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(54) Sound-absorbing element for noise abatement barriers

(57) A sound-absorbing element for noise abatement barriers comprising a sheet (2) with a first portion (3) and a second portion (4) lying one over the other, a plurality of tubular cavities (5) in said second portion (4) being arranged along at least one axis (X) substantially parallel to a plane (G) on which the element lies, at least one side of the sheet perpendicular to said axis (X) being shaped so that between two elements placed side by side along the axis (X) there is a chamber (7) designed to receive a portion of the sound waves coming to bear on the surface, such that said waves are able to spread through said tubular cavities (5).

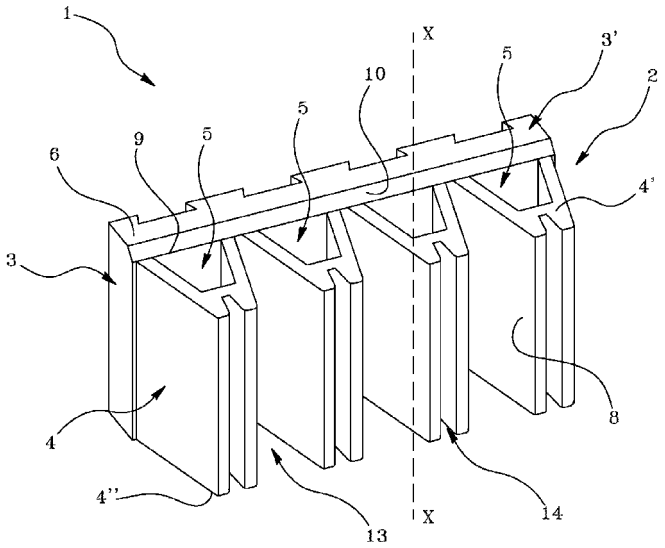

Fig. 1

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Description

[0001] The present invention relates to a sound-absorbing element for noise abatement barriers. More in particular, the invention relates to an element for coating sound-absorbing panels used for making road, motorway and similar noise abatement barriers.

[0002] As is known, the phenomenon of sound pollution generated by vehicles represents an increasingly felt problem especially for roads that cross and are in the proximity of built-up areas or residential areas.

[0003] This is due both to the considerable increase in circulating vehicles, especially medium and large sized vehicles used for transportation, and to the intense exploitation of the territory which over the last years has led to the building of houses also in the proximity of main road networks.

[0004] For these reasons, suitable noise abatement barriers are increasingly used which are placed at the sides of the road in the stretches in the proximity of built-up or residential areas.

[0005] In most cases, these barriers consist of prefab panels which may be of different shapes and types.

[0006] For example, a highly widespread type consists of panels made of concrete coated with a plurality of sound-absorbing elements.

[0007] These elements generally consist of a sheet made of concrete, granulate or similar material, wherein the face facing the road stretch, i.e. that exposed to sound waves, is provided with a plurality of projections such as to define as many cavities or chambers thereinbetween, wherein a share portion of the incident sound energy is gradually deadened.

[0008] The deadening or absorbing effect of the sound wave energy is a function, among the others, of the dimensions of these cavities the effectiveness whereof, according to the theory of Helmholtz resonators, also depends on the wavelength of the sound to be deadened.

[0009] For example, elements are known, the surface whereof has a plurality of side by side rectilinear notches or grooves having a decreasing section towards the interior of the element.

[0010] While elements thus configured are easy to manufacture, they have a quite poor absorbing capability in relation to their thickness and to the mass of material used to build the element.

[0011] An element for sound-absorbing panels is also known from Italian patent N. 1372790 by the same applicant which on one side has a series of grooves with undercuts adapted to define a series of cavities (Helmholtz resonators) accessible by as many notches provided on the exposed outer face of the element.

[0012] However, also these elements thus configured have some limitations.

[0013] In fact, in order to obtain a high performance, for example to meet the maximum, sound-absorbing class A4, it is necessary to keep quite large dimensions, and in particular thickness, aided by the use of more precious materials such as concrete.

[0014] In this context, the object of the present invention is to propose a sound-absorbing element for noise abatement barriers which overcomes the drawbacks of the prior art.

