 7 shows an 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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 (10) comprising:

first hollow portions (12A) arranged in a substantially same plane and having first panel resonance frequency; and
second hollow portions (12B) arranged in the substantially same plane having second panel resonance frequency different from the first panel resonance frequency,
wherein each of the first hollow portion (12A) include a first sectional area; and each of the second hollow portions (12B) includes a second sectional area different from the first sectional area, wherein a solid portion forming member (15, 16) is disposed inside of a part of of the first and second hollow portions (12A, 12B), the solid portion forming member (15, 16) having a section shape which substantially corresponds to a section shape of the specific hollow portion

2. The hollow panel according to claim 1, wherein the first hollow portion (12A) and the second hollow portion (12B) are alternatively arranged in the substantially same plane.
.

3. The hollow panel according to claim 1, wherein a sectional shape of the first and second hollow por-

tions (12A, 12B) is a trapezoidal.

4. The hollow panel according to any of the preceding, claims, wherein each of the first hollow portions (12A) includes a first width (W1), and each of the second hollow portions (12B) includes a second width (W2) different from the first width (W1), wherein the first width (W1) is defined between a pair of partition walls (13) defining the first hollow portion (12A), and the second width (W2) is defined between a pair of partition walls (13) defining the second hollow portion (12B).

5. The hollow panel according to any of the preceding claims, wherein said solid portion forming member (15) is inserted into said specific one of said first and second hollow portions (12A, 12B).

6. The hollow panel according to any of claims 1 to 4, wherein said solid portion forming member (15,16) is placed in a direction intersecting with the direction along which said first and second hollow portions (12A, 12B) extend.

7. The hollow panel according to any of the preceding claims, comprising:

first and second partition walls (13) defining said first and second hollow portion (12A, 13B) , wherein a thickness (T1) of the first partition walls is different from that (T2) of the second partition walls.

8. The hollow panel according to claim 7, wherein the first and second partition walls (13) are alternatively arranged.

Patentansprüche

1. Eine hohle Platte (10), die Folgendes aufweist:

erste hohle Teile (12A), die in einer im Wesentlichen gleichen Ebene angeordnet sind und eine erste Plattenresonanzfrequenz aufweisen; und zweite hohle Teile (12B), die in der im Wesentlichen gleichen Ebene angeordnet sind und eine zweite Platenresonanzfrequenz aufweisen, die sich von der ersten Plattenresonanzfrequenz unterscheidet,
wobei jeder der ersten hohlen Teile (12A) eine erste Schnittfläche aufweist und jeder der zweiten hohlen Teile (12B) eine zweite Schnittfläche aufweist, die sich von der ersten Schnittfläche unterscheidet,
wobei ein Glied (15, 16), das einen festen Teil bildet, innerhalb eines Teils der ersten und zweiten hohlen Teile (12A, 12B) angeordnet ist, wobei das Glied (15, 16), das einen festen Teil bildet, ein Profil aufweist, das im Wesentlichen dem Profil des spezifischen, hohlen Teils entspricht.

2. Hohle Platte gemäß Anspruch 1, wobei der erste hohle Teil (12A) und der zweite hohle Teil (12B) abwechselnd in der im Wesentlichen gleichen Ebene angeordnet sind.

3. Hohle Platte gemäß Anspruch 1, wobei ein Profil der ersten und zweiten hohlen Teile (12A, 12B) trapezförmig ist.

4. Hohle Platte gemäß einem der vorangehenden Ansprüche, wobei jeder der ersten hohlen Teile (12A) eine erste Breite (W1) umfasst, und jeder der zweiten hohlen Teile (12B) eine zweite Breite (W2) umfasst, die sich von der ersten Breite (W1) unterscheidet, wobei die erste Breite (W1) zwischen einem Paar von Trennwänden (13) definiert wird, die den ersten hohlen Teil (12A) definieren, und die zweite Breite (W2) zwischen einem Paar von Trennwänden (13) definiert wird, die den zweiten hohlen Teil (12B) definieren.

5. Hohle Platte gemäß einem der vorangehenden Ansprüche, wobei das Glied, das den festen Teil bildet, in einen bestimmten der ersten und zweiten hohlen Teile (12A, 12B) eingeführt wird.

6. Hohle Platte gemäß einem der Ansprüche 1 bis 4, wobei das Glied (15, 16), das den festen Teil bildet, in einer Richtung angeordnet wird, die sich mit der Richtung schneidet, entlang derer sich die ersten und zweiten hohlen Teile (12A, 12B) erstrecken.

