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(54) ACOUSTIC BARRIER DEVICE AND ACOUSTIC BARRIER FOR RAILWAY LINES

(57) The acoustic barrier device (1) for railway lines comprises a support body (2) comprising a vertical wall (2a) designed to face a railway line, at least one anchoring member for anchoring the support body (2) to a track bed of the railway line, and sound dampening means. The the sound dampening means comprises a rectangular cover plate (3) with a plurality of through holes (3a) fixed to the support body (2), and at least one rectangular sound-absorbing sheet (4) positioned between a support surface (2b) of the vertical wall (2a) and the cover plate (3).

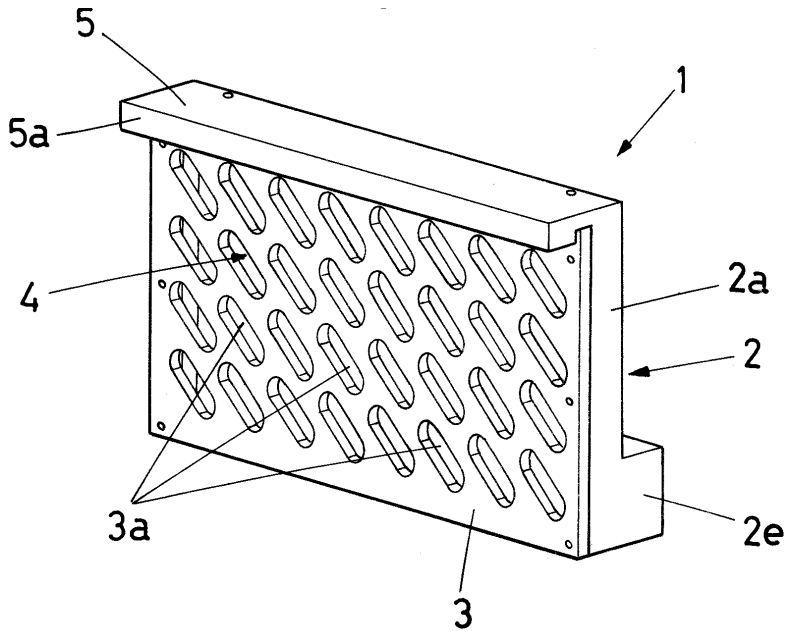

FIG.2

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Description

TECHNICAL FIELD

[0001] The present invention relates to acoustic barriers for railway lines that are positioned alongside the railway lines to reduce noise generated by a railway vehicle travelling on rails, to the environment near a railway line.

STATE OF THE ART

[0002] Railways are considered an environmental-friendly collective transport medium. However, travelling railway vehicles generate noise, for example, due to the contact of the rotating wheels of the railway vehicles with the rails, vibrations of parts of the vehicles located at its lower portion and vibrations of the railway structure itself (e.g. rails, sleepers, ballast), which is considered acoustic pollution, especially in urban areas where the noise is felt particularly disturbing and may even lead to health problems at the medium to long term.

[0003] To mitigate noise pollution caused by railway traffic, acoustic barriers have been developed. The most common acoustic barriers are tall acoustic walls of a height of more than three meters which are comprised of contiguous modular wall devices placed alongside the railway lines. The tall acoustic walls deflect upwards the noise generated by the travelling vehicle and attenuate the noise level emitted towards areas adjacent to the railway line from said noise. However, these tall acoustic walls are disadvantageous inasmuch their installation requires e.g. providing strong foundations, occupying specific strips of land placement at a distance from the track bed which is sufficient to comply with legal regulations, relatively complex structures to provide sufficient stability and robustness. Moreover, the tall acoustic walls cause a negative visual impact as they obstruct the horizontal visibility of landscapes and building located at the other side.

[0004] To avoid the inconveniences of tall acoustic walls, modular walls device having a reduced height have been developed. Thus, EP1355006A1 discloses an acoustic barrier device of low height for railway lines which is shaped as a tile which, in its cross section, is tapered from its base towards its free and which has a concave rounded surface facing the railway line. The tile-shaped acoustic barrier device disclosed in EP1355006A1 has a core filled with sound-absorbing material and an outer shell enveloping the core and it is fixed to the flange of the rails of the railways line by means of connecting plates. Whilst these low tile-shaped curved acoustic barrier device overcomes the disadvantages inherent specifically in modular wall devices for tall acoustic walls, it is disadvantageous inasmuch as its manufacturing process is complex as it requires providing a one-pieced shell and filling the shell with the sound-absorbing material. Furthermore, they must be connected to both parts of the flange of each rail forming a continuous element along and parallel to the rails. The barrier must also be placed at a predetermined distance from the rail to avoid any interference with the railway vehicles.

[0005] It was therefore desirable to create an acoustic barrier device for railway lines which would overcome the afore-described drawbacks and inconveniences of prior art acoustic barriers.

DESCRIPTION OF THE INVENTION

[0006] A first aspect of the invention relates to an acoustic barrier device for railway lines which overcomes drawbacks and inconveniences of prior art acoustic barriers.

[0007] A second aspect of the invention relates to an acoustic barrier device for railway lines, comprising a support body comprising a vertical wall designed to face a railway line and at least one anchoring member for anchoring the support body alongside the railway line, which is designed to attenuate noise which is generated at the lower portion of the railway vehicle by the contact of the rotating wheels of the railway vehicle with the rails, vibrations of parts of the vehicle located at its lower portion and vibrations of the railway structure itself, by absorbing and deflecting sound waves such that they are spread mainly upwards along a sound path.

[0008] A third aspect of the invention relates to an acoustic barrier device which is easy to manufacture and easy to maintain and replace.

[0009] A fourth aspect of the invention relates to an acoustic barrier device having a reduced height allowing it to be installed proximate to the railway line at the same time that it does not substantially affect the visual appearance of the railway line.

[0010] A fifth aspect of the invention relates to an acoustic barrier device which may be installed to comply with legal requirements which allow the presence of auxiliary device in the track bed only up to predetermined heights.

[0011] A sixth aspect of the invention relates to an acoustic barrier for a railway line comprising a plurality of adjacent acoustic barrier devices complying one or more of the previously recited aspects.

[0012] The acoustic barrier device for railway lines, comprises a support body comprising a vertical wall designed to face a railway line, at least one anchoring member for anchoring the support body to a track bed alongside the railway line, and sound dampening means to attenuate noise which is generated at the lower portion of the railway vehicle by the contact of the rotating wheels of the railway vehicle with the rails. According to the invention the sound dampening means comprises a cover plate with a plurality of through holes fixed to the support body, and at least one sound-absorbing sheet positioned between the vertical wall and the cover plate. The cover plate and the sound absorbing sheet are preferably rectangular in shape.

[0013] The cover plate is preferably made of concrete

and more preferably of a concrete having a density of at least 2000 kg/m^3. In some embodiments the cover plate has a width between 50mm and 100mm.

[0014] Preferably, the through holes are evenly distributed in the cover plate and occupy at least 40% of cover plate. The through holes may have the cross section of a rectangle with rounded corners. Preferably, each of the through holes comprises a longitudinal axis which is oblique with respect to the vertical axis of the cover plate.

[0015] In some embodiments the through holes have a depth between 50 and 100 mm allowing the passage of a wide range of acoustic waves. In addition, their depth (50 to 100 mm) makes them act as the neck of a Helmholtz resonator depending on the thickness of the neck of the holes and the cavity space behind it, to combine it with the effect of perforated panels with chamber and absorbing material that allows to expand the effect of the resonance frequencies.

[0016] According to the invention, the holes in the cover plate allow noise to pass through to the sound absorbing foil so that behind the cover plate, reflections between the vertical wall of the support body of the mini-barrier and the cover plate are reduced and the noise levels coming through the holes themselves to the outside are again minimized allowing the desired absorption rate to be obtained. In some embodiments the support body comprises a recessed surface defining a housing with a depth between 4 and 7 mm where the sound absorbing sheet is placed. The sound absorbing sheet can be made of a sound-absorbing material with an absorption index a_w greater than 0.8, for example mineral wool or glass fiber and a sound-absorbing DLalfa coefficient of at least 10 dBA according to UNE EN 1793.1. in the frequency range object of the study (100 Hz and 10 KHz). Thus, the waves passing through the through holes are partly absorbed by this sound absorbing material.

[0017] The combined effect of the absorption in the recessed surface with the acoustic performance of the through holes of great depth (50 to 100 mm of depth) of the cover plate and the resonances in the holes allow to provide the acoustic barrier device with an acoustic isolation capacity DLr greater than 24 dB and an acoustic absorption capacity DLalfa higher than 4 dB according to UNE EN 1793.1. in the frequency range object of the study (100 Hz and 10 KHz).

[0018] In some embodiments the support body has a width greater than 0.15 m not allowing the noise to pass through the barrier and to produce a reverberant effect between the cover plate and the support body. This support body can be manufactured in any material with an insulation higher than 30 dB (UNE 1793.2) and preferably made of concrete and more preferably of a concrete having a density of at least 2000 kg/m^3.

[0019] The acoustic barrier device may further comprise coupling members to couple it to at least an adjacent barrier device. The coupling members may be metal plates screwed to adjacent acoustic barrier devices at the backside of each acoustic barrier device.

[0020] The height of the support body when installed on a track bed is lower than 1.5 m.

[0021] The support body may advantageously comprise a bottom portion which is thicker than the vertical wall, and which protrudes behind from the vertical wall in a horizontal direction opposite to the support surface of the vertical wall. The bottom portion provides a low center of gravity to the acoustic barrier device as well enough space to allow placing the anchor members.

