



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
20.01.2021 Bulletin 2021/03

(51) Int Cl.:
E01F 8/00 (2006.01)

(21) Application number: **20185110.2**

(22) Date of filing: **10.07.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **17.07.2019 FI 20194098**

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(54) **NOISE BARRIER AND METHOD FOR PRODUCING THE SAME**

(57) Noise barrier and method for producing the same. The noise barrier (9) comprises at least one noise element (1), which has a frame and a noise cancellation structure attached to the frame. The noise element is supported between pillars (10). The frame of the noise element is produced from wood planks and comprises a horizontal frame (13) and a vertical frame (30). An outer surface of the noise element has on the side of a first flank (2a) a cladding damper (5) provided with perforations (20). Spaces defined between the horizontal frame (13) and the vertical frame (30) are each provided with a layer of sound insulating wool (15). Furthermore, the outer surface of the noise element (1), on the side of a second flank (2b), has an outer cladding panel (12).

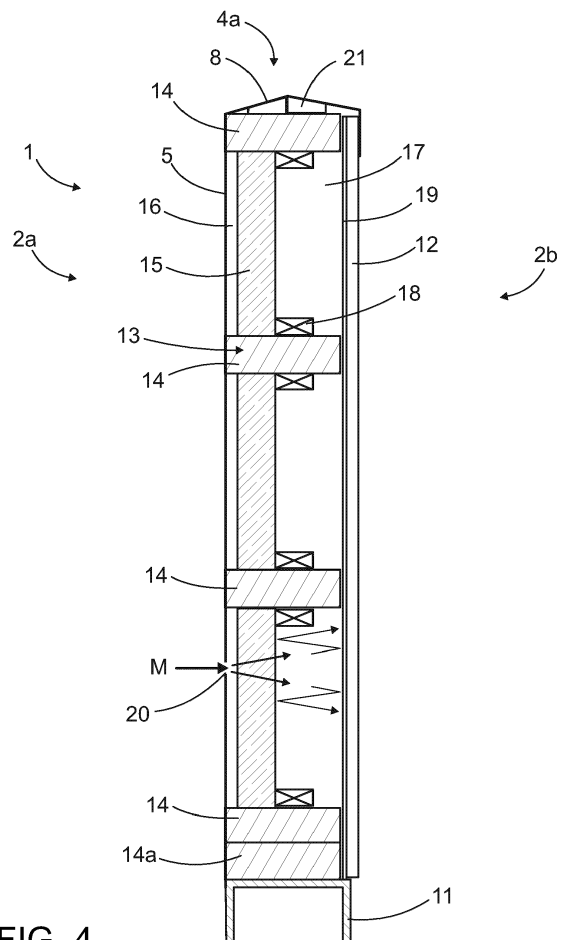


FIG. 4

Description

BACKGROUND OF THE INVENTION

[0001] The invention relates to a noise barrier which is intended to be placed at the border of a traffic corridor in order to combat noise generated on a traffic corridor.

[0002] The invention further relates to a method for manufacturing a noise barrier.

[0003] The object of the invention is described in more detail in the preambles of the independent claims of the application.

[0004] Noise is generated on traffic corridors, which is a significant nuisance for people living and spending time in the surrounding areas. Increasingly, however, traffic corridors have to be built close to residential areas, offices and public buildings, whereby traffic noise is causing a constantly growing problem. Efforts have been made to combat noise emissions by building noise barrier walls between the traffic corridor and the site to be protected from noise, which walls prevent the passage of noise. However, shortcomings have been observed in the current noise barriers, e.g. in terms of their durability and noise reduction capacity.

BRIEF DESCRIPTION OF THE INVENTION

[0005] The idea of the invention is to provide a new and improved noise barrier and a method for its production.

[0006] The characteristic features of the noise barrier according to the invention are set out in the characterizing part of the independent device claim.

[0007] The characteristic features of the method according to the invention are set out in the characterizing part of the independent method claim.

[0008] The idea of the presented solution is that the frame of the noise barrier is made of wood planks and noise attenuating elements are attached to the frame. The outer surface on the side of the noise source, i.e. the traffic corridor, has a perforated damper, which, thanks to its perforations, allows sound to enter the noise element. Sound entered in the housing-like structure is attenuated by an interior sound insulating wool layer. The structure is thus noise absorbing. The noise element has a weatherproof outer cladding panel on the residential-side flank. In other words, the noise cancellation structure of the noise element comprises at least the following components or sections, viewed from the traffic corridor towards the residential-side: perforated cladding damper, sound insulating wool, and outer cladding panel. Said noise cancellation structure is supported on a frame structure of wood material.

[0009] The advantage of the presented solution is that the noise element is a housing-like structure having sound-attenuating material and structural parts inside. The structure thus has a noise or sound absorbing structure which thus attenuates the sound and not merely pre-

vents it from passing. Furthermore, the presented structure is durable, inexpensive to manufacture and visually good looking. Yet as another advantage is considered the fact that the noise element can be produced from standard materials of construction industry which have good availability and reasonable price. Furthermore, no special equipment is required for construction.

[0010] The idea of one embodiment is that the horizontal frame of the noise element comprises at least four evenly spaced impregnated wooden horizontal planks. The vertical frame, in turn, comprises impregnated wooden vertical planks at least at the ends of the noise element. Said horizontal planks and vertical planks are of the same timber and have a length in their cross-section which is multiple times compared to the thickness. The width can be, for example, 3 times the thickness. The longer sides of the horizontal planks and the vertical planks are in the thickness direction of the noise element and the shorter sides are adapted to serve as mounting surfaces for the outer cladding. The horizontal planks form a good sturdy structure for carrying wind loads. Structural durability is necessary not only for wind load pressure but also for dynamic air pressure load generated by vehicles. Furthermore, the noise barrier may also be subject to loads due to ejecting of ploughed snow. These forces are well received by horizontal planks. The planks of the vertical frame connect the horizontal planks to each other and also provide mounting surfaces for attaching the noise element to the pillars. The advantage of impregnated timber is low price, good weather resistance, easy workability and light-weight structure.

[0011] The idea of one embodiment is that the planned service life for the noise barrier is at least 50 years. In addition, the noise barrier meets current design standards for traffic corridor projects.

[0012] The idea of one embodiment is that the sound-attenuating wool layer or the sound-attenuating material layer is made of plastic-fiber based material which is weather-resistant and noise-absorbing.