[0015] In detail, it is an object of the present invention to propose a sound-absorbing element for noise abatement barriers with a reduced thickness compared to known panels but which at the same time ensures a high absorption of the sound energy. In more detail, it is an object of the present invention to propose a sound-absorbing element for noise abatement barriers which allows a smaller volume of material to be used for the manufacture thereof, the occupied surface being the same.

[0016] In more detail, it is an object of the present invention to propose a sound-absorbing element for noise abatement barriers which allows high sound-absorbing levels to be achieved using less precious and therefore less expensive materials compared to known elements.

[0017] Another object of the present invention is to provide a sound-absorbing element for noise abatement barriers which is lighter and allows the use of undersized support structures compared to known ones.

[0018] The above objects are substantially achieved by a sound-absorbing element according to one or more of the annexed claims.

[0019] In particular, said objects are achieved by a sound-absorbing element for noise abatement barriers comprising a sheet with a first portion and a second portion lying one over the other, a plurality of tubular cavities in said second portion being arranged along at least one axis substantially parallel to a plane on which the element lies, at least one side perpendicular to said axis being shaped so that between two elements placed side by side along the axis there is a chamber designed to receive a portion of the sound waves coming to bear on the surface, such that said waves are able to spread through said tubular cavities.

[0020] Other features and advantages will appear more clearly from the exemplary and therefore non limiting description of a preferred but non exclusive embodiment of the invention, as illustrated in the annexed drawings, wherein:

- figure 1 shows a perspective view of the sound-absorbing element according to the invention;
- figure 2 shows a plan view of the sound-absorbing element of figure 1;
- figure 3 shows a side cutaway view of the sound-absorbing element of figure 1;
- figure 4 shows a side cutaway view of the sound-absorbing element according to a further embodiment;
- figure 5 shows a front view of a portion of a noise abatement barrier, installed in the proximity of a road network, provided with a sound-absorbing element according to the invention;
- figure 6 shows a side cutaway view of the noise abatement barrier of figure 5. With reference to the

annexed figures, the sound-absorbing element indicated with reference numeral 1 comprises a sheet 2 made of concrete, granulate, foamed clay or other suitable building materials.

[0021] Said sheet comprises a first portion 3 and a second portion 4 lying one over the other along a direction perpendicular to a plane G where the element lies on a panel P of a noise abatement barrier B (figures 5 and 6).

[0022] According to the invention, said second portion is provided with one or more tubular cavities 5 arranged along at least one axis X substantially parallel to said plane where the element lies.

[0023] More precisely, said tubular cavities 5 extend between two opposite sides 4' and 4", of the second portion 4 of sheet 2, perpendicular to said axis X.

[0024] In the practice, said tubular cavities 5 are through and are provided with a first opening 5' arranged at a first side 4' of the second portion 4 of sheet 2, and with a second opening 5" arranged at a second opposite side 4" of said second portion 4 of sheet 2 (fig. 3).

[0025] According to the invention, said tubular cavities 5 are configured for trapping the sound waves which, bouncing on the inner walls of said cavity, increasingly lose a part of their energy which is absorbed by the material.

[0026] To this end, at least one side of sheet 2 perpendicular to axis X is configured so that between two side by side elements along said axis there is a chamber 7 adapted to receive a portion of the sound waves directed towards the surface and allow the spreading thereof within said tubular cavities 5.

[0027] According to a first preferred embodiment, the first portion 3 of sheet 2 is provided, on at least one side 3' perpendicular to said axis X, with a projecting ledge 6 so as to keep the second portions 4 of two adjacent elements on the panel spaced apart, as shown in figure 5.

[0028] More in detail, said ledge 6 allows the first side 4' of one element to be kept spaced apart from a second opposite side 4" of an adjacent element along a direction parallel to axis X.

[0029] A chamber 7 is therefore defined between a first side 4' of a second portion of one element and a second side 4" of a second portion 2 of an adjacent element, adapted to receive a portion of the sound waves directed towards the exposed outer surface 8 of the second portion 4 of sheet 2.

[0030] Entering through an inlet 7' of chamber 7, the sound waves can spread into the tubular cavities 5 where, reflecting multiple times on the inner walls, they lose a part of their energy which is dispersed in the material.