7. Hohle Platte gemäß einem der vorangehenden Ansprüche, die Folgendes aufweist:

erste und zweite Trennwände (13), die die ersten und zweiten hohlen Teile (12A, 12B) definieren, wobei sich eine Dicke (T1) der ersten Trennwände von der (T2) der zweiten Trennwände unterscheidet.

8. Hohle Platte gemäß Anspruch 7, wobei die ersten und zweiten Trennwände (13) abwechselnd angeordnet sind.

Revendications

1. Panneau creux (10) comportant :

des premières parties creuses (12A) disposées sensiblement dans le même plan et ayant une première fréquence de résonance de panneau ;

et

des deuxièmes parties creuses (12B) disposées sensiblement dans le même plan ayant une deuxième fréquence de résonance de panneau différente de la première fréquence de résonance de panneau,

chacune des premières parties creuses (12A) comprenant une première section ; et chacune des deuxièmes parties creuses (12B) comprenant une deuxième section différente de la première section,

un élément formant une partie pleine (15, 16) étant disposé à l'intérieur d'une partie des premières et deuxièmes parties creuses (12A, 12B), l'élément formant une partie pleine (15, 16) ayant une forme en coupe qui correspond sensiblement à une forme en coupe de la partie creuse spécifique.

2. Panneau creux selon la revendication 1, dans lequel la première partie creuse (12A) et la deuxième partie creuse (12B) sont disposées de manière alternée sensiblement dans le même plan.

3. Panneau creux selon la revendication 1, dans lequel une forme en coupe des premières et deuxièmes parties creuses (12A, 12B) est une forme trapézoïdale.

4. Panneau creux selon l'une quelconque des revendications précédentes, dans lequel chacune des premières parties creuses (12Aà comprend une première largeur (W1), et chacune des deuxièmes parties creuses (12B) comprend une deuxième largeur (W2) différente de la première largeur (W1), la première largeur (W1) étant définie entre une paire de parois de séparation (13) définissant la première partie creuse (12A), et la deuxième largeur (W2) étant définie entre une paire de parois de séparation (13) définissant la deuxième partie creuse (12B).

5. Panneau creux selon l'une quelconque des revendications précédentes, dans lequel ledit élément formant une partie pleine (15) est inséré dans ladite partie spécifique desdites premières et deuxièmes parties creuses (12A, 12B).

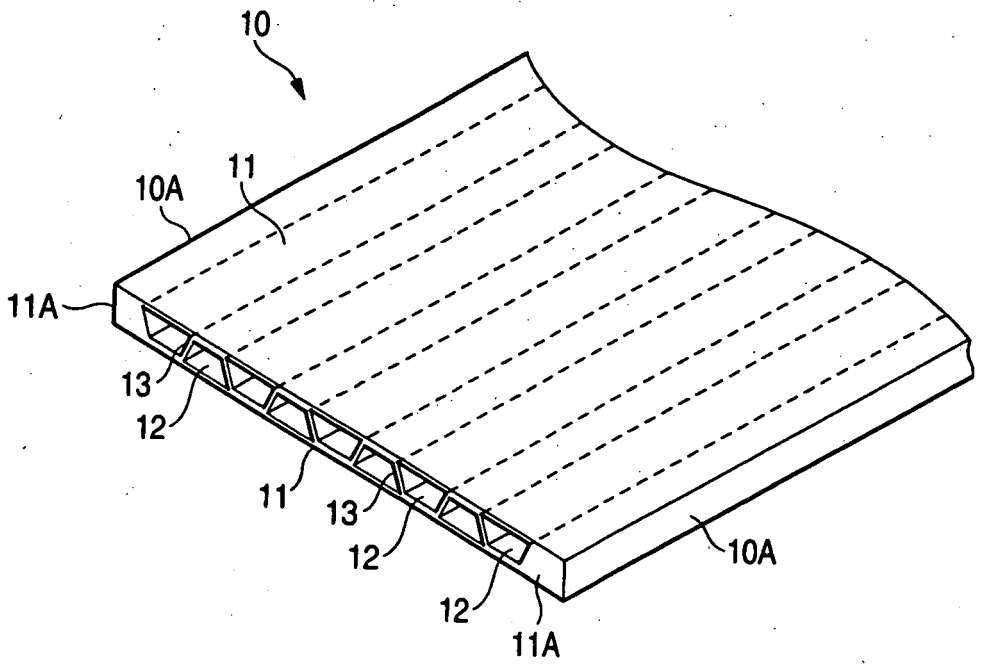
6. Panneau creux selon l'une quelconque des revendications 1 à 4, dans lequel ledit élément formant une partie pleine (15, 16) est placé dans une direction coupant la direction le long de laquelle s'étendent lesdites premières et deuxièmes parties creuses (12A, 12B).