[0013] The idea of one embodiment is that the sound-attenuating wool layer or the sound-attenuating material layer can alternatively be noise-absorbing cellulose wool, rock wool or mineral wool.

[0014] The idea of one embodiment is that the noise element has a sealing plate structure on the side of the residential-side flank, which, as its name implies, seals the housing structure towards the residential side and prevents sound from escaping from the housing structure.

[0015] The idea of one embodiment is that there are air gaps on one or both sides of the sound-attenuating material. The air gap(s) play an important role in sound attenuation, at least when using sound-attenuating wool of smaller thickness.

[0016] The idea of one embodiment is that the noise element has one air gap. The air gap is then arranged on the residential side in relation to the sound-attenuating wool layer. Then, the sound-attenuating material may be

against the inner surface of the outer cladding damper.

[0017] The idea of one embodiment is that the inner part of the noise element is substantially completely free of air gaps, whereby the sound-attenuating material extends from the inner surface of the element to the opposite inner surface. In this solution it is possible to use sound-attenuating wool or material having relatively sparse structure.

[0018] The idea of one embodiment is that said outer cladding panel is of cement board. It is preferable to use cement board of weatherproof quality. The mass per surface area of the cement board is relatively large, which contribute to reducing noise.

[0019] The idea of one embodiment is that said outer cladding panel is made of plywood, for example weatherproof film faced plywood. It is still possible to use a stone plate, an aluminium plate, a composite plate or a CLT plate as the outer cladding panel.

[0020] The idea of one embodiment is that the seams of said sealing plate and the outer cladding panel are placed mutually at different points in order to provide a tight and air-impermeable structure.

[0021] The idea of one embodiment is that said seams of the outer cladding panel are sealed with sealing tape, adhesive tape, sealing compound or a similar seal. It is further possible that the outer cladding panel is a uniform piece, whereby it has no seams.

[0022] The idea of one embodiment is that the frame of the noise element is made of impregnated timber. All timber used in the noise element can be pressure impregnated.

[0023] The idea of one embodiment is that the noise barrier has the following dimensions: Height 1000 mm and distance between pillars 4000 mm. The thickness of the basic structure is less than 200 mm and with the protective mesh about 300 mm. Of course, it is also possible to dimension the noise barrier on a case-by-case basis as required by the traffic corridor.

[0024] The idea of one embodiment is that the sound insulation capacity of the structure is at least 30 dB, preferably at least 34 dB. The thin perforated damper permits sound to enter the housing structure, where the sound is attenuated and may also be reflected back and forth several times between different layers of the structure. The sound waves reflected back and forth are thus attenuated inside the structure.

[0025] The idea of one embodiment is that the cladding damper comprises a perforation of about 30%, i.e. 30% of the total surface area equals the surface area of the perforations.

[0026] The idea of one embodiment is that the size of the perforations in the cladding damper is 3 mm. The shape of the openings can be round, square or rectangular.

[0027] The idea of one embodiment is that the cladding damper does not have perforations next to the horizontal planks included in the horizontal frame. The perforations are useless next to the horizontal planks, since due to

the planks, sound cannot anyway enter the structure from the location next to the planks. In addition, the fastening can be made strong between the cladding damper and the horizontal planks since the fastening point does not have sound openings.

[0028] The idea of one embodiment is that the cladding damper is a 1.2 mm thick pvdf-coated steel sheet. Such a cladding damper is very resistant to weather load and is also mechanically resistant. The appearance and colour of the cladding damper may be chosen on a case-by-case basis.

[0029] The idea of one embodiment is that the cladding damper is of a thin aluminium sheet. It is also possible to produce the traffic corridor side cladding from a sheet of composite material, which may thus comprise a binder of plastic material and a fiber reinforcement.

[0030] The idea of one embodiment is that the cladding damper extends in the upper part of the noise barrier as a uniform structure over the upper edge of the noise barrier onto the residential side surface of the noise barrier and thus forms a weather protection. The cladding damper thus forms an integrated cap plate at the top of the noise barrier. This gives a non-water-collecting structure and an excellent rain protection for the sound insulation. The uniform structure is also visually attractive, mechanically durable and inexpensive.

[0031] The idea of one embodiment is that the noise element comprises the following detailed features: the cladding damper is of steel; the thickness of the first air gap is at least 19 mm; the thickness of the sound insulating wool layer is 50 mm; the dimensions of the wooden planks of the frame in the thickness direction of the noise barrier are at least 140 mm; the thickness of the second air gap is at least 60 mm; the sealing plate is of plywood; and the outer cladding panel is of cement board. Such a structure has been found to work very well during measurements.

[0032] The idea of one embodiment is that the outer cladding panel is of a weatherproof cement board with a thickness of at least 10 mm, preferably 13 mm. Weatherproof cement board is a strong and rigid board suitable for external structures. Cement board may be completely inorganic, so it will not rot and decompose. In addition, it is non-combustible, shape-resistant and easy to machine.

[0033] The idea of one embodiment is that the sealing plate is made of weatherproof softwood plywood and has a thickness of at least 5 mm, preferably 6.5 mm.

[0034] The idea of one embodiment is that the lower part of the noise barrier has a horizontal steel plinth beam having a U-profile with the flanges pointing downwards.

[0035] The idea of one embodiment is that the upper surface side of the uppermost wooden plank included in the horizontal frame of the noise element has shaped pieces for forming a ridge profile on the uppermost surface of the noise barrier. Said shaped pieces may be of impregnated wood.

[0036] The idea of one embodiment is that the pillars

are I-profile beams produced from steel. In this case, the end beams included in the vertical frame of the noise element are arranged between the flanges of said I-beam. An advantage is quick installation, as the noise element can simply be lifted between the flanges. Thanks to the structure, a shape locking is formed between the pillar and the noise element. Finally, a further locking can be made by means of a screw fastening and a wooden wedge or the like. Thus, the noise element remains in place after lifting because it is supported vertically by the plinth beam, and the flanges of the pillar prevent it from falling until it is locked.

[0037] The idea of one embodiment is that the noise barrier comprises at least one protective mesh at a transversal distance from the outer surface of the noise element. The protective mesh is adapted to prevent painting of graffiti and other smudging of the noise barrier. The protective mesh is typically arranged on the residential side of the noise barrier.

[0038] The idea of one embodiment is that the protective mesh is a three-wire mesh, which has horizontal wires in two different transversal planes and which has vertical wires in one plane between the horizontal wires.