[0031] Preferably, in order to facilitate the entrance of the sound waves into said tubular cavities 5, a front edge 9 of ledge 6 is provided with a bevel which defines an inclined wall 10 arranged on the bottom of chamber 7.

[0032] After impinging said bottom wall 10, the sound waves entering into said chamber 7 are reflected towards the second openings 5" of the upper element.

[0033] The size of chamber 7 affects the capability of the same to trap a part of the sound waves directed towards the outer surface 8 of the element.

[0034] In the embodiment shown, sides 4' and 4" are arranged substantially parallel to each other at a distance D.

[0035] A value of distance D, corresponding to the height of ledge 6, which ensures good sound-absorbing performance, is in the range between 5 mm and 50 mm. According to some tests carried out by the applicant, maximum performance is achieved with a distance D of 15 mm.

[0036] Likewise, angle a of the bottom wall 10 of chamber 7 affects the percentage of waves reflected within cavities 5.

[0037] An angle a which ensures good sound-absorbing performance is in the range between 40° and 70° of inclination relative to the plane G where the element lies on panel P.

[0038] According to the tests carried out, maximum performance is achieved with an angle a of about 60°.

[0039] According to a further embodiment shown in figure 4, at least one side 4' of the second portion 4 of the sheet is inclined relative to the lying plane G so as to create chamber 7.

[0040] In the practice, the first side 4' of one element and side 4" of an adjacent element are diverging from each other.

[0041] Also in this case, a portion of the sound waves directed on the surface of the element, entering through inlet 7' of chamber 7, can spread within the tubular cavities 5, where they are deadened.

[0042] In the example of figure 4, side 4" is substantially perpendicular to the lying plane G whereas the first side 4' is inclined by an angle b equal to or smaller than 90°. Preferably, said angle b is in the range between 45 ° and 90°.

[0043] Likewise, both sides 4' and 4" may be inclined so as to be diverging and thus create chamber 7 which allows the sound waves to propagate within cavities 5.

[0044] In this case, the angle comprised between sides 4' and 4" of two adjacent elements is in the range between 0 and 45°.

[0045] According to the described inventive concept, an even further embodiment (not shown in the figure) can be provided with both a ledge 6 on at least one of sides 3' of the first portion of the sheet, and at least one side 4' of the second portion 4 inclined by an angle b relative to the lying plane G.

[0046] The tubular cavities 5, according to the invention, preferably have a constant trapezoid or triangular shaped section.

[0047] The pair of converging walls 12 (the trapezium or triangle sides), in fact, allows the wavelength field whereat cavities 5 produce an actual deadening effect to be widened.

[0048] The remaining portion of sound waves that is not trapped into chamber 7, on the other hand, is partly

absorbed and partly reflected by the exposed outer surface 8 of the second portion 4 of the element, as it happens in known elements.

[0049] To this end, advantageously, said outer surface 8 has a plurality of first grooves 13 extending from the first side 4' to the second opposite side 4" of the second portion 4 of sheet 2.

[0050] On the one hand, said grooves allow the extension of the outer surface 8 to be increased, and on the other hand they allow the creation of further cavities wherein the sound waves reflect on their walls, dissipating a part of their energy.

[0051] The depth of said first grooves preferably substantially coincides with the thickness of the second portion 4 of sheet 2.

[0052] In the practice, said first grooves are interposed between one tubular cavity 5 and a consecutive one.

[0053] Preferably, further second grooves 14 are provided on the outer surface 8 with smaller dimensions, in particular depth, compared to the first ones.

[0054] The adoption of grooves with differently sized profiles in fact allows the field of wavelengths of the sound waves that can be effectively deadened with said elements to be increased.

[0055] On the back surface 15 of the first portion 3 of sheet, on the other hand, there are provided recesses 16 with undercuts, in particular shaped as a dovetail, adapted to improve the grip of the concrete layer 17 that is interposed between the element and panel P.

[0056] Thanks to the present invention it is therefore possible to make a sound-absorbing element with a high noise abatement power.