7. Panneau creux selon l'une quelconque des revendications précédentes, comportant :

des premières et deuxièmes parois de séparation (13) définissant lesdites premières et deuxièmes parties creuses (12A, 12B), une épaisseur (T1) des premières parois de séparation étant différente de celle (T2) des deuxièmes parois de séparation.

8. Panneau creux selon la revendication 7, dans lequel les premières et deuxièmes parois de séparation (13) sont disposées de manière alternée.

FIG. 1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10A
11
11A
13
12
11
13
12
12
11A
10A

FIG. 2

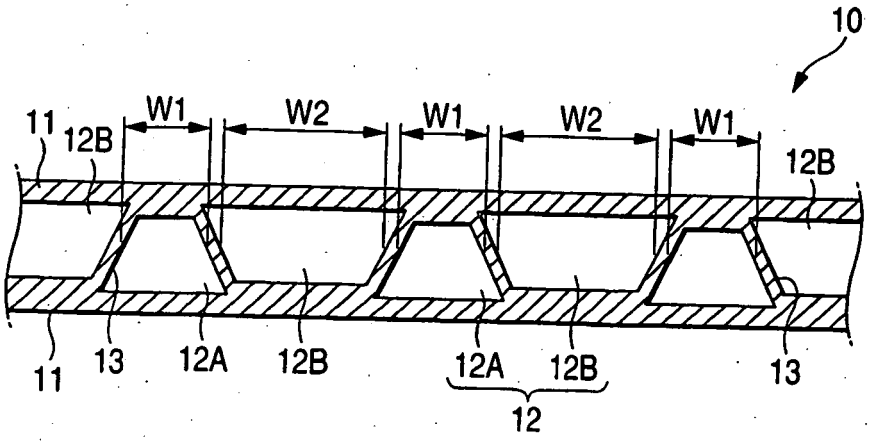

10
11
12B
W1
W2
W1
W2
W1
12B
11
13
12A
12B
12A
12B
13
12

FIG. 3

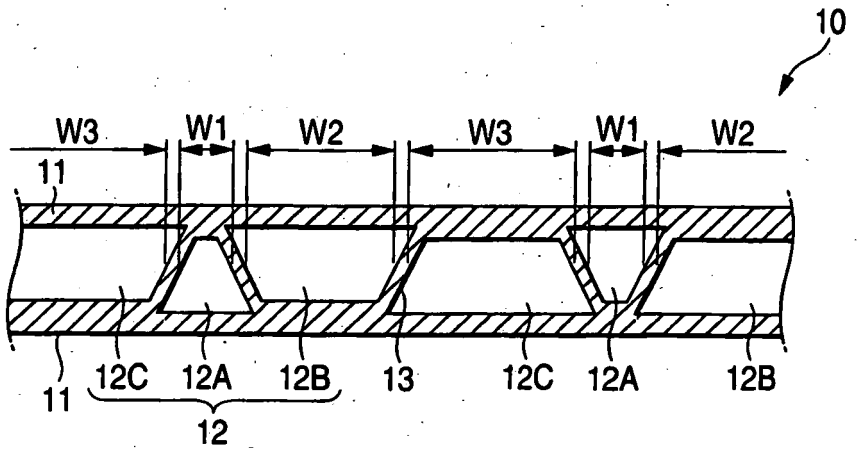

10
W3
W1
W2
W3
W1
W2
11
11
12C
12A
12B
13
12C
12A
12B
12