[0039] The idea of one embodiment is that the protective mesh is fastened by means of the housing structures. The housing structures can be of metal. Said housing structures are attached on both sides of the pillar of the noise barrier and there is further a housing structure in the midway of the noise barrier. In this case the noise barrier comprises at one flank of the noise barrier two successive protective meshes, each fastened between the housing next to the pillar and the middle housing.

[0040] The idea of one embodiment is that the housing structure for attaching the protective mesh comprises, attached to the flank of the noise barrier, a substantially U-shaped bottom profile having a flank with openings for receiving and supporting the horizontal wires of the protective mesh. After installing the protective mesh, a cover profile is fitted on top of the bottom profile for locking the protective mesh in place. The protective mesh can simply be lifted in place for being supported by the openings in the bottom profile, and the fastening may finally be locked by means of the cover profile. This makes installation quick and easy.

[0041] The idea of one embodiment is that the noise barrier is a rail track noise barrier intended for use in connection with a railway or similar rail vehicle corridor. The structure and materials of the noise element then take into account the spectral weighting of the railway traffic noise and the dynamic air pressure load.

[0042] The idea of one embodiment is that the noise barrier is a road noise barrier intended for use in connection with a road or similar roadway corridor. The structure and materials of the noise element then take into account the spectral weighting of road traffic noise and e.g. the strength against load from the ploughed snow.

[0043] It should be mentioned that traffic corridors are motorways, train tracks, tram lines, metro lines and sim-

ilar corridors along which vehicles pass. Traffic noise is generated e.g. from vehicle engines and other power-trains, tires and wheels, and high-speed airflows passing by. A noise barrier is a structure constructed along traffic corridors to cut off the passage of sound from a sound source to a site to be protected. A noise barrier is usually placed as close as possible to the border of the corridor, but at the same time taking into account the maintenance of the corridor.

[0044] The above embodiments and the features set forth therein may be combined to provide the desired solutions.

BRIEF DESCRIPTION OF THE FIGURES

[0045] Some embodiments of the presented solution are shown in more detail in the following figures, in which

Fig. 1 schematically shows a noise element seen from the traffic corridor side,

Fig. 2 schematically shows a noise barrier seen from the traffic corridor side,

Fig. 3 schematically shows a noise barrier seen from the residential side,

Fig. 4 shows schematically and in cross-section the structure of a noise element,

Fig. 5 shows schematically, seen from above and in cross-section, the fastening of the noise elements to the pillar and further the fastening of the protective meshes,

Fig. 6 schematically shows the fastening of the protective mesh by means of the housing structure,

Fig. 7 is a simple diagram of the components of the noise barrier,

Fig. 8 is a simple diagram of the components and structures included in the noise cancellation structure,

Fig. 9 is a simple diagram of the components and structures included in an alternative noise cancellation structure;

Fig. 10 shows schematically and in cross-section the structure of an alternative noise element, and

Figs. 11 to 13 further show as simple diagrams some construction alternatives for the noise control structure.

[0046] For the sake of clarity, some embodiments of the presented solutions are shown in simplified form in the figures. In the figures, the same reference numerals are used to refer to the same elements and features.

DETAILED DESCRIPTION OF SOME EMBODIMENTS

[0047] The noise element 1 shown in Fig. 1 is an elongated wall-like structure comprising a first flank 2a, which is visible in the figure, and an opposite second flank. It further has opposite ends 3a, 3b and longitudinal upper edge 4a and lower edge 4b. The first flank 2a has a clad-

ding damper 5 or cladding panel with through-openings. The cladding damper 5 may have perforated portions 6 and non-perforated portions 7. As previously mentioned, the portions 7 may be next to the horizontal frame of the element 1. The cladding damper 5 may also extend over the upper edge 4a and may form a cap plate 8.

[0048] Fig. 2 shows a noise barrier 9, in which the noise element 1 according to Fig. 1 is fastened between the pillars 10. The pillars 10 may be supported on foundations in the ground. Between the pillars 10 may be supported a plinth beam 11, on which the noise element 1 can rest. The pillars 10 and the plinth beam 11 may be assembled and erected on site, while the noise element 1 may be manufactured under factory conditions, transported to the installation site and lifted by crane between the pillars. Fig. 2 further illustrates with broken lines that several noise elements 1' as shown may be arranged in parallel to form a uniform wall of desired length.

[0049] Figure 3 shows the noise barrier 9 seen from the side of its second flank 2a. The outermost visible surface of this residential side flank 2b is formed by the outer cladding panel 12. As can be seen, the second flank 2b has no openings. The outer cladding panel 12 is a weatherproof panel that protects the housing-like internal structure of the noise element 1.

[0050] Figure 4 shows a structure of the noise element 1. The noise element 1 comprises a frame, of which the horizontal planks 14 included in the horizontal frame 13 can be seen in Fig. 1. Furthermore, the lower edge of the element 1 may have a plinth plank 14a against the plinth beam 11. The horizontal planks may be of impregnated wood as well as the planks included in the vertical frame of the element 1. The planks may have dimensions of, for example, 48*148 mm and arranged in the structure so that the shorter sides face the flanks 2a and 2b of the element. A layer of sound insulating wool 15 is arranged between the horizontal planks 14. Between the sound insulating wool layer 15 and the cladding damper 5 is a first air gap 16, and on the other side of the sound insulating wool layer 15 is a second air gap 17 which is larger than the first air gap 16. To support the sound insulating wool layer 15, the flanks of the horizontal planks 14 may have supporting elements 18, which may be, for example, of impregnated timber. On the side of the second flank 2b are two overlapping platelike structures. More towards inside is a sealing plate 19 and outermost is an outer cladding panel 12.

[0051] For the sake of clarity Figure 4 shows only one perforation 20 of the cladding damper 5. Noise M enters the housing-like structure through the perforations 20 in the cladding damper 5. The first air gap 16 facilitates the entry of the noise M. Noise M is attenuated as it passes in the sound insulating wool layer 15 and the attenuated noise M passed through the layer propagates towards the rear edge of the second air gap 17. Since the wall formed by the sealing plate 19 and the outer cladding panel 12 is dense, the noise is reflected back towards the sound insulating wool layer 15 and is attenuated.

Sound waves can continue their movement in the other air gap while they are constantly attenuating.

[0052] It can also be seen from Figure 4 that the cladding damper 5 may be extended uniformly over the upper edge 4a of the noise element 1. The upper edge 4a may have shaped pieces 21 so that the upper edge 42 may have a ridge-like shape.