[0022] In an embodiment, the support surface comprises a rectangular recessed surface formed in the vertical wall surrounded by a rectangular frame formed by peripheral wall portions of the vertical wall. The recessed surface is dimensioned to receive the sound absorbing sheet.

[0023] The rectangular recessed surface may comprise at least one partition wall extending vertically through the rectangular recessed surface such that each partition wall divides the recessed surface into two cavities, each for receiving one sound absorbing sheet. This allows to accurately place various sound absorbing sheets in the cavity provided by the recessed surface and the cover plate, and to replace only one sound absorbing sheet which has become deteriorated instead of a whole long single sheet.

[0024] In some embodiments, the barrier device comprises an overhang at the top edges of the vertical wall of the support body and the cover plate, and which horizontally extends beyond the top edge of the cover plate. The overhang can also be chamfered at 30° to 45° with respect to the horizontal. The overhang generates a reverberant space formed by the barrier, the train and the support structure (platform or ballast). Acoustic waves are reflected between the train and the barrier device creating a reverberant space.

[0025] The overhang generates an acoustic diffraction effect when the waves leaving the reverberation chamber meet the edges of overhang. At these points of "collision" the wave breaks generating another wave train of lower intensity that acts with the previous one attenuating the noise that is transmitted to the environment.

[0026] In some embodiments the upper surface of the overhang can be flat with two diffraction axes. In alternate embodiments the overhang comprises a non-flat geometry (to have more surface area) and thus more than two diffraction points. The overhang can also comprise different materials that provide acoustic absorption, which in combination improves the effect of the barrier device. The overhang may be formed by a top portion of the vertical wall of the support body, a top portion of the cover plate or by a separate cover member fixed to the top edges of the vertical wall and the cover plate. The cover member may be removable such that, when it is removed, easy access to the sound absorbing sheet is possible and extraction thereof may be performed in an easy manner.

[0027] When the overhang is a top portion of the vertical wall of the support body or when the overhang is a

separate cover member fixed to the top edges of the vertical wall and the cover plate, the overhang may comprise a lower axial recess dimensioned to receive the top edge of the cover plate.

[0028] The acoustic barrier for a railway line according to the invention comprises a plurality of adjacent acoustic barrier devices comprising one or more features of the above described acoustic barrier device. The acoustic barrier devices may be coupled to each other by coupling members and to the track bed of the railway line by anchoring members coupling only some of the acoustic barrier devices.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] To complete the description and in order to provide for a better understanding of the invention, a set of drawings is provided. Said drawings form an integral part of the description and illustrate embodiments of the invention, which should not be interpreted as restricting the scope of the invention, but just as examples of how the invention can be carried out. The drawings comprise the following figures:

Figure 1 shows a front view of a railway vehicle travelling on a railway at one side of which an acoustic barrier device according to an embodiment of invention is positioned.

Figure 2 is a perspective view of a first embodiment of the acoustic barrier device according to the invention.

Figure 3 is a perspective view of the support body of the acoustic barrier device shown in figure 2.

Figure 4 is a perspective view of the cover plate of the acoustic barrier device shown in figure 2.

Figure 5 is a top plan view of the acoustic barrier device shown in figure 2.

Figure 6 is an elevational view of the support body of the acoustic barrier device shown in figure 2.

Figure 7 is a front view of the left side of the support body of the acoustic barrier device shown in figure 2.

Figure 8 is an front view of the back side of the support body of the acoustic barrier device shown in figure 2.

Figure 9 is an front view of the left side of the cover plate of the acoustic barrier device shown in figure 2.

Figure 10 is a perspective view of a support body according to a second embodiment of the acoustic barrier device according to the invention.

Figure 11 is a perspective view of a cover plate according to a second embodiment of the acoustic barrier device according to the invention.

Figure 12 is an elevational view the support body shown in figure 10.

Figure 13 is a front view of the front sideof the support body of the acoustic barrier device shown in figure 10.

Figure 14 is a front view of the back side of the support body of the acoustic barrier device shown in figure 10.

Figure 15 is an elevational front view the cover plate shown in figure 11.

Figure 16 is an front view of the left side of the cover plate shown in figure 11.

Figure 17 is an front view of the right side of the cover plate shown in figure 11.

Figure 18 is an elevational view the second embodiment of the acoustic barrier device comprising the support body shown in figures 10 and 12-15 and the cover plate shown in figures 11 and 15-17.

Figure 19 is a perspective view of an embodiment of a sound absorbing sheet that can be used in the acoustic barrier device according to the invention.

Figure 20 is a schematic partial top plan view of an example of an acoustic barrier facing a railway line.

Figure 21 shows a front view of a railway vehicle travelling on a railway at one side of which an acoustic barrier device according to an embodiment of invention is positioned and showing the acoustic waves reflected between the train and the barrier device.

Figure 22 shows a front view of a railway vehicle travelling on a railway at one side of which an acoustic barrier device according to an embodiment of invention is positioned, showing the acoustic diffraction effect when the waves leaving the reverberation chamber meet the edges of overhang.

DESCRIPTION OF WAYS OF CARRYING OUT THE INVENTION

[0030] Figure 1 shows a railway vehicle -10- traveling on rails -11a- of a railway line -11- and an acoustic barrier device -1-. The acoustic barrier device -1- is anchored to the track bed -11c- in a manner known *per se* which may be conventional ballast -11d-. Alternatively, the acoustic barrier device -1- may be anchored to an anchor element, such as a conventional concrete plate or concrete block (not shown in the figures) in the track bed -11c-, in a manner also known *per se* in the art.

[0031] Noise generated at the lower portion of the railway vehicle -10-, for example, by the contact of the rotating wheels of the railway vehicle -10- with the rails, vibrations of parts of the vehicle located at its lower portion and vibrations of the railway structure itself (e.g. rails, sleeper, ballast), is attenuated and sound waves are deflected by the presence of the acoustic barrier device -1- in an reverberation area -RA- to travel upwards in a sound path -SP-. The structure and materials of the acoustic barrier device -1- is designed to provide an acoustic isolation capacity DLr greater than 24 dB and an acoustic absorption capacity DLalfa greater than 4 dBA.

[0032] As shown in more detail in figure 2, the acoustic barrier device -1- comprises a support body -2- comprising a wall -2a-, and a sound dampening means comprising a rectangular cover plate -3- with a plurality of through

holes -3a- fixed to the support body -2-, and at least one rectangular sound absorbing sheet -4- positioned between a surface -2b- of the wall -2a- and the cover plate -3-. The sound dampening means are arranged on the wall -2- of the support body -2- to face the railway line -11-. The through holes -3a- are evenly distributed in the cover plate -3- and occupy at least 40% of cover plate -3- and have a cross section of a rectangle with rounded corners. As depicted in figure 9, each of the through holes -3a- comprises a longitudinal axis -L- which is oblique with respect to the vertical axis -V- of the cover plate -3-. Preferably, the acoustic barrier device -1- comprises coupling members to couple it to at least an adjacent barrier device -1-.

[0033] As shown in figures 3, the support surface is a rectangular recessed surface -2b- formed in the vertical wall -2a- surrounded by a rectangular frame formed by peripheral wall portions -2c- of the vertical wall -2a-, the recessed surface -2b- being dimensioned to receive the sound absorbing sheet -4-. In the embodiment shown in figure 10, the rectangular recessed surface -2b- comprises at least one partition wall -2d- extending vertically through the rectangular recessed surface -2b-, such that each partition wall -2d- divides the recessed surface -2b- into two cavities, each for receiving one sound absorbing sheet -4-.

[0034] The sound absorbing sheet -4- is made of a sound absorbing material such that the sound absorbing sheet -4- has a sound absorbing DLalfa coefficient of at least 10 dBA at a sheet thickness of 7 cm. At least a surface facing the cover plate -3- of the sound absorbing sheet -4- is covered by a sound-permeable protector sheet -9- (figure 18) to protect the sound absorbing sheet -4- against environmental conditions and foreign agents. The protector sheet -8- may be designed to envelope the whole sound absorbing sheet -4-.

[0035] Figures 3, 6, 10, 12, 14 and 18 show that the support body -2- comprises a bottom portion -2e- which is thicker than the vertical wall -2a-, and which protrudes behind from the vertical wall -2a- in a horizontal direction opposite to the support surface of the vertical wall -2a-.

[0036] As shown in figures 2, 3, 5, 6, 11, 15, 17 and 18, the barrier device -1- comprises an overhang -5- at the top edges -2f, 3b- of the vertical wall -2a- and the cover plate -3-, and which horizontally extends beyond the top edge -3b- of the cover plate -3-.

[0037] In the embodiment shown in figures 2, 3 and 5, the overhang -5- is formed by a top portion of the vertical wall -2a- of the support body -2-, comprises a lower axial recess -7- dimensioned to receive the top edge -3b- of the cover plate -3-.

[0038] In the embodiment shown in figures 11, 15, 17 and 18, the overhang -5- is formed by a top portion of the cover plate -3- and comprises a free rim portion -5a- and a deflector wall -6- vertically extending upwards from the rim portion -5a-. The top edge -2f- of the vertical wall -2a- and the top edge -3b- of the cover plate -3- are fitted together by a separate cover member -8-. Instead of the overhang -5- being formed by a top portion of the cover plate -3-, it may be formed by the separate cover member -8- fixed to the top edges -2f, 3b- of the vertical wall -2a- and the cover plate -3-.