FIG. 4

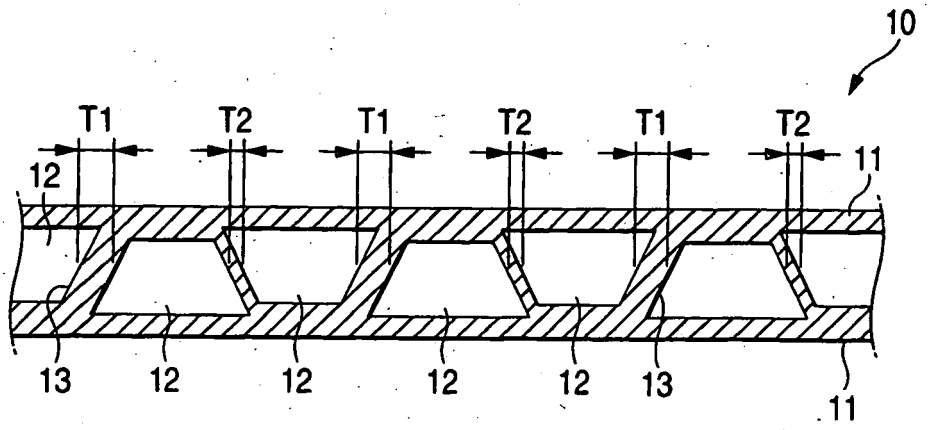

10
T1
T2
T1
T2
T1
T2
12
11
13
12
12
12
12
13
11

FIG. 5

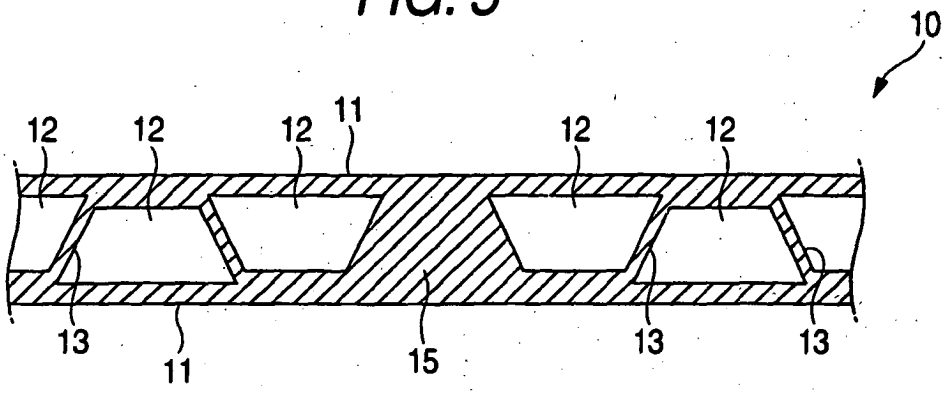


FIG. 6

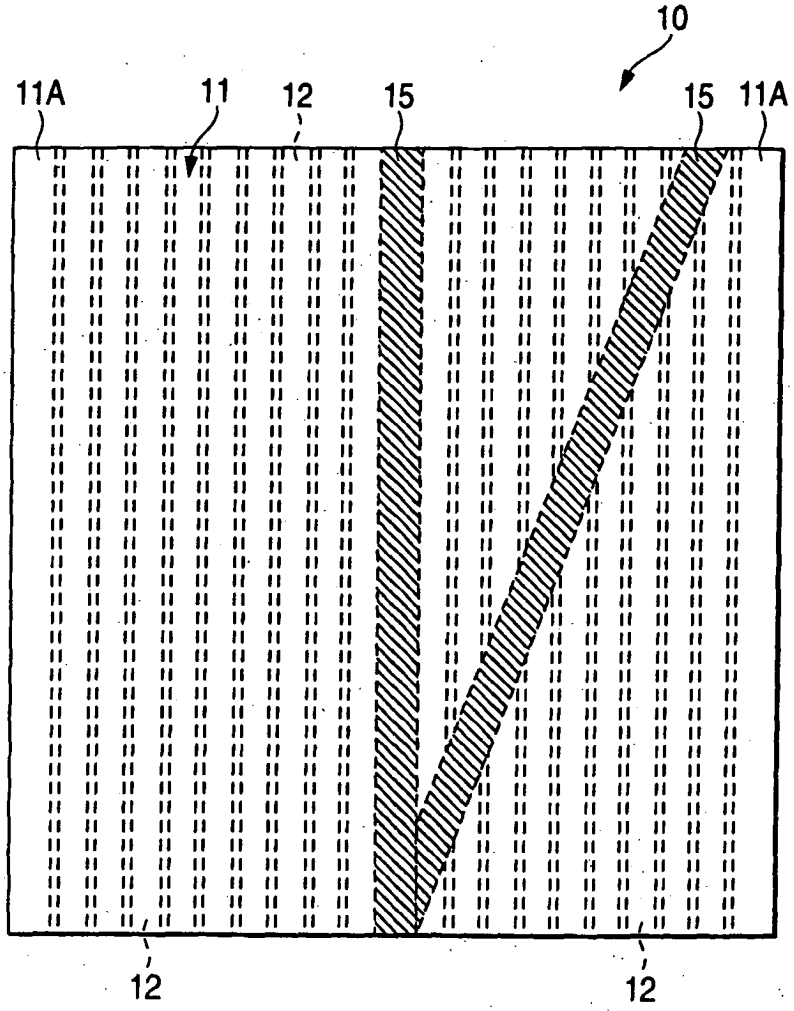


FIG. 7

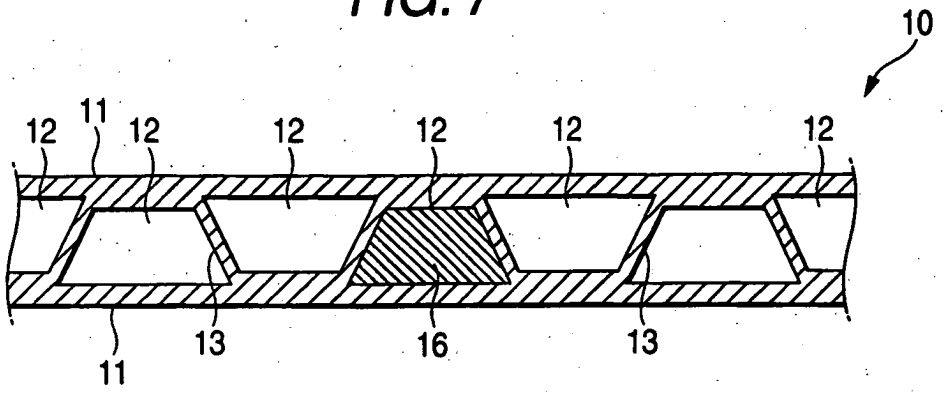
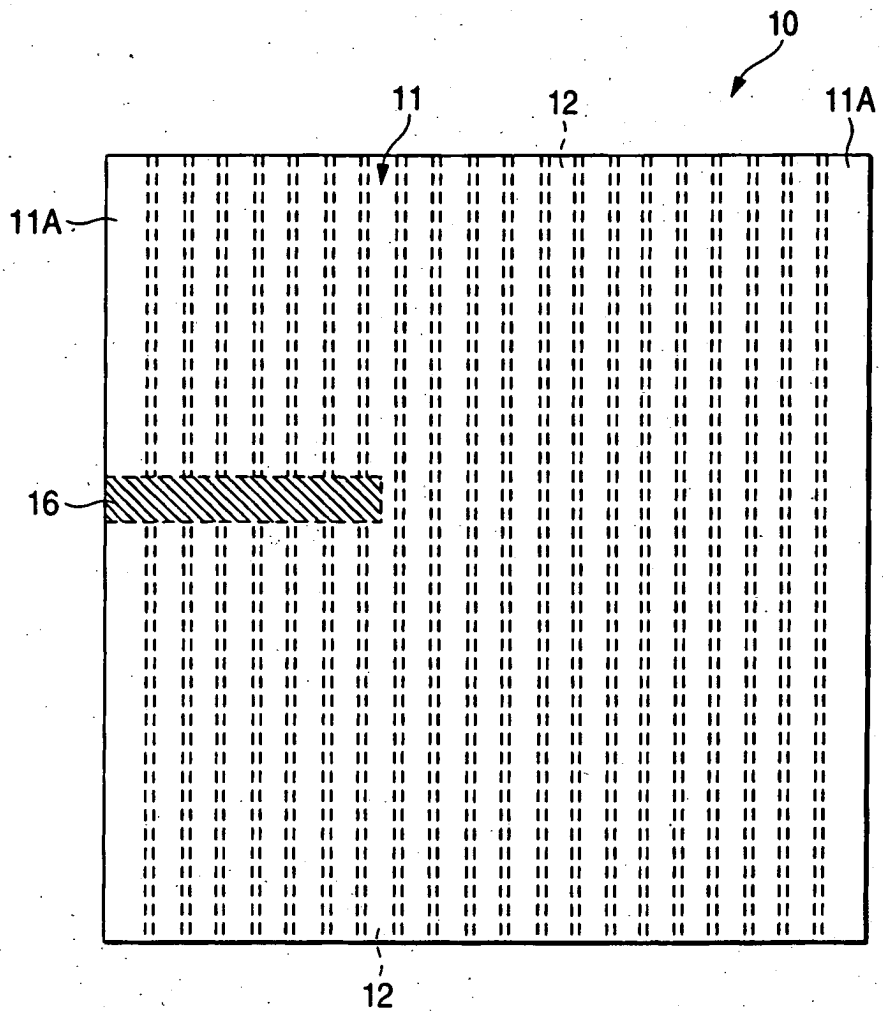


FIG. 8



REFERENCES CITED IN THE DESCRIPTION

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