[0053] Figure 5 shows the fastening of the noise elements 1a, 1b to a vertical pillar 10 having the shape of an I-profile. In this case the pillar 10 has flanges 22 between which the vertical planks 23 included in the vertical frame of the noise element 1 are arranged. The distance between the flanges 22 can be wide in relation to the thickness of the noise barrier 1, which facilitates installation. A locking piece 24, which may be of impregnated wood, can be arranged between the flange 22 and the vertical plank 23. The joint may further be locked with screws 25. The vertical frame 30 of the noise element 1 comprises at least the vertical planks 23 at the ends.

[0054] It can be seen from Figure 5 that the side of its other flank 2b may have a protective mesh 26, which may be a three-wire mesh and comprise horizontal wires 27a and vertical wires 27b. The protective mesh 26 may be supported by means of the fastening housing 28 to a distance from the outer cladding panel 12 of the noise element 1. The fastening housings 28 may be metallic and may comprise a bottom profile 28a and a cover profile 28b. The flank of the bottom profile 28a may have openings 29 for the horizontal wires 27a of the protective mesh 26. These openings 29 are more clearly seen in Figure 6. When the protective mesh 26 is adapted to be supported by the bottom profile 28a, the fastening is locked by means of the cover profile 28b. The cover profile 28b may be fastened, for example, with screws.

[0055] The diagram of Figure 7 shows features included in the noise barrier. These points have already been discussed in detail earlier in this document.

[0056] The diagram of Figure 8 shows features included in noise controlling. These points have already been discussed in detail earlier in this document.

[0057] Fig. 9 shows a noise cancellation structure in which the spaces between the corridor side cladding damper 5 and the residential side outer cladding panel 12, delimited by a wooden frame, are filled with sound insulating wool 15. The sound insulating wool used can have a porous quality which allows noise to enter well and absorbs it.

[0058] The alternative structure shown in Figure 10 differs from that shown in Figure 4 in that it lacks air gaps within the structure. Furthermore, the structure does not comprise a sealing plate. In other respects, the basic structure may be as described above.

[0059] Figures 11 to 13 still show some alternative structural combinations.

[0060] The figures and their description are only intended to illustrate the idea of the invention. However, the scope of the invention is defined in the claims.

Claims

1. A noise barrier (9), which is intended to be arranged at the border of a traffic corridor in order to prevent emission of traffic noise,
and which noise barrier (9) comprises:

 at least one noise element (1) which is an elongate wall-like structure having a frame and a noise cancellation structure attached to the frame;
 and which noise element (1) has a first flank (2a) intended for the traffic corridor side; a second flank (2b) intended for the side of the site to be protected from noise; two opposite ends (3a, 3b); and a longitudinal top edge (4a) and a longitudinal bottom edge (4b); and
 at least two pillars (10) which may be supported on the ground for supporting the noise element (1) vertically;
characterized in that
 the frame of the noise element (1) is produced from wood planks (14, 23) and comprises a horizontal frame (13) and a vertical frame (30);
 the outer surface of the noise element (1) has on the side of the first flank (2a) a cladding damper (5) provided with perforations (20);
 the spaces defined between the horizontal frame (13) and the vertical frame (30) are each provided with a layer of sound insulating wool (15); and
 the outer surface of the noise element (1) on the side of the second flank (2b) has an outer cladding panel (12).
2. The noise barrier according to claim 1, **characterized in that**
 the horizontal frame (13) of the noise element (1) comprises at least four evenly spaced impregnated wooden horizontal planks (14);
 the vertical frame (30) comprises impregnated wooden vertical planks (23) at least at the ends (3a, 3b) of the noise element (1);
 the horizontal planks (14) and the vertical planks (23) are of the same timber and have a width dimension in their cross-section which is several times compared to the thickness; and
 the longer sides of the horizontal planks (14) and the vertical planks (23) are in the thickness direction of the noise element (1) and the shorter sides are adapted to serve as fastening surfaces of the outer cladding (5, 12).
3. The noise barrier according to claim 1 or 2, **characterized in that**
 the outer surface of the frame (13, 30) has a sealing plate (19) on the side of the second flank (2b); and
 said outer cladding panel (12) is against the sealing plate (19), the outer surface having a two-layer plate structure.
4. The noise barrier according to any one of the preceding claims 1 to 3, **characterized in that**
 the noise element (1) comprises at least one air gap (17); and
 at least one of said air gaps (17) is on the side of the second flank (2b) of the noise element (1) relative to the sound insulating wool layer (15).
5. The noise barrier according to any one of the preceding claims 1 to 4, **characterized in that**
 between said cladding damper (5) and the sound insulating wool layer (15) is a first air gap (16), and on the opposite side of the sound insulating wool layer (15), a second air gap (17), respectively; and
 the thickness of said second air gap (17) is at least three times compared to the thickness of said first air gap (16).
6. A method of forming a noise barrier, the method comprising:

 forming a noise element (1), which is an elongate wall-like structure, by constructing a frame and attaching a noise cancellation structure to the frame; and
 erecting at least two pillars (10) on the ground and supporting the noise element (1) vertically to the pillars (10)
characterized by
 producing the frame of the noise element (1) from wooden planks (14, 23) and providing the frame with a horizontal frame (13) and a vertical frame (30);
 fitting a cladding damper (5) provided with perforations (20) on the outer surface of the noise element (1) to the side of a first flank (2a);
 providing each space defined between the horizontal frame (13) and the vertical frame (30) with a layer of sound insulating wool (15); and
 fitting an outer cladding panel (12) on the outer surface of the noise element (1) to the side of a second flank (2b).