[0057] In particular, thanks to the quantity of sound energy absorbed in the tubular cavities 5, the element thus configured ensures the maximum sound-absorbing class A4 even using less precious and expensive materials, such as foamed clay. The panel may in any case be made of concrete mixed with other suitable materials such as wood, recycled plastic fragments, pebble, etc.

[0058] Moreover, thanks to the provision of cavities 5 and outer grooves 13 and 14, the elements requires a smaller volume of material with the same surface compared to known elements with a further saving in terms of money and weight.

[0059] Moreover, thanks to the lower weight, it is possible to make noise abatement barriers with support panels slightly undersized compared to known ones.

[0060] Several changes and variations can be made to the present invention as described and illustrated, all falling within the scope of the inventive concept; moreover, all details can be replaced with technically equivalent elements.

Claims

1. A sound-absorbing element for noise abatement barriers comprising a sheet (2) with a first portion (3) and a second portion (4) lying one over the other, a plurality of tubular cavities (5) in said second portion (4) being arranged along at least one axis (X) substantially parallel to a plane (G) on which the element lies, at least one side of the sheet perpendicular to said axis (X) being shaped so that between two elements placed side by side along the axis (X) there is a chamber (7) designed to receive a portion of the sound waves coming to bear on the surface, such that said waves are able to spread through said tubular cavities (5).

2. A sound-absorbing element for noise abatement barriers according to claim 1, **characterised in that** at least one side (3') of said first portion (3) substantially perpendicular to said axis (X) has a projecting ledge (6).

3. A sound-absorbing element for noise abatement barriers according to claim 2, **characterised in that** the height of said ledge is in the range of 5 to 50 mm.

4. A sound-absorbing element for noise abatement barriers according to claim 2 or 3, **characterised in that** the front edge (9) of said ledge (6) is bevelled to form an angle (a) in the range of 0° to 60 °.

5. A sound-absorbing element for noise abatement barriers according to claim 1 or 2, **characterised in that** at least one side (4', 4") of said second portion perpendicular to the axis (X) slopes in relation to said plane (G) at an angle (b) in the range of 45° to 90 °.

6. A sound-absorbing element for noise abatement barriers according to claim 1 or 2, **characterised in that** the sides (4', 4") perpendicular to the axis (X) slope away from one another, the angle between said sides being in the range of 0° to 45°.

7. A sound-absorbing element for noise abatement barriers according to any of the previous claim, **characterised in that** said tubular cavities (5) extend at least between a first side (4') and a second opposite side (4") of said second portion (4) of the sheet (2) forming the element.

8. A sound-absorbing element for noise abatement barriers according to any of the previous claims, **characterised in that** said tubular cavities (5) have a cross-section of trapezoid or triangular shape.

9. A sound-absorbing element for noise abatement barriers according to any of the previous claims, **characterised in that** the outer surface (8) of the element has a plurality of first grooves (13) extending from the first side (4') to a second opposite side (4") of the second portion (4) of the sheet (2), said grooves having a depth substantially coinciding with

the thickness of said second portion (4).

10. A sound-absorbing element for noise abatement barriers according to any of the previous claims, **characterised in that** the outer surface (8) of the element has a plurality of second grooves (13) extending from the first side (4') to the second, opposite side (4") of the second portion (4) of the sheet (2).