[0039] In a practical embodiment, the afore-described acoustic barrier device -1- may be dimensioned as follows:

Support body -2-:

height: 1.20 m
length: 2 m

Bottom portion -2e- of the support body -2-:

height: 0.3 m
thickness: 0.35 m

Vertical wall -2a- of the support body -2-:

thickness: 0.15 m
height: 0.85 m - 0.9

Recessed surface -2b- in the vertical wall -2a- of the support body -2- and the cover plate -3- providing a cavity for housing the sound-absorbing sheet -4:

depth: 7 mm
height: 0.8 m - 1.07 m

Cover plate -3-:

thickness 50 mm
height: 0.85 m - 1.15 m

[0040] Figure 20 shows an acoustic barrier for a railway line -11-, wherein the acoustic barrier -12- comprises a plurality of adjacent acoustic barrier devices -1- having one or more of the properties of the above described acoustic barrier device -1-. The acoustic barrier devices -1- are coupled to each other by coupling members and to the track bed of the railway line -11- by anchoring members (not shown in figure 20).

[0041] Figure 21 shows the acoustic waves reflected between the train and the barrier device.

[0042] Figure 22 shows the acoustic diffraction effect when the waves leaving the reverberation chamber meet the edges of overhang when the upper surface of the overhang - 5- is flat. The overhang -5- can comprise a non-flat upper surface with different geometries - 51, 52, 53, 54- and thus having more than two diffraction axes.

[0043] In this text, the terms first, second, third, etc. have been used herein to describe several devices, elements or parameters, it will be understood that the devices, elements or parameters should not be limited by these terms since the terms are only used to distinguish one device, element or parameter from another.

[0044] In this text, the term "comprises" and its deriva-

tions (such as "comprising", etc.) should not be understood in an excluding sense, that is, these terms should not be interpreted as excluding the possibility that what is described and defined may include further elements, steps, etc.

[0045] On the other hand, the invention is obviously not limited to the specific embodiment(s) described herein, but also encompasses any variations that may be considered by any person skilled in the art (for example, as regards the choice of materials, dimensions, components, configuration, etc.), within the general scope of the invention as defined in the claims.

Claims

1. An acoustic barrier device (1) for railway lines, comprising

   a support body (2) comprising a vertical wall (2a) designed to face a railway line (11), at least one anchoring member for anchoring the support body (2) to a track bed (11c) alongside the railway line (11), and sound dampening means to attenuate noise which is generated at the lower portion of the railway vehicle by the contact of the rotating wheels of the railway vehicle with the rails **characterized in that**
   the sound dampening means comprise a cover plate (3) with a plurality of through holes (3a) fixed to the support body (2), and at least one sound-absorbing sheet (4) positioned between the vertical wall (2a) and the cover plate (3).

2. The device according to claim 1, wherein the support body comprises a recessed surface defining a housing with a depth between 4 and 7 mm where the sound absorbing sheet (4) is placed.

3. The device according to claims 1 or 2, wherein the cover plate has a width between 50mm and 100mm.

4. The device according to claims 1, 2 or 3, wherein the cover plate is made of a concrete having a density of at least 2000 kg/m^3

5. The device according to any of claims 1 to 4, wherein the barrier device (1) comprises an overhang (5) at the top edges (2f, 3b) of the vertical wall (2a) and the cover plate (3), and which horizontally extends beyond the top edge (3b) of the cover plate (3).

6. The device according to claim 5, wherein the overhang (5) comprises a non-flat upper surface having more than two diffraction axes.

7. The device according to claim 5 or 6, wherein the overhang (5) is formed by one of

   a top portion of the vertical wall (2a) of the support body (2);
   a top portion of the cover plate (3);
   a separate cover member (8) fixed to the top edges (2f, 3b) of the vertical wall (2a) and the cover plate (3).

8. The device according to any of previous claims, wherein the through holes have a depth between 50 and 100 mm for allowing the passage of a wide range of acoustic waves.

9. The device according to any of previous claims, wherein the through holes (3a) are evenly distributed in the cover plate (3) and occupy at least 40% of cover plate (3).

10. The device according to any of previous claims, wherein the through holes (3a) have a cross section of a rectangle with rounded corners.

11. The device according to Claim 10, wherein each of the through holes (3a) comprises a longitudinal axis (L) which is oblique with respect to the vertical axis (V) of the cover plate (3).

12. The device according to any of claims 1 to 11, wherein the sound absorbing sheet (4) is made of a sound-absorbing material with an absorption index a_w greater than 0.8 and a sound-absorbing DLalfa coefficient of at least 10 dBA according to UNE EN 1793.1. in the frequency range object of the study (100 Hz and 10 KHz)

13. The device according to any of claims 1 to 12, wherein the sound-absorbing sheet (4) is selected form mineral wool or glass fiber

14. The device according to any of claims 1 to 13, comprising coupling members to couple it to at least an adjacent barrier device (1).

15. An acoustic barrier for a railway line (11), wherein the acoustic barrier (12) comprises a plurality of adjacent acoustic barrier devices (1) as defined in any of claims 1 to 14.