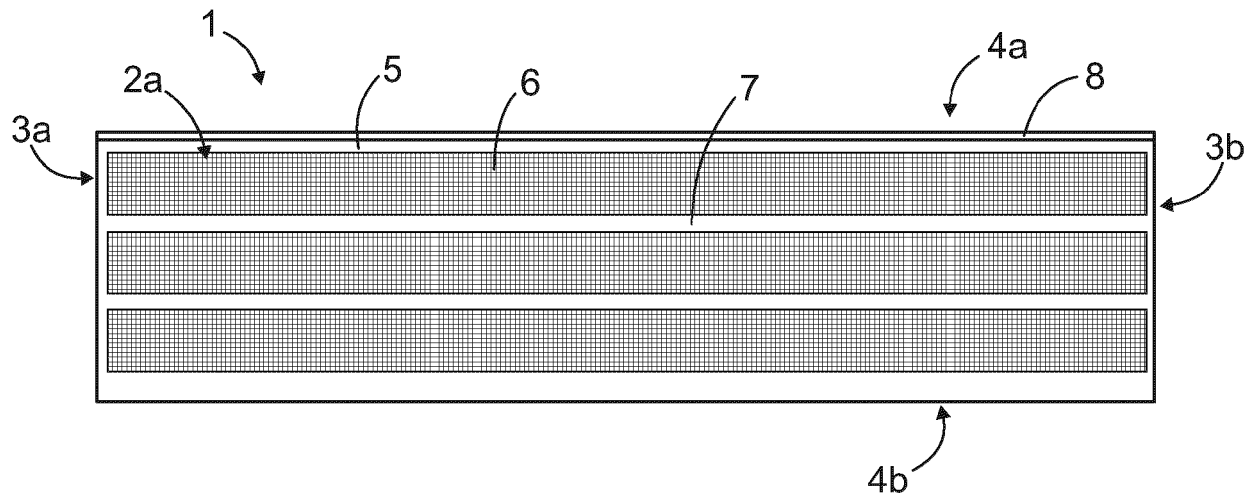


FIG. 1

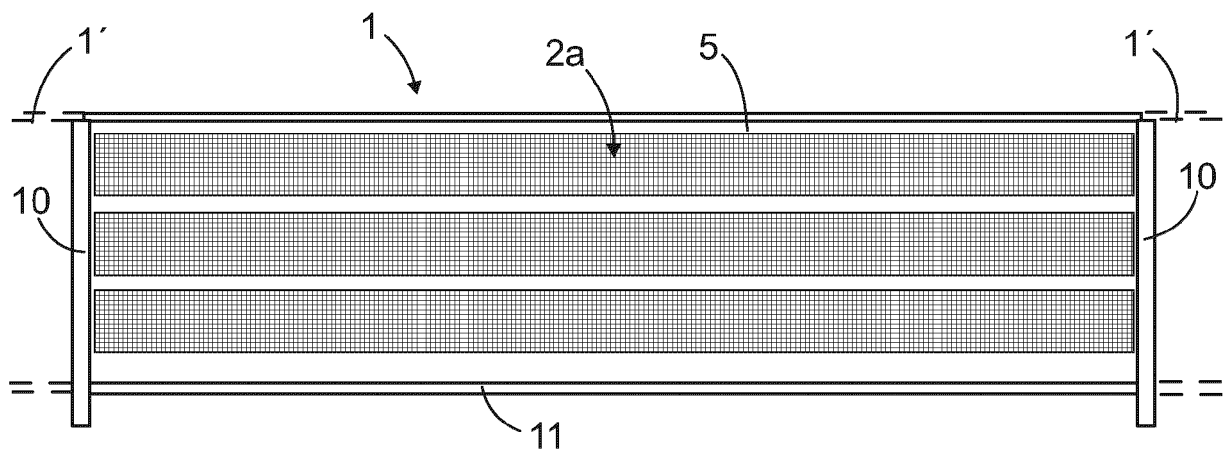


FIG. 2

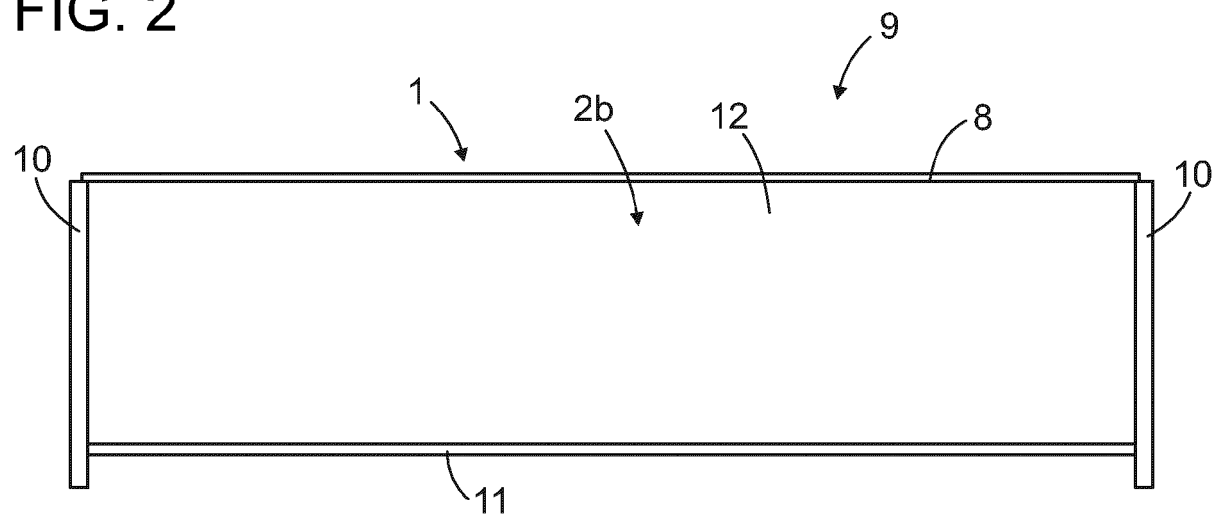