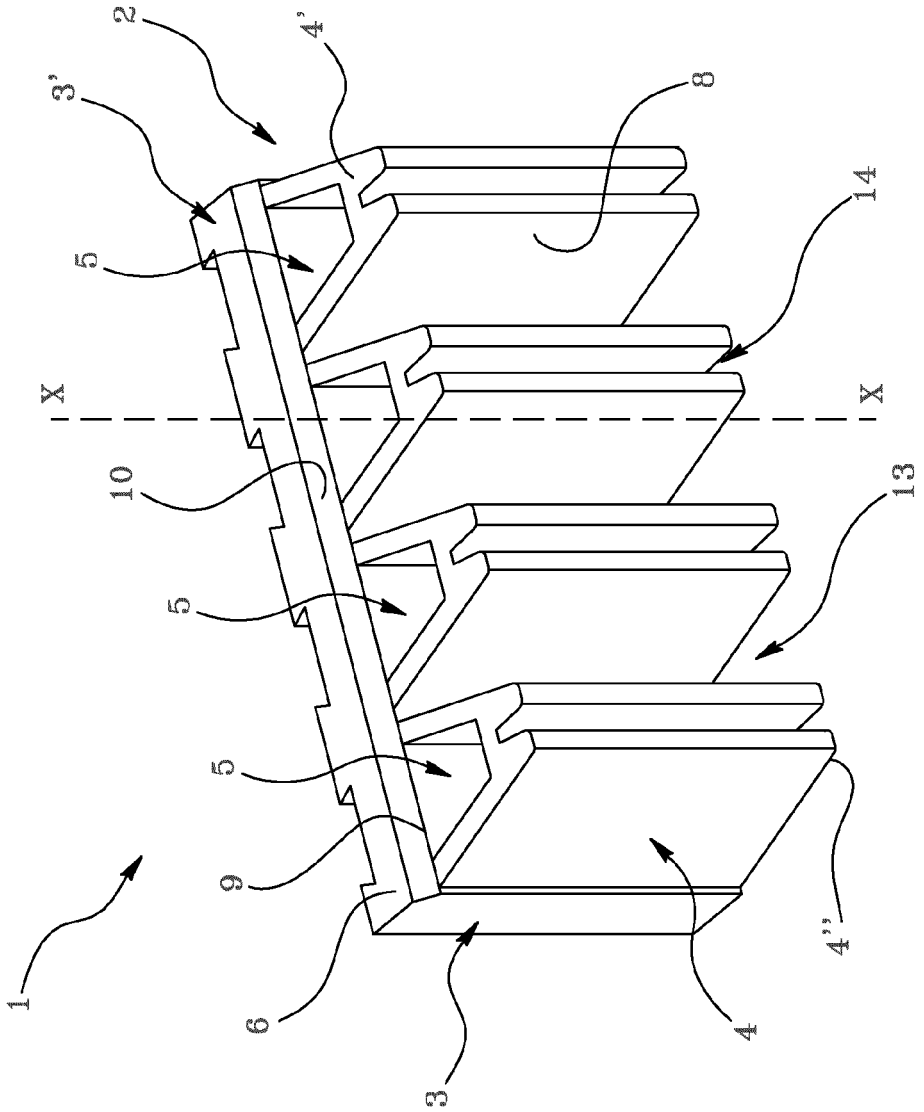

Fig. 1

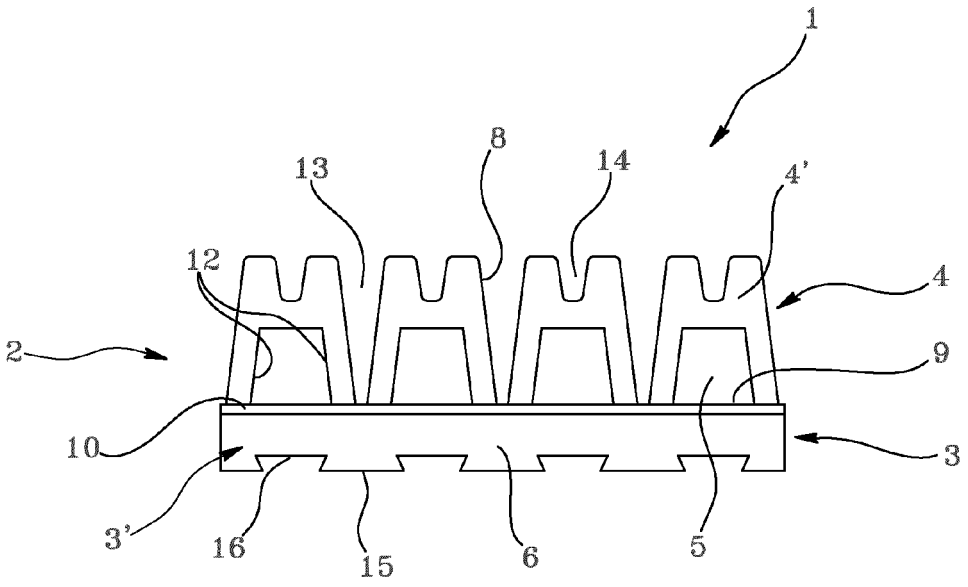

Fig. 2