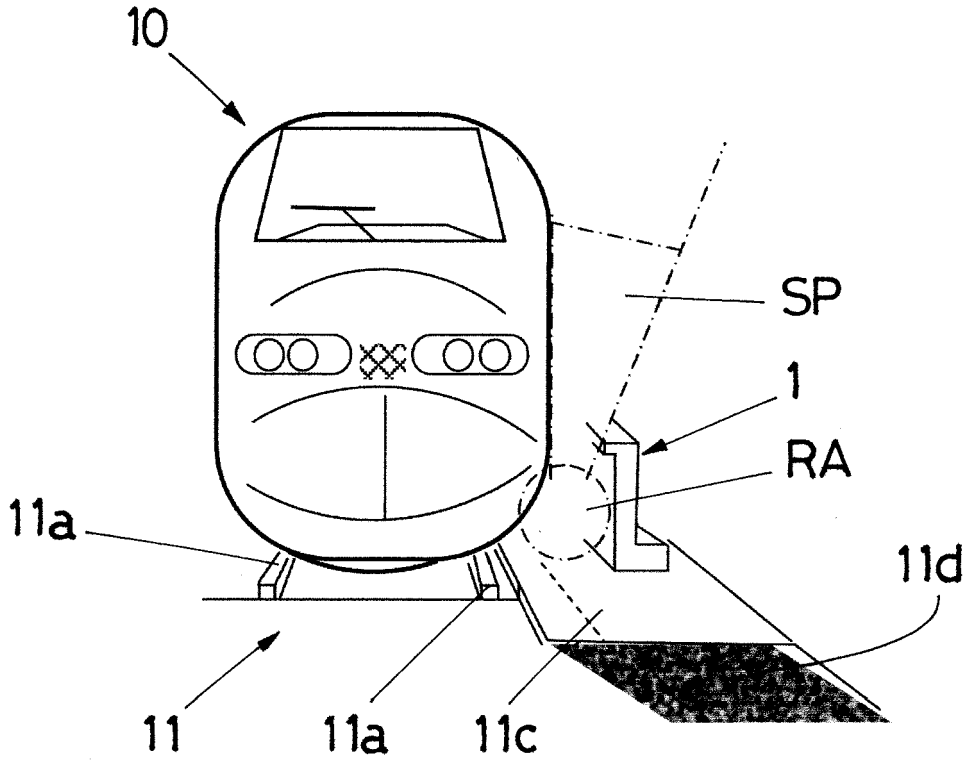

FIG.1

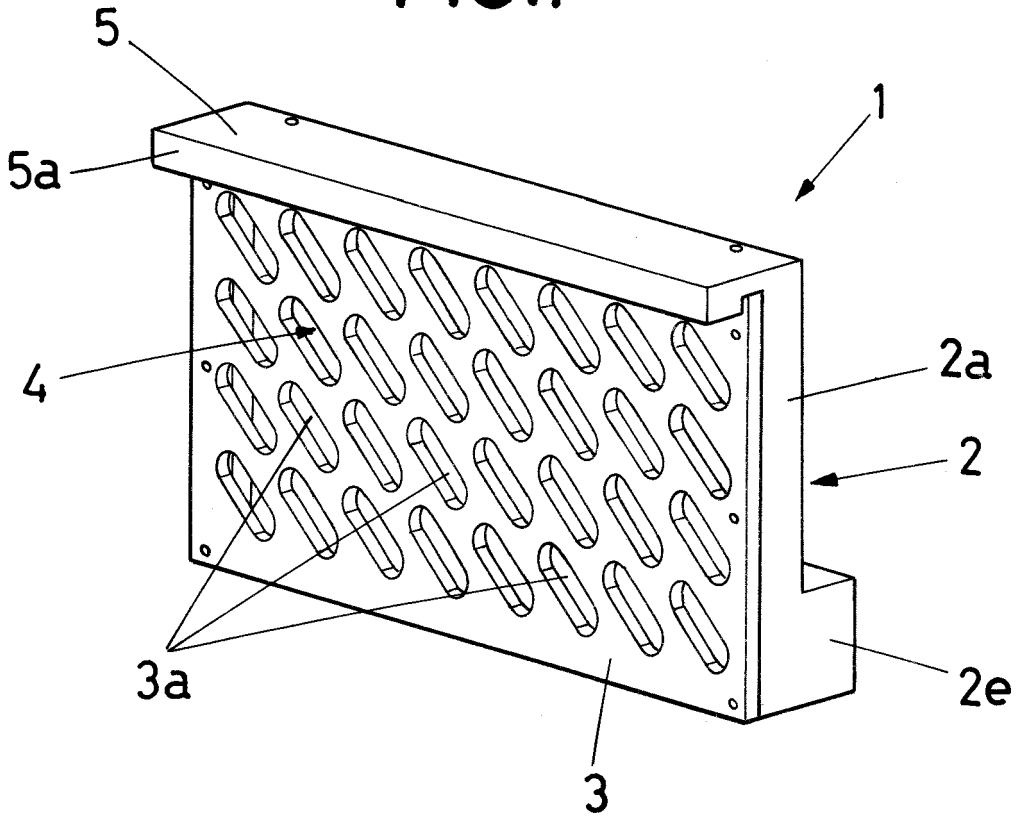

FIG.2

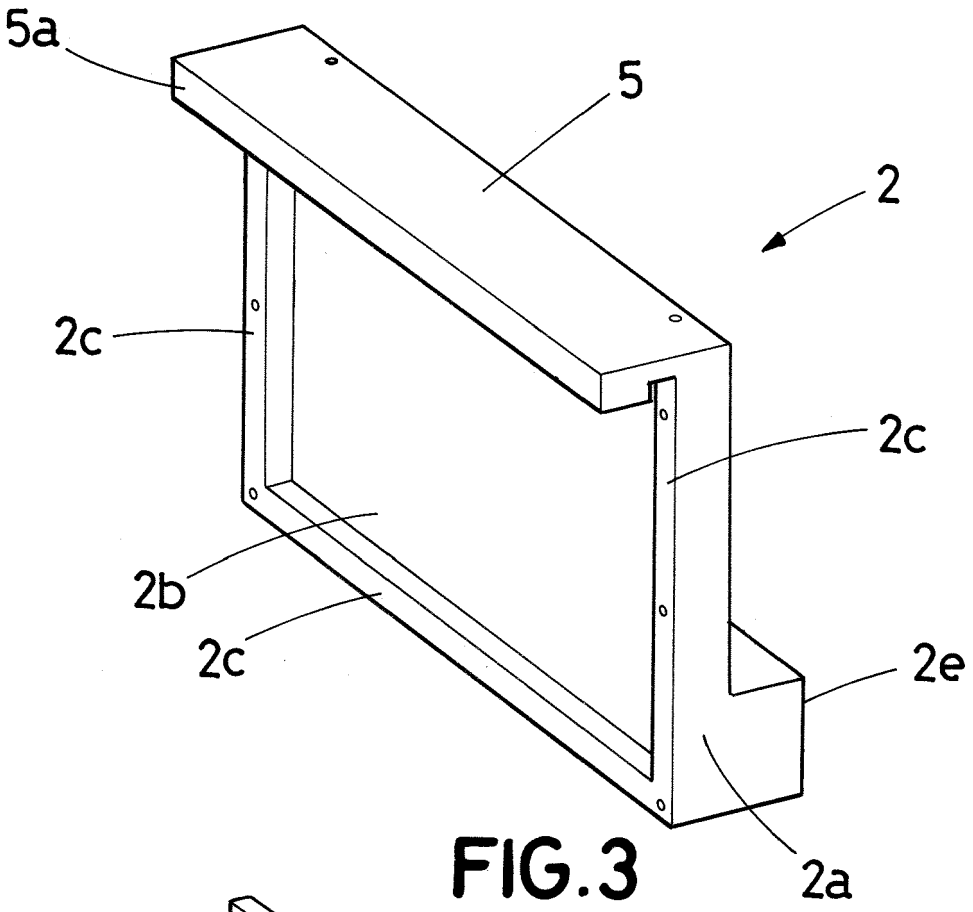

FIG.3

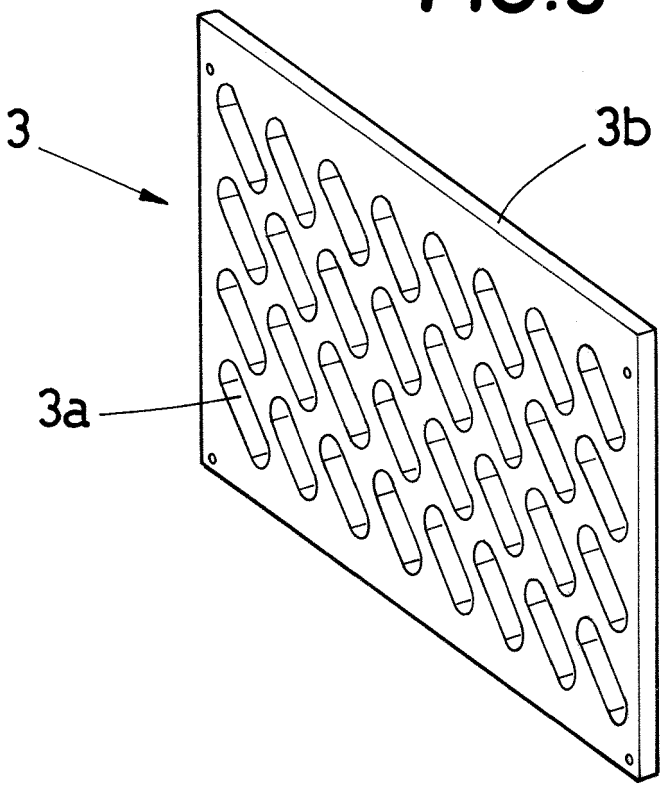

FIG.4

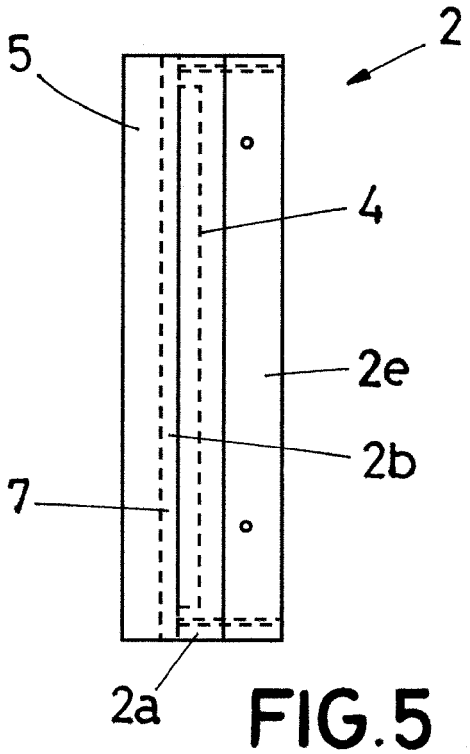

FIG.5

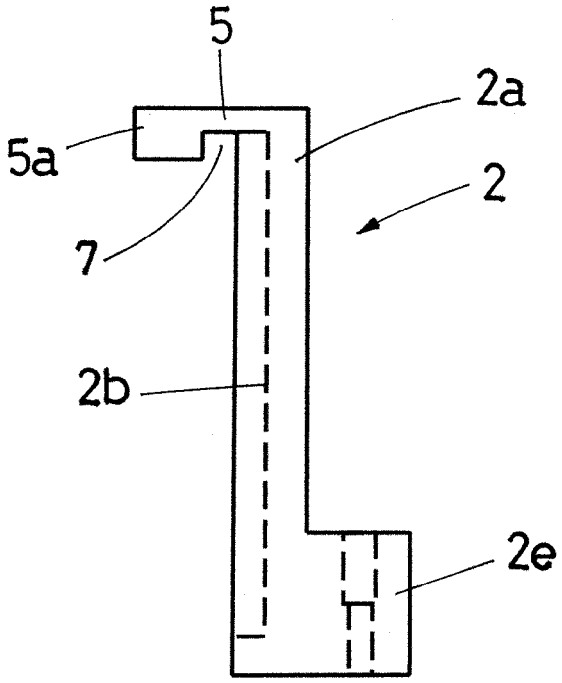

FIG.6

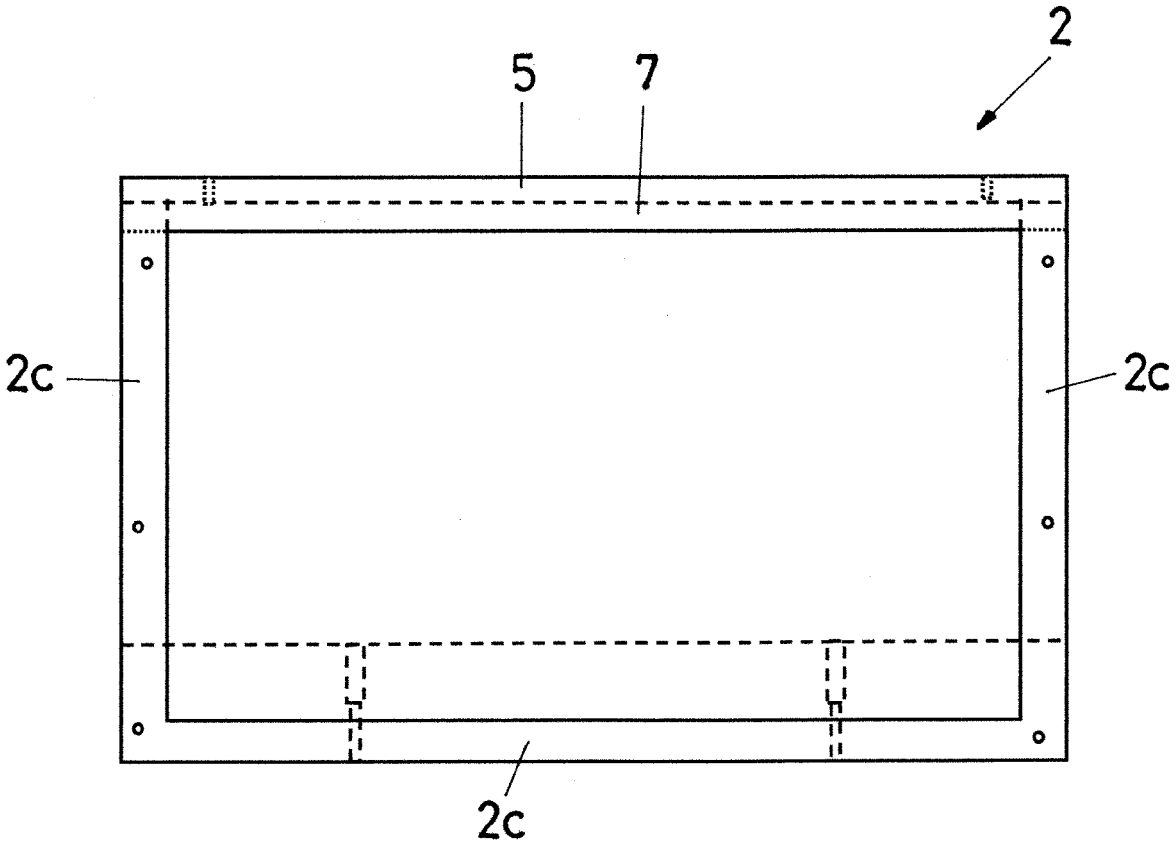

FIG.7

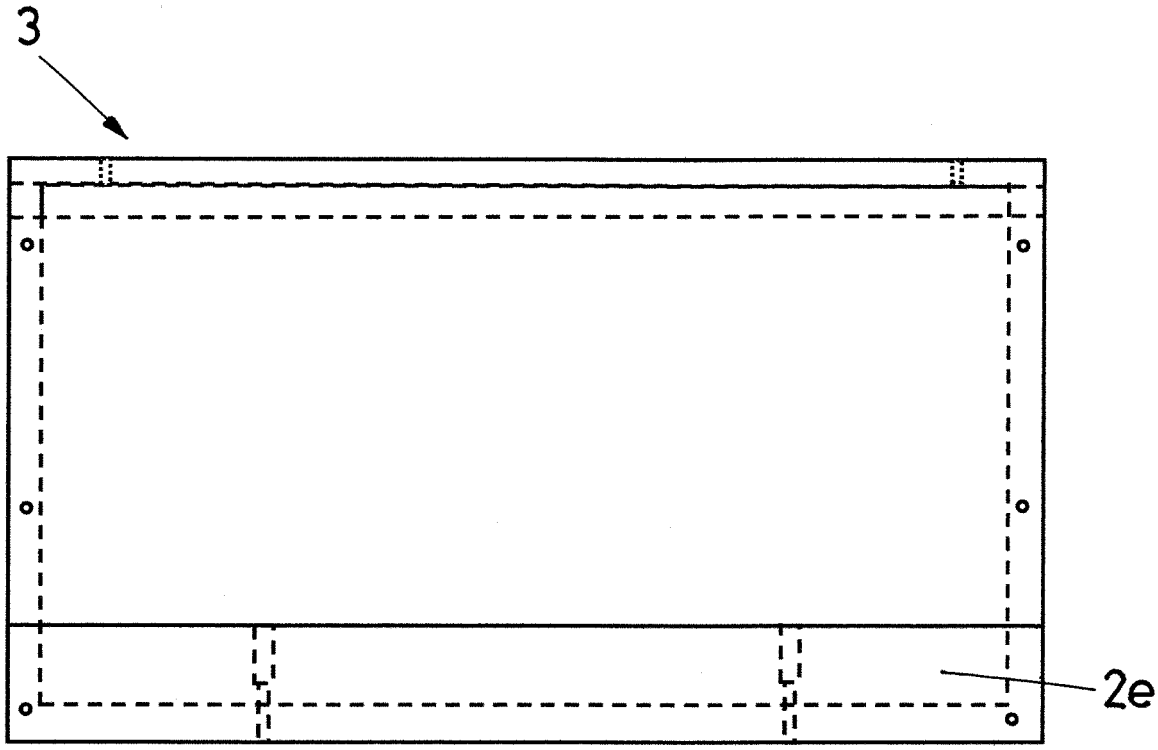

FIG.8

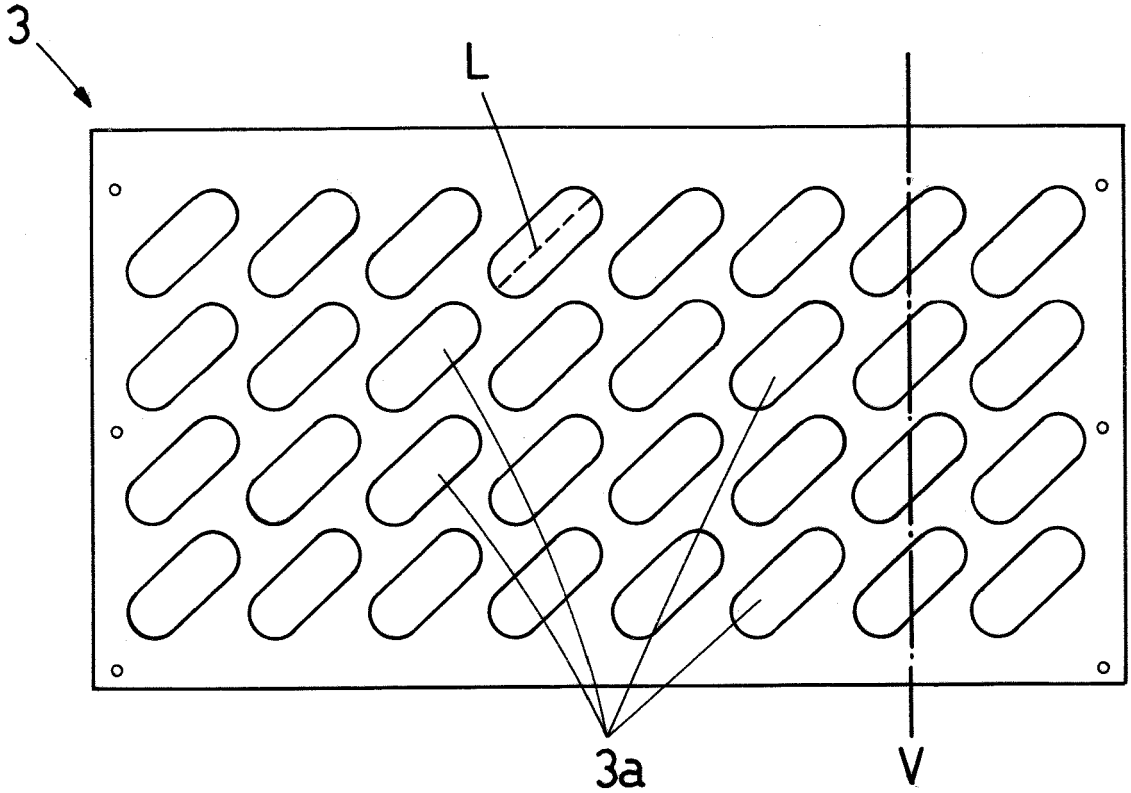

FIG.9