FIG. 3

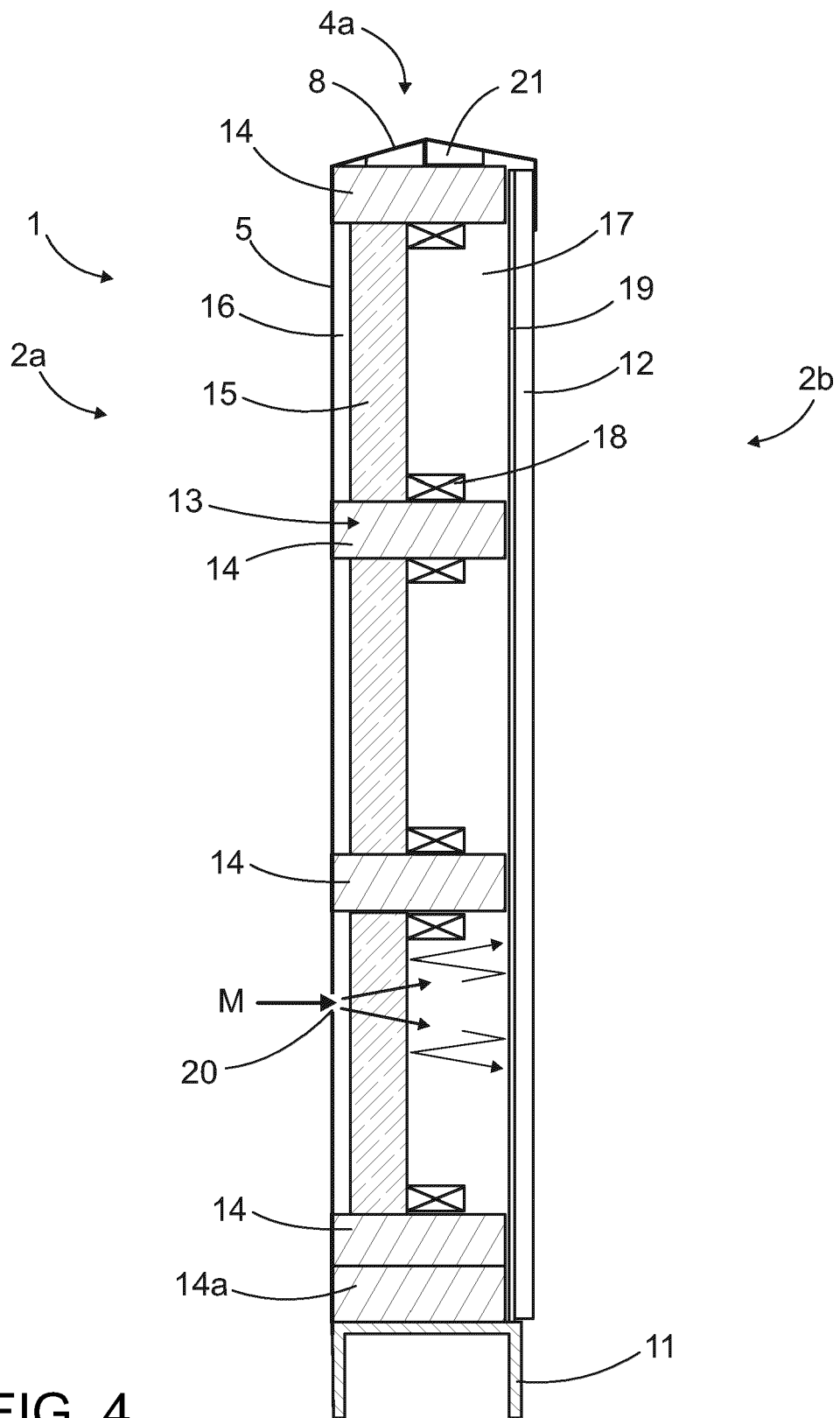
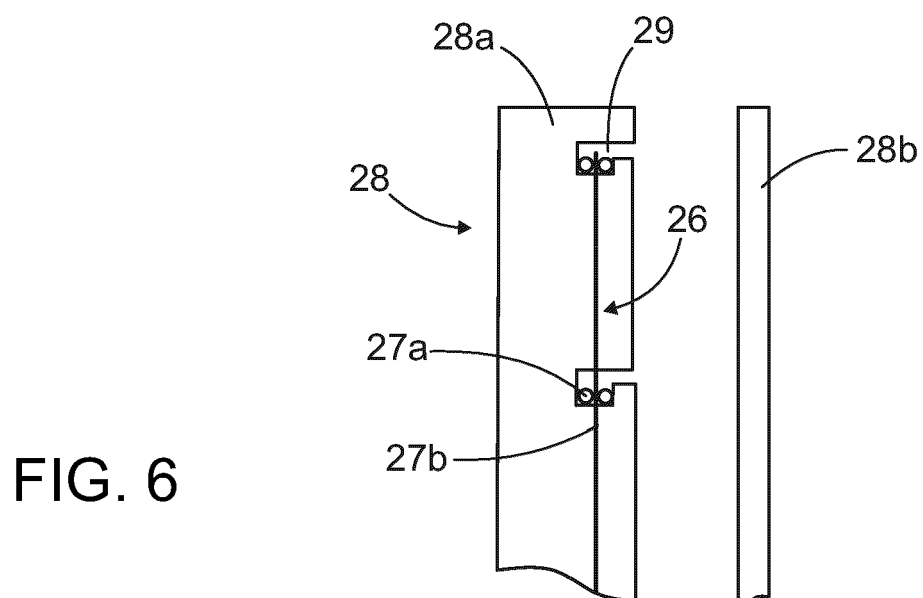
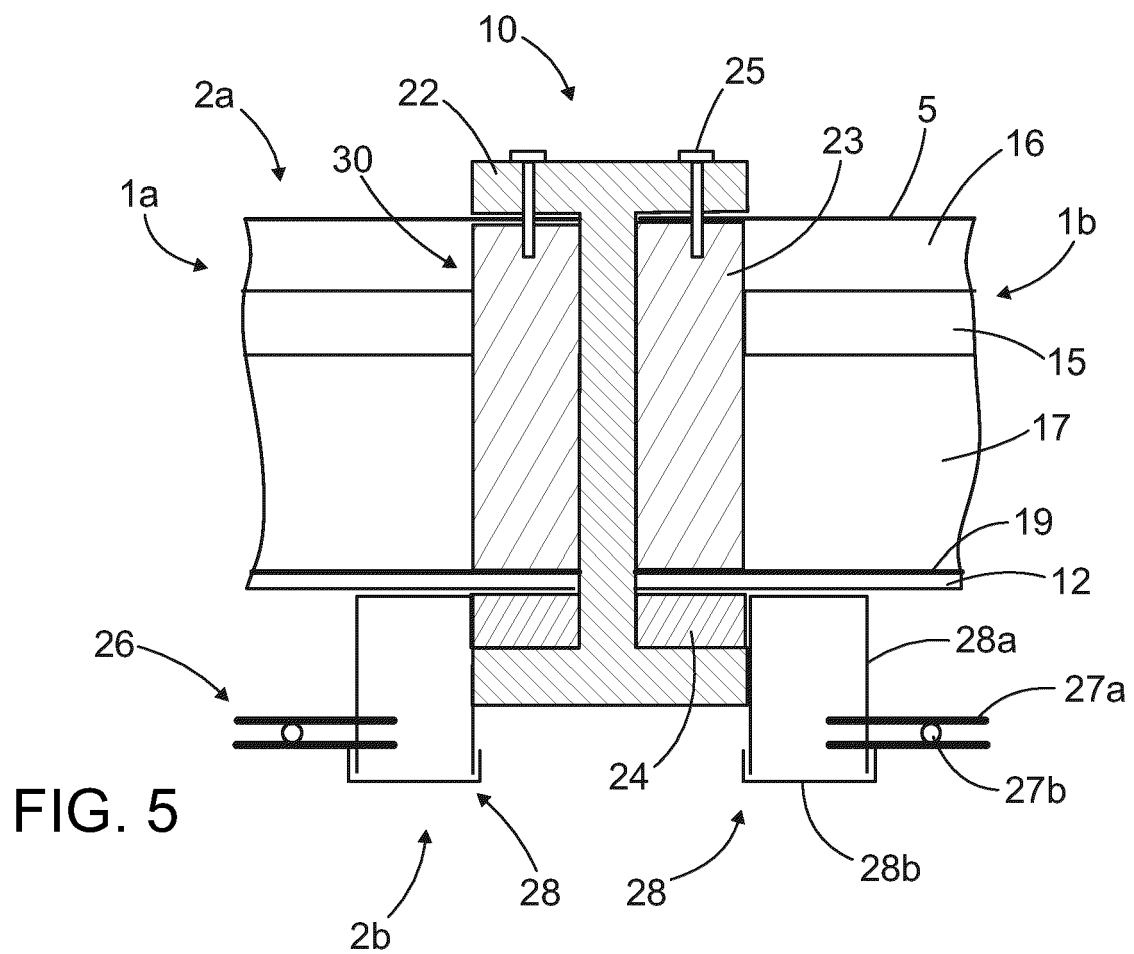