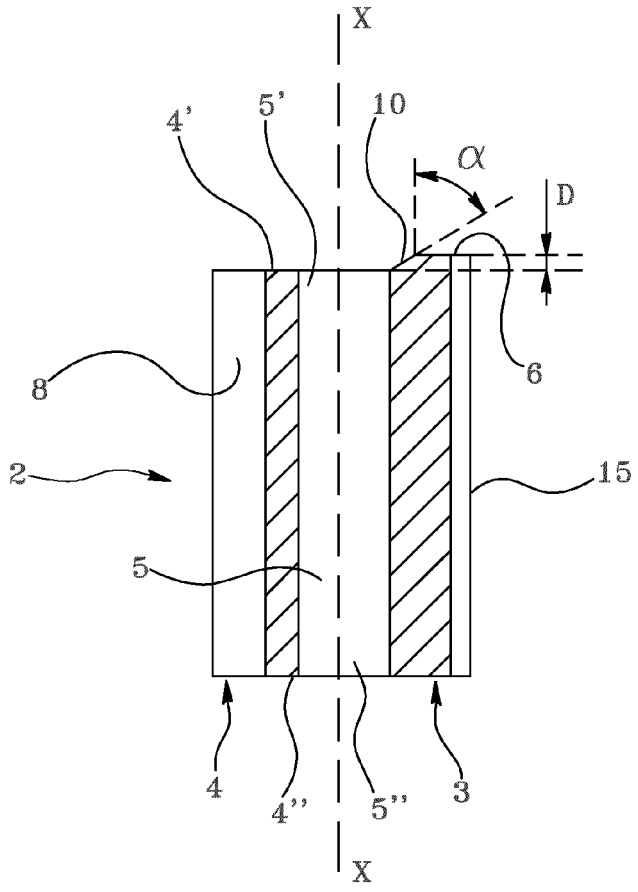

Fig. 3

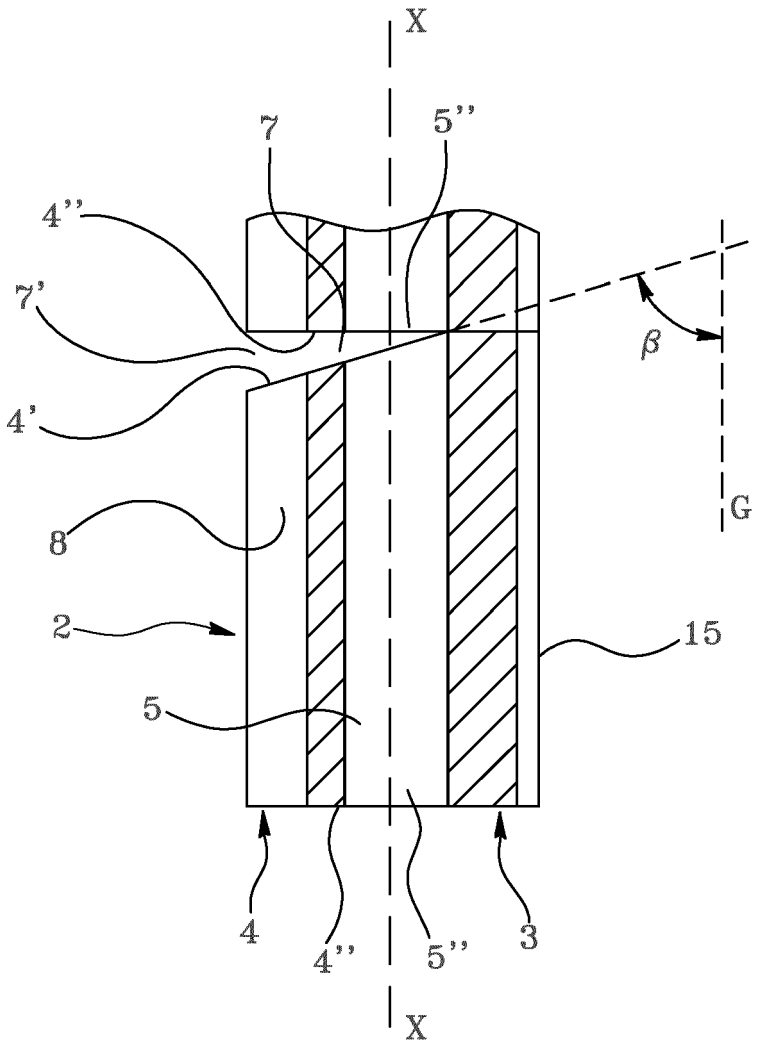

Fig. 4