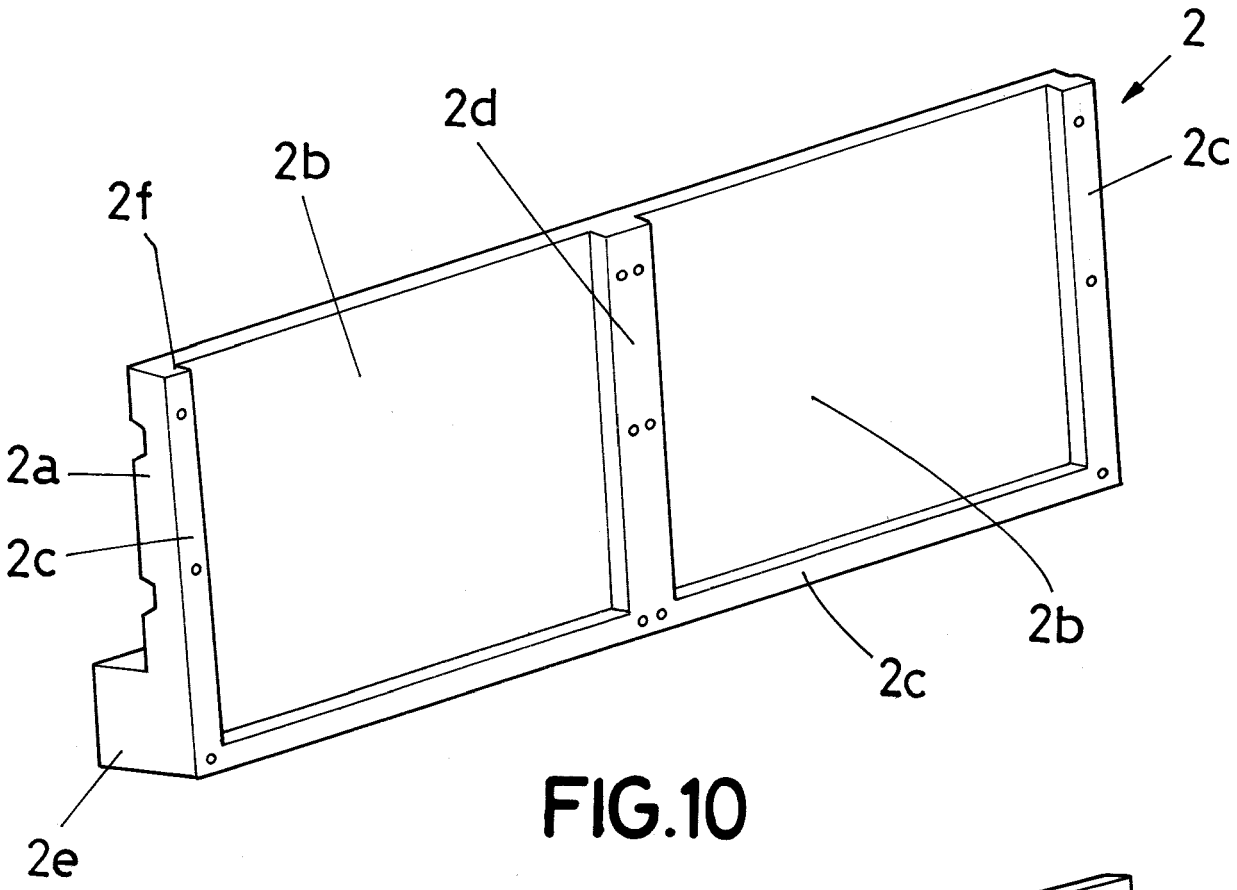

FIG.10

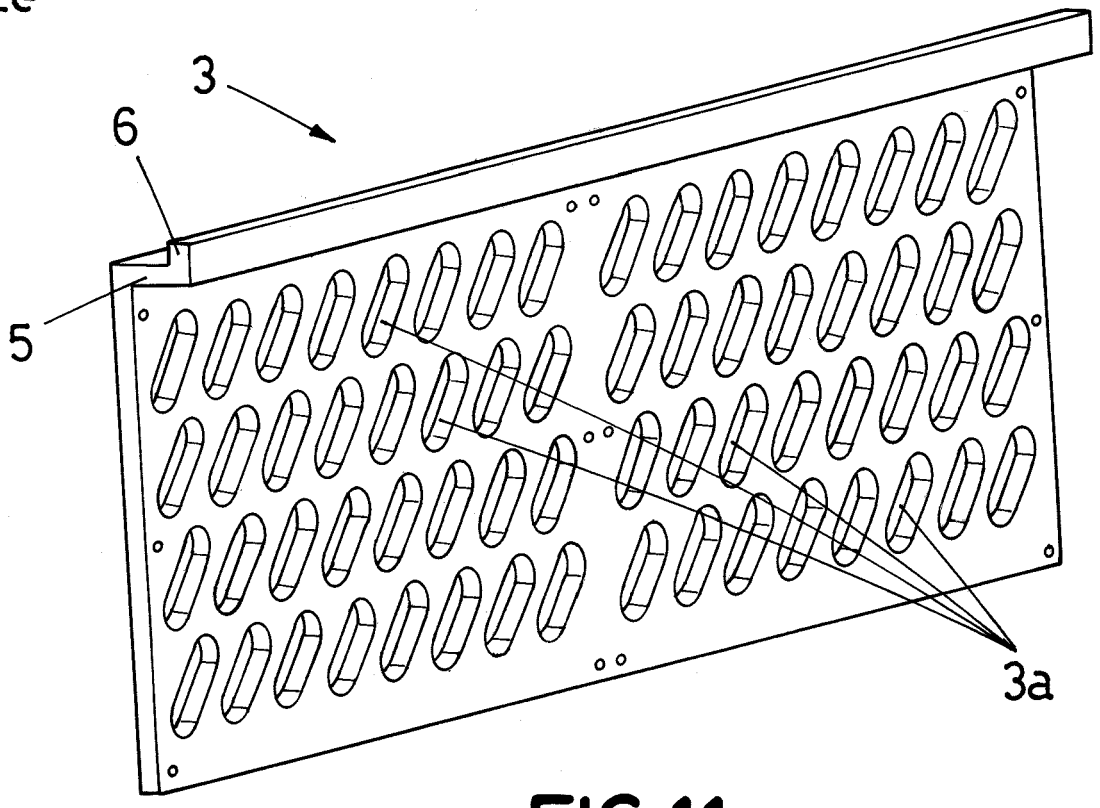

FIG.11

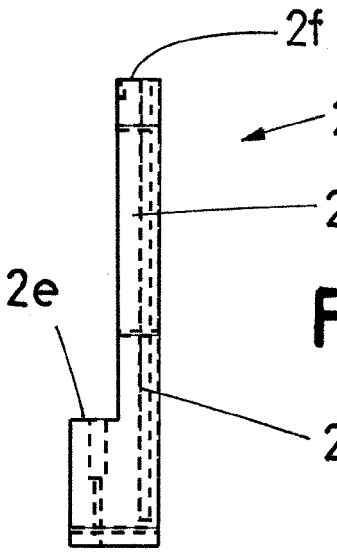

FIG.12

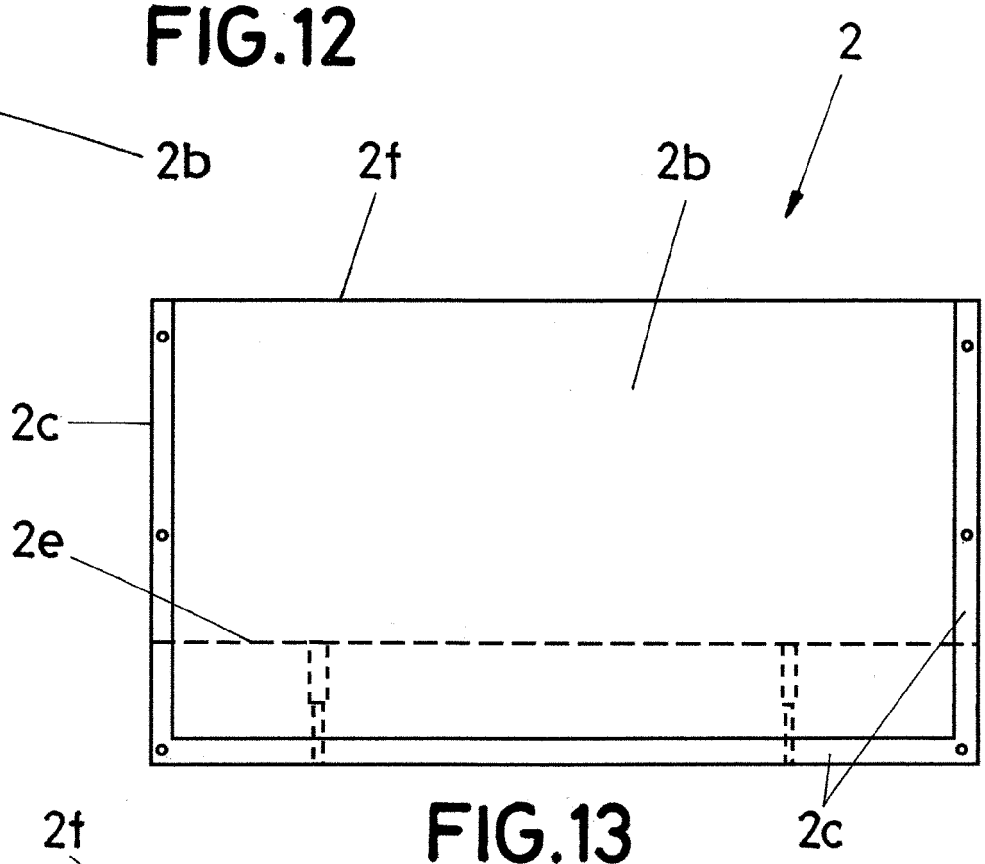

FIG.13

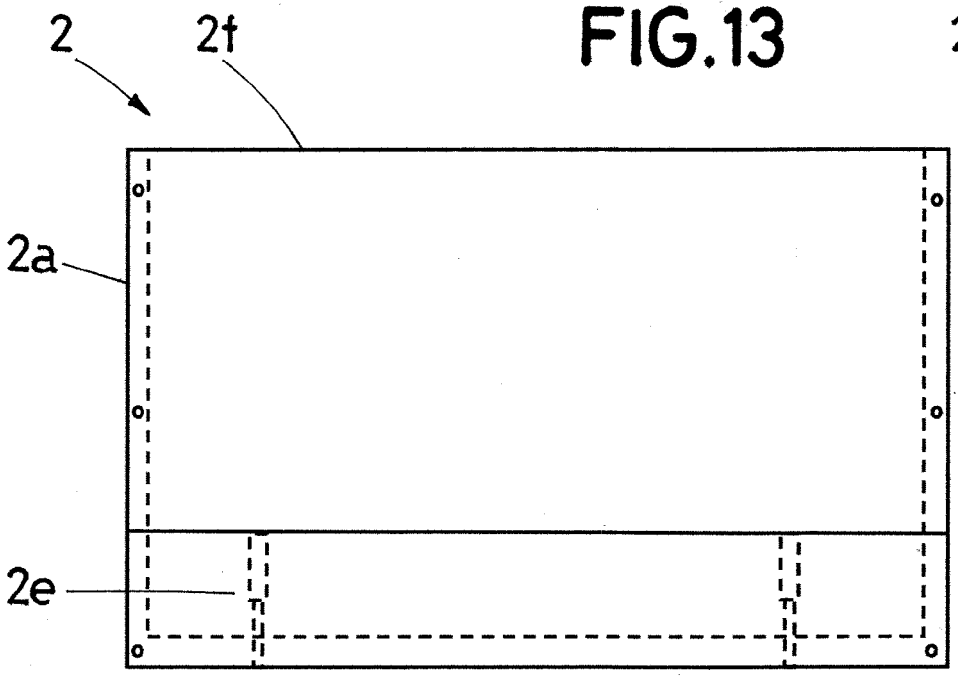

FIG.14

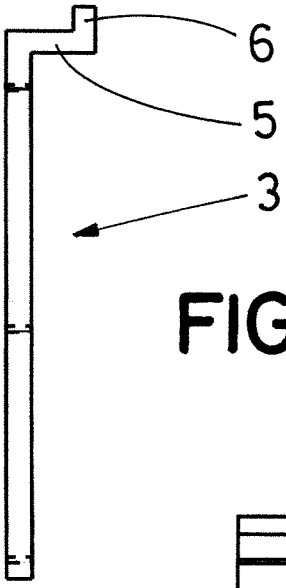

FIG.15

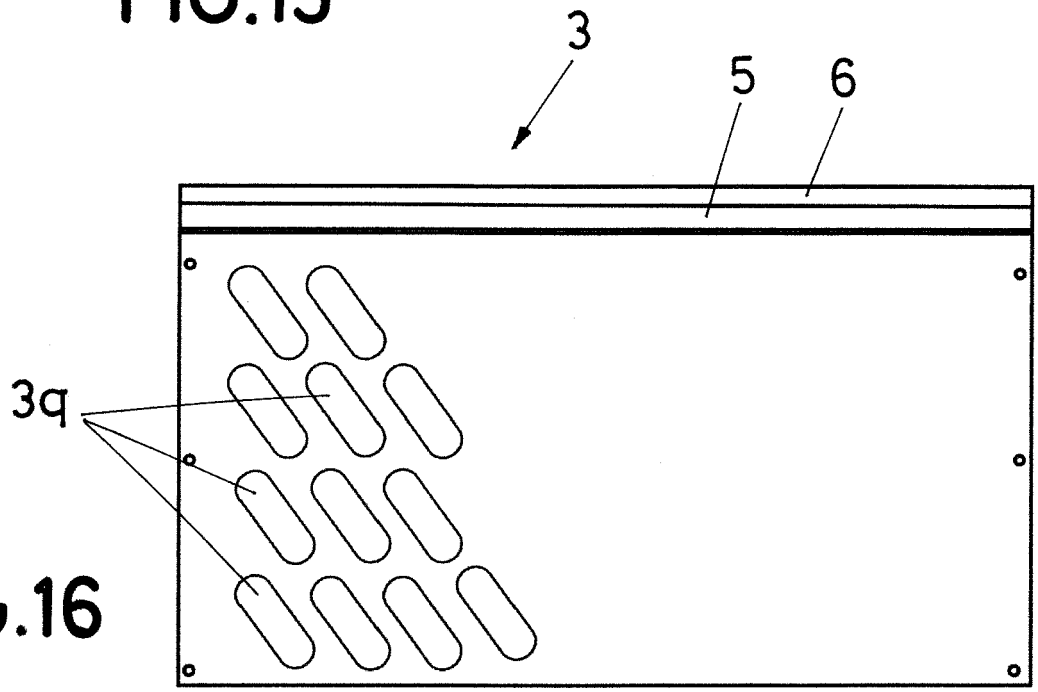

FIG.16

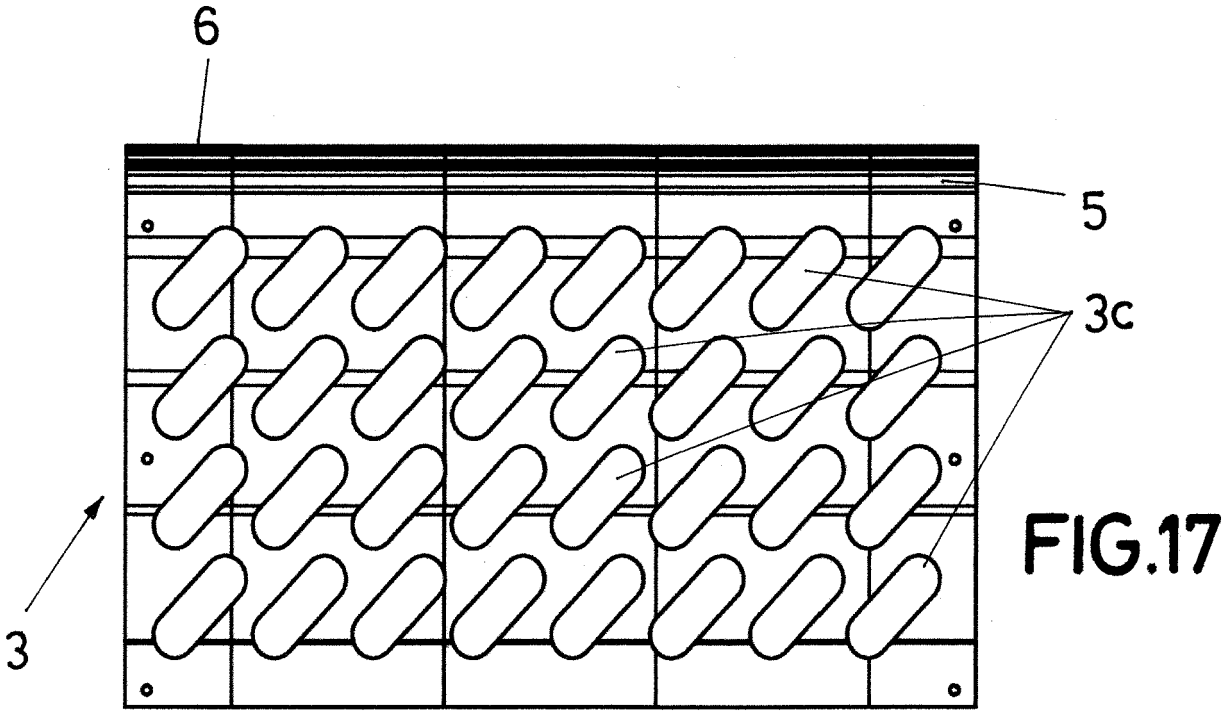

FIG.17

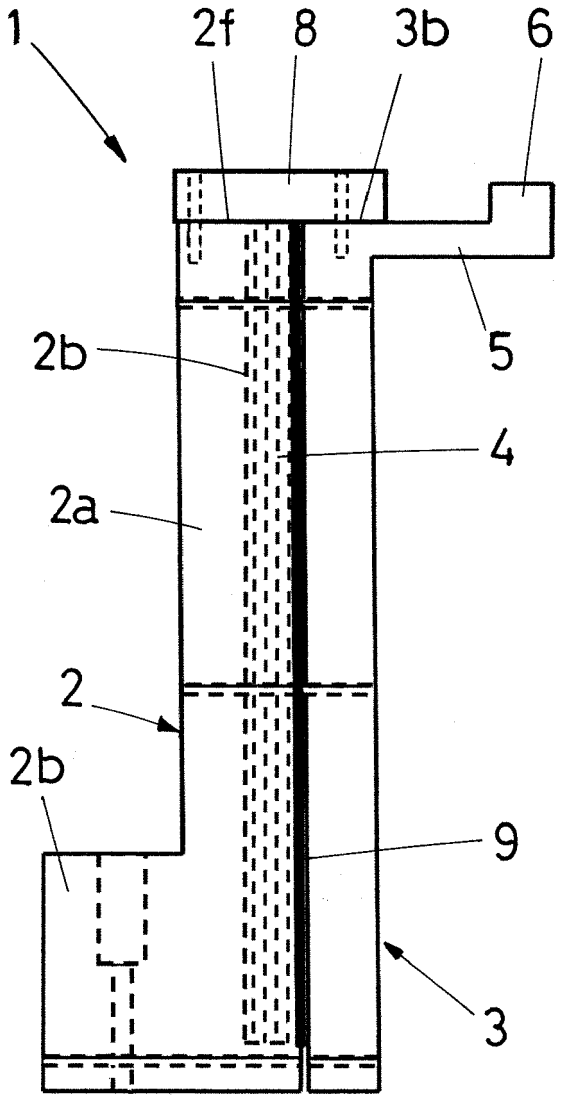

FIG.18