FIG. 4



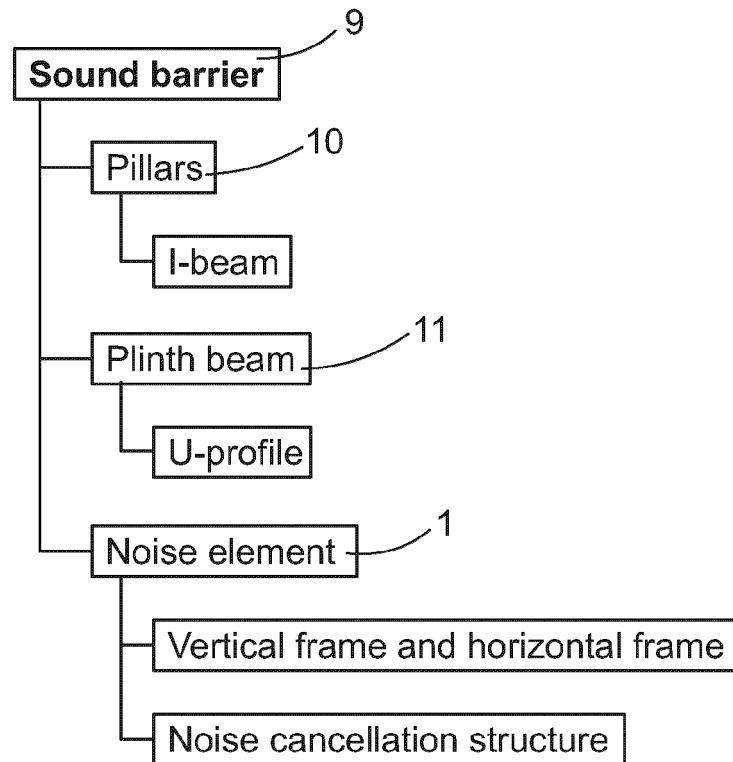


FIG. 7

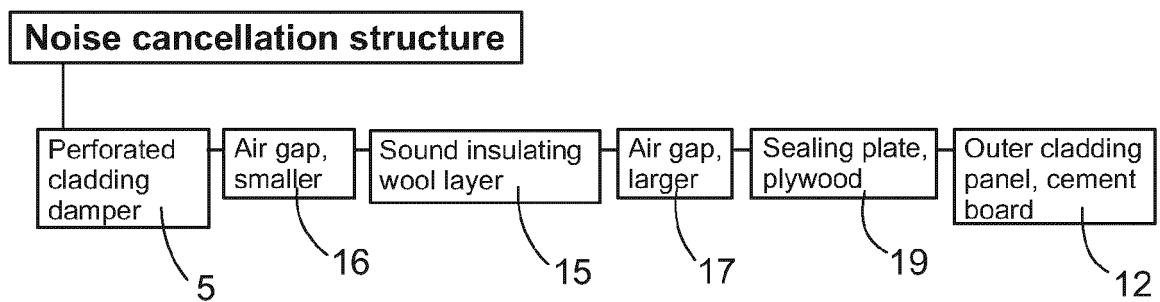


FIG. 8

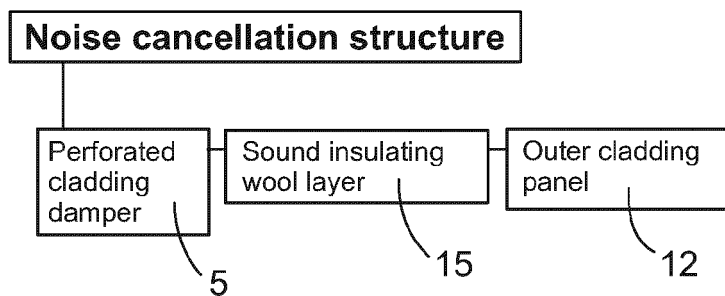


FIG. 9

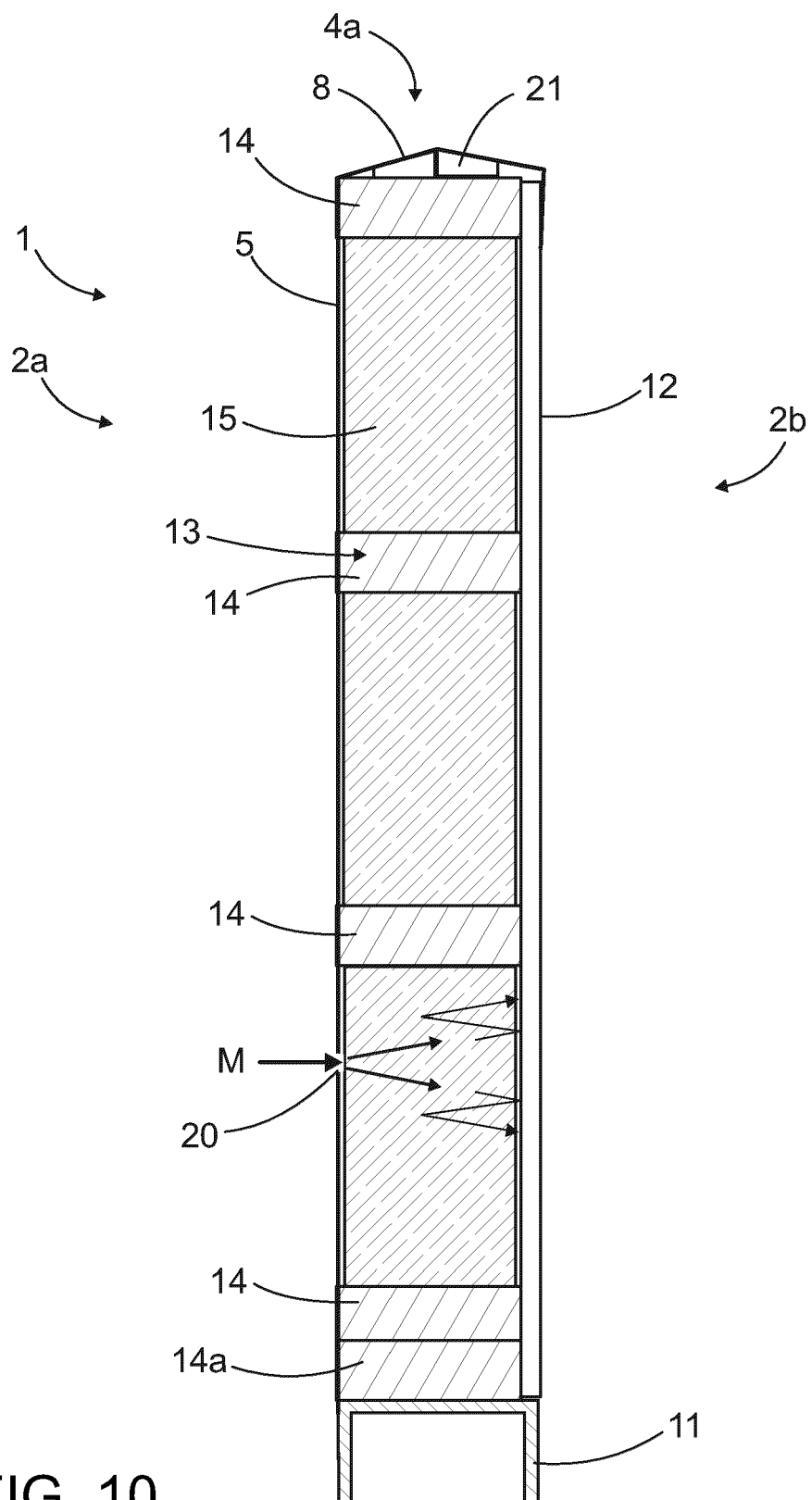


FIG. 10

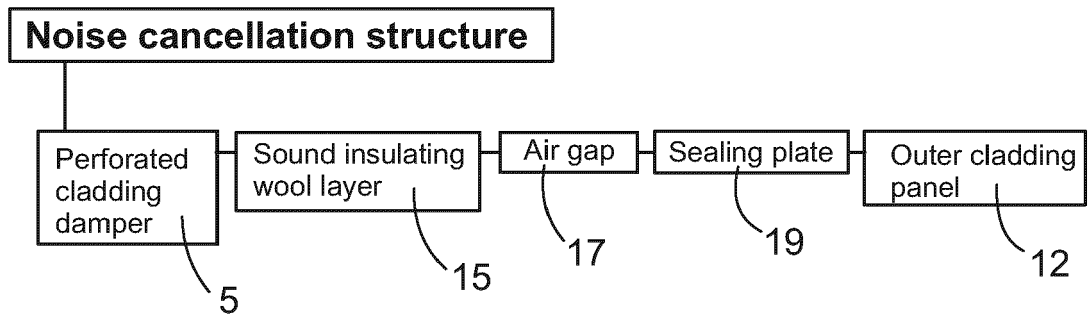


FIG. 11

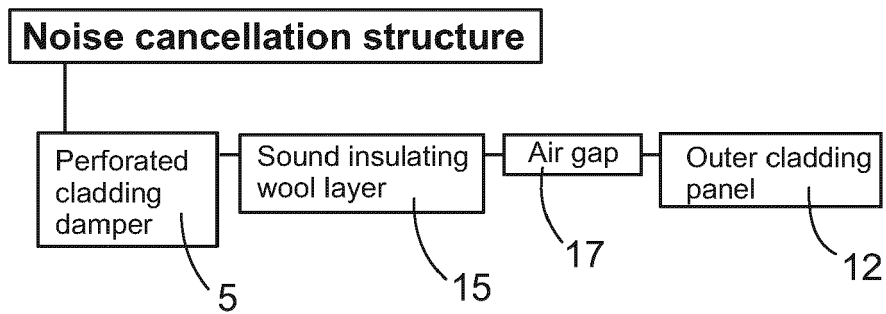


FIG. 12

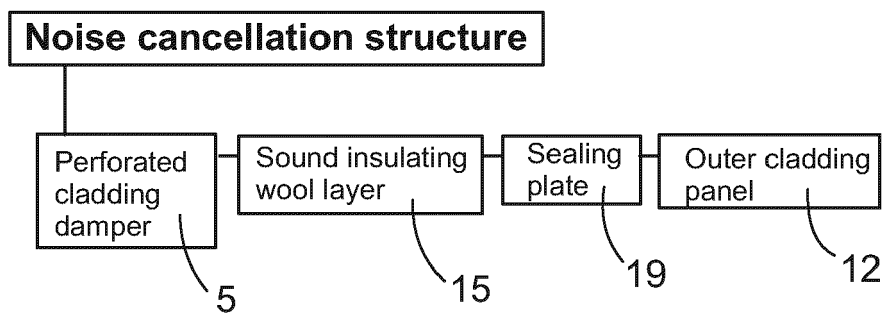


FIG. 13



EUROPEAN SEARCH REPORT

Application Number
EP 20 18 5110

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 22 October 2020	Examiner Stern, Claudio
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