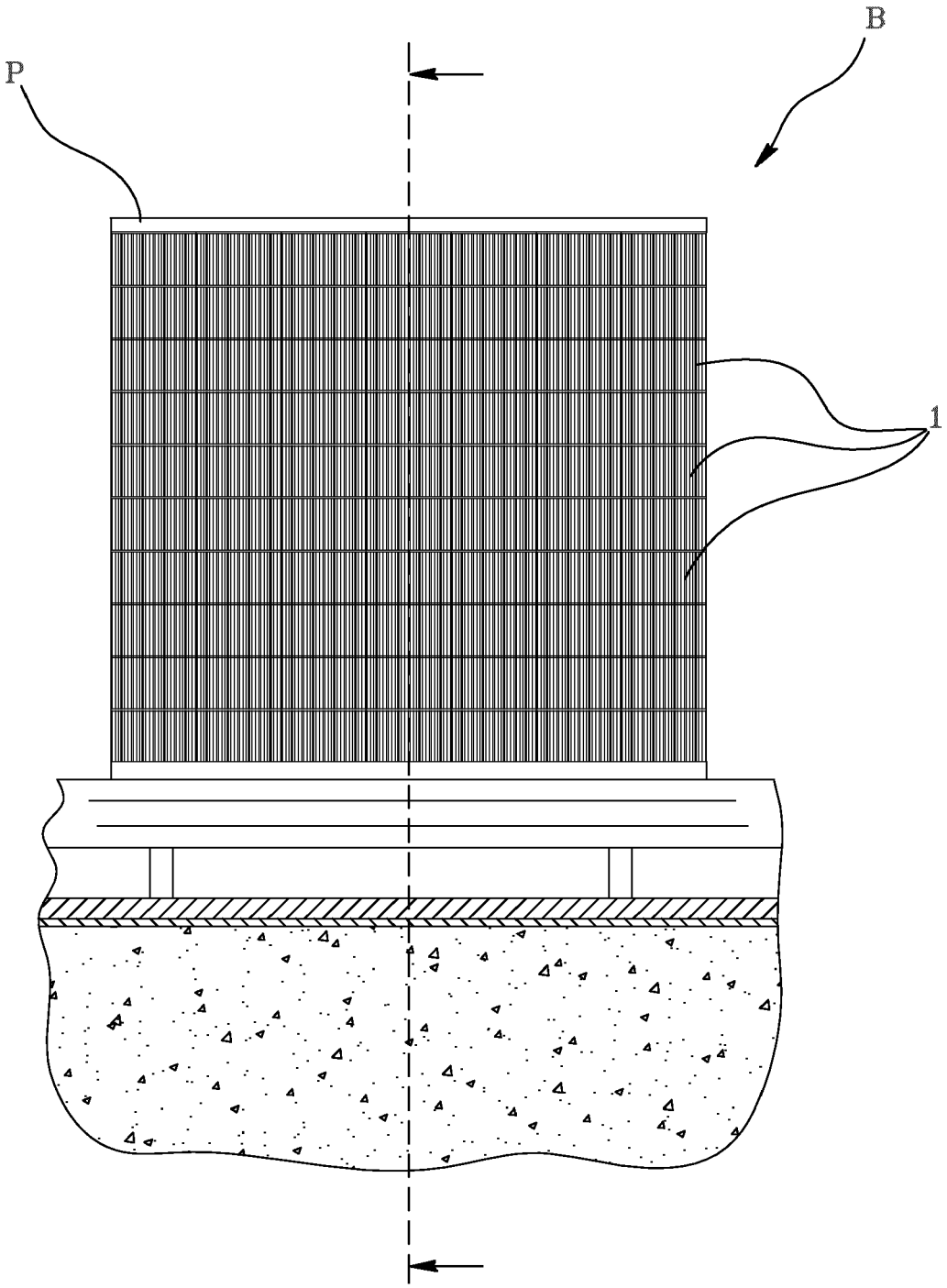

Fig. 5

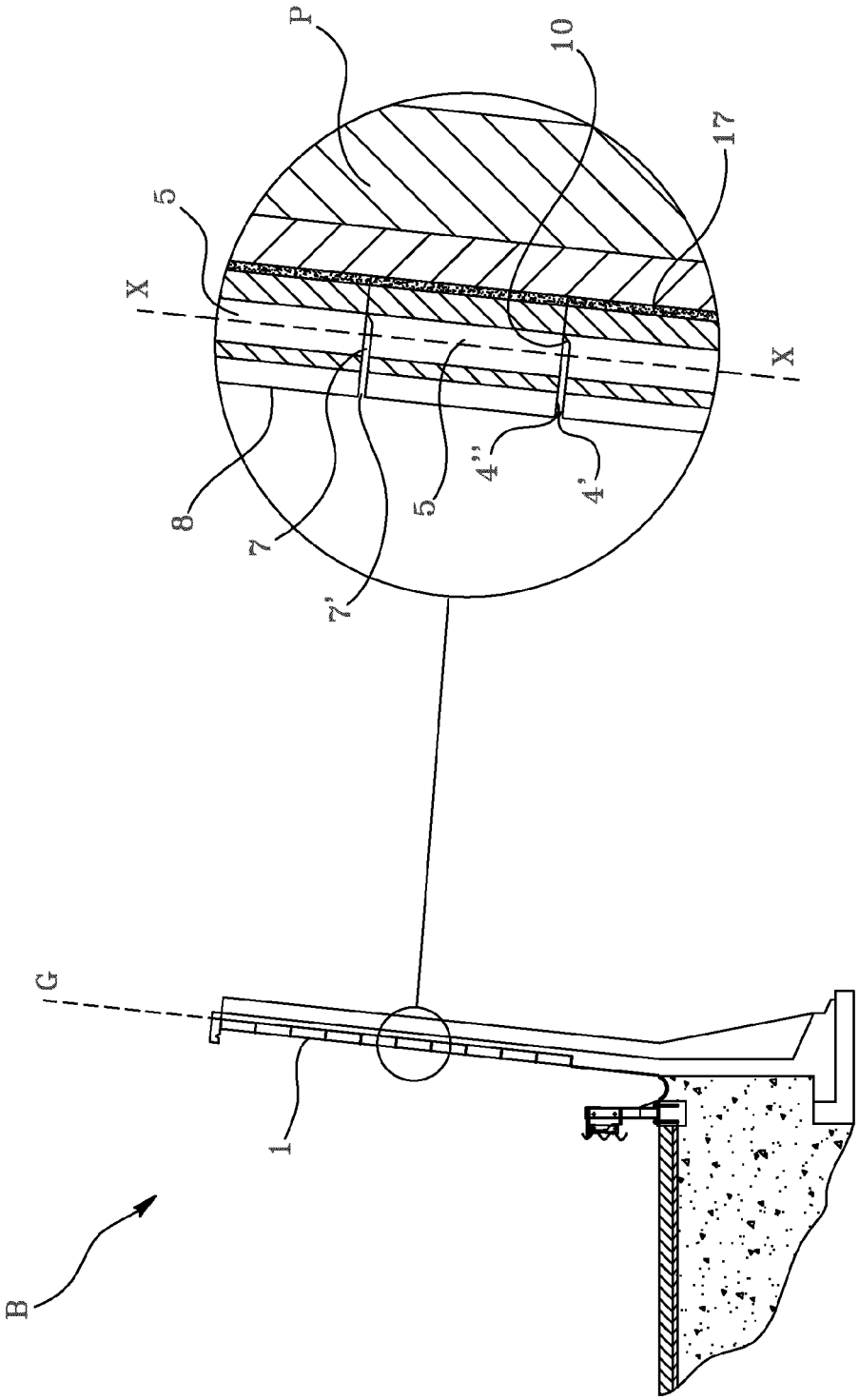

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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