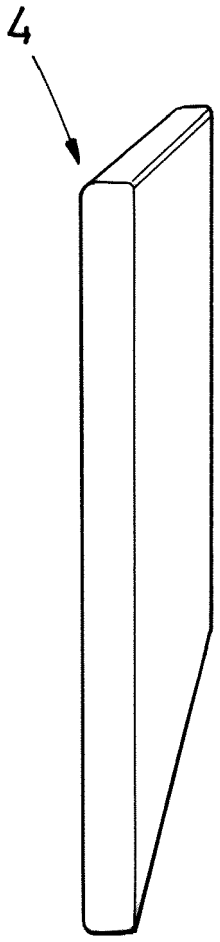

FIG.19

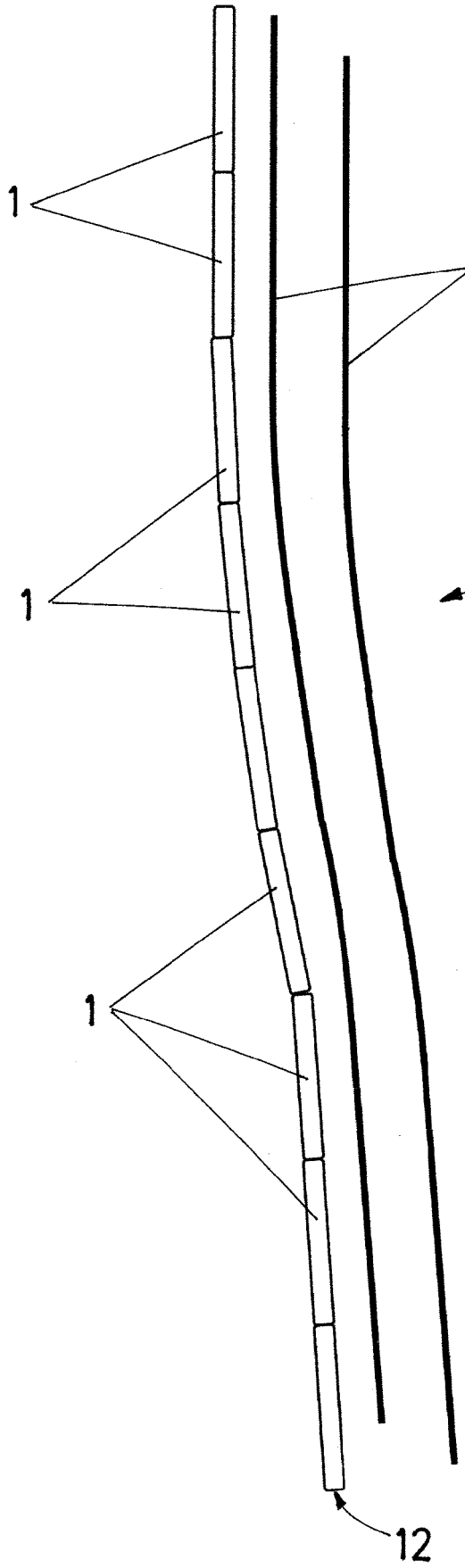

FIG. 20

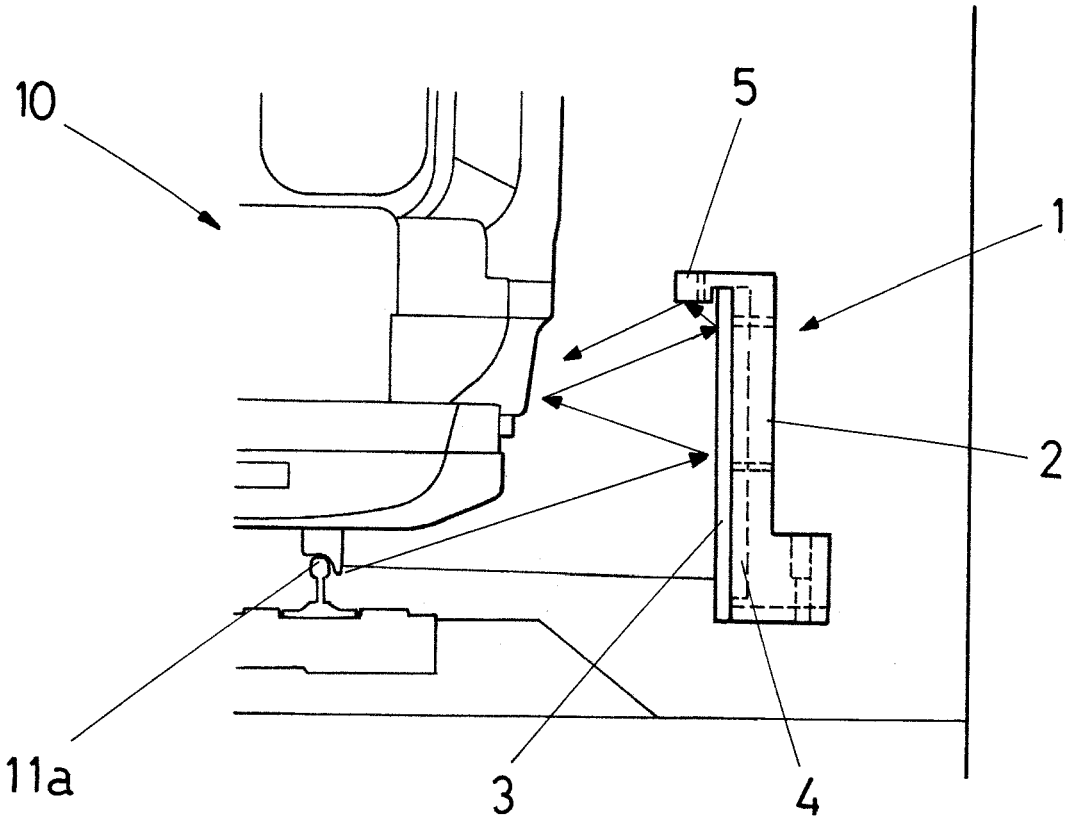

FIG. 21

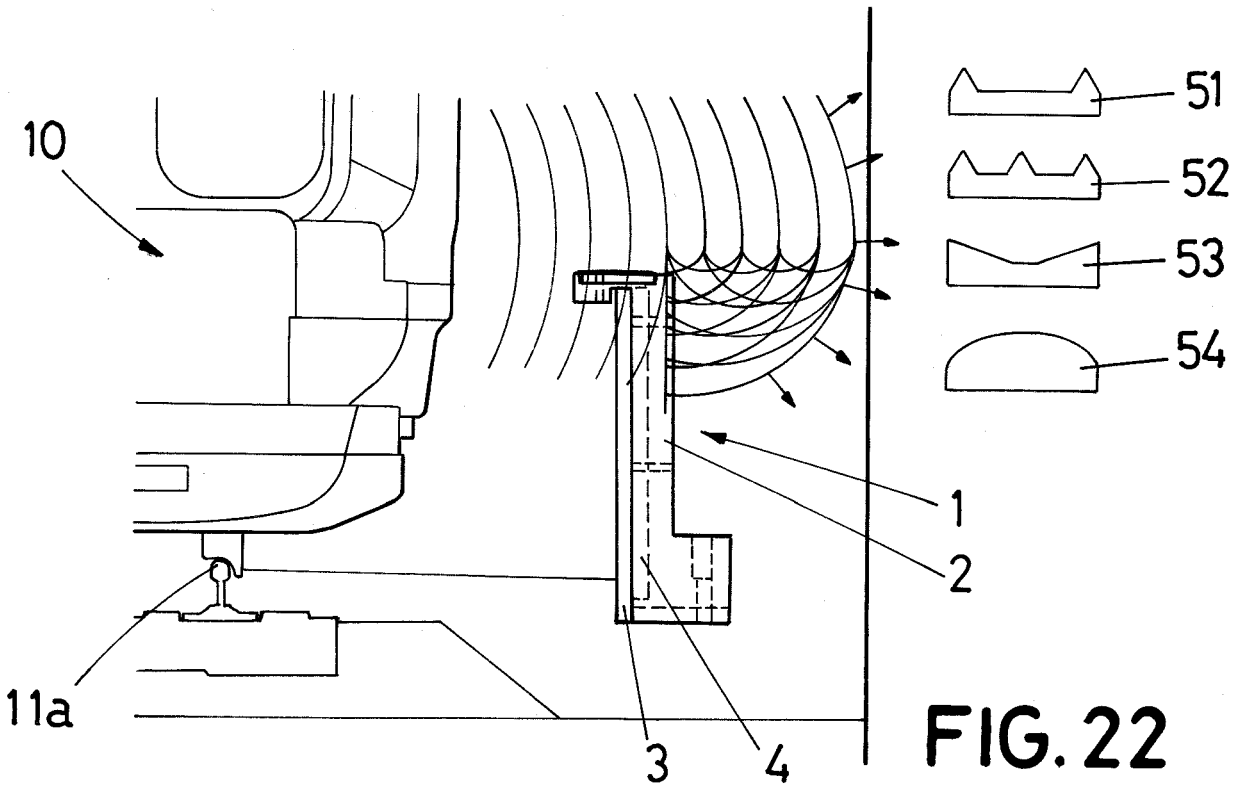

FIG. 22

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EUROPEAN SEARCH REPORT

Application Number
EP 22 38 2457

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	FR 2 612 217 A1 (ROUSSET MICHEL [FR]) 16 September 1988 (1988-09-16) * the whole document *	1-15	INV. E01F8/00
X	BE 892 899 A (CBR CEMENTBEDRIJVEN NV) 16 August 1982 (1982-08-16) * page 4, line 9 - page 6, line 21 * * page 7, lines 24-28; figures 1,2 *	1-15	
X	DE 26 49 132 A1 (STEWING ALBERT) 3 May 1978 (1978-05-03) * page 9, line 20 - page 10, line 28; figures 1-4 *	1-15	
A	IT 2017 0000 6516 A1 (PREGYMIX S R L) 23 July 2018 (2018-07-23) * figures 1-3 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC) E01F E01B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 October 2022	Flores Hokkanen, P

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24-10-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2612217 A1	16-09-1988	NONE	
BE 892899 A	16-08-1982	NONE	
DE 2649132 A1	03-05-1978	NONE	
IT 201700006516 A1	23-07-2018	----------	

EPO FORM P0459

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Patent documents cited in the description

- EP 1355006 A1 **[0004]**