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(71) Applicant: **Anas S.p.A.**
00185 Rome (IT)

(72) Inventors:
- **DE MARCO, Marcello**
  00185 Rome (IT)
- **BELLUCCI, Patrizia**
  00185 Rome (IT)
- **GRECCO, Raffaella**
  00185 Rome (IT)
- **PERUZZI, Laura**
  00185 Rome (IT)
- **BONOLI, Gianluca**
  00185 Rome (IT)

(74) Representative: **Colombo, Stefano Paolo et al**
Marchi & Partners S.r.l.
Via Vittor Pisani, 13
20124 Milano (IT)

(54) **NOISE BARRIER WITH FLAT SOUND-ABSORBING PANELS AND ASSOCIATED ASSEMBLY METHOD**

(57) A noise barrier comprising a plurality of support uprights and a plurality of wall elements supported by said support uprights is described, said noise barrier further comprising sound-absorbing modules supported by the support uprights and at least partially superimposed on the wall elements wherein at least one sound-absorbing module is supported only by a support upright, and wherein the rear face of at least one sound-absorbing module is at a non-zero distance from the support upright.

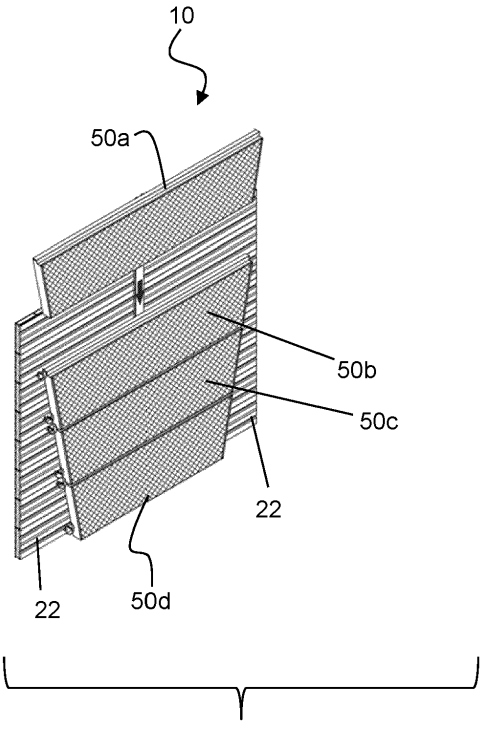

Fig. 9.4

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Description

TECHNICAL SECTOR

[0001] The present invention relates to the sector of structures, typically installed in the vicinity of roads or motorways, for protection against noise and/or noise pollution. In particular, it relates to a noise barrier and the associated method with which such a noise barrier is assembled. As well as being installed in the vicinity of roads and motorways, the noise barriers may be installed close to railways, factories or any other infrastructure where noise and/or noise pollution is generated.

PRIOR ART

[0002] As is known, the transit of vehicles along a road or a motorway creates noise. The noise is typically generated by the rolling movement of tyres, by air streams and aerodynamic noise, by vehicle engine noise and by the use of acoustic signalling devices or the like.

[0003] Along roads where there is particularly heavy traffic or in any case high noise levels it is known to install noise barriers in order to limit the noise in the area close to these roads. For example, when a roadway section is located close to a receiver (residence, school, hospital, etc.), a noise barrier is installed in order to limit the noise coming from the road and make the noise level acceptable for those persons living in the affected receivers.

[0004] The noise barriers may be installed close to roads and motorways, but also close to other sources of noise and/or noise pollution. For example, they may be installed close to railways lines or airport runways or industrial zones.

[0005] Typically, a known noise barrier is composed of panels installed on a special structure which is secured and/or fixed onto a suitable support.

[0006] The panels may be of the sound-insulating and/or sound-absorbing type. Sound-insulating panels are able to lessen the noise levels produced by the sound source in the region of the receivers affected by the noise. In some cases, sound-insulating panels may also be characterized by sound-absorbing properties, i.e. the capacity to absorb the sound energy generated by the noise source. The effectiveness of the screening system depends on the sound characteristics of the panels and the geometric structure of the noise barrier.

[0007] KR 2013 0015284 A, WO 2010/092606 A1 and US 5713 161 A relate to noise barriers.

SUMMARY OF THE INVENTION

[0008] The object defined by the Applicant is that of improving the acoustic performance in terms of the sound absorption of the sound-insulating noise barriers.

[0009] According to the present invention the improvement in the acoustic sound-absorbing performance of the noise barrier is obtained by means of the mounting of suitable sound-absorbing panels which are fastened onto the uprights of the screening system.

[0010] According to the present invention a noise barrier comprising a plurality of support uprights and a plurality of wall elements supported by said support uprights is provided, said noise barrier further comprising sound-absorbing modules supported by said support uprights and at least partially superimposed on said wall elements. According to the present invention, at least one sound-absorbing module is supported only by a support upright, not by two or more support uprights. According to embodiments, each sound-absorbing module of the plurality of sound-absorbing modules is supported only by a supporting upright. Furthermore, according to the invention, the rear face of at least one sound-absorbing module is at a non-zero distance from the support upright and/or from a wall element. According to embodiments, each sound-absorbing module of the plurality of sound-absorbing modules is spaced from the supporting upright that supports it and/or from a wall element.

[0011] In embodiments, at least one of the sound-absorbing modules comprises a substantially flat surface exposed to a noise source.

[0012] In embodiments, at least one of the sound-absorbing modules comprises a layer of sound-absorbing material.

[0013] In embodiments, at least one of the sound-absorbing modules comprises a box-like body.

[0014] In embodiments, the layer of sound-absorbing material is arranged inside the box-like body.

[0015] In embodiments, the substantially flat surface exposed to a noise source is perforated and/or comprises an expanded metal sheet and/or comprises a mesh or the like.

[0016] In embodiments, at least one of the support uprights comprises an H shaped section and wherein at least one of said sound-absorbing modules comprises a coupling device on a rear face of the sound-absorbing module for fastening the at least one sound-absorbing module to the support upright by means of engagement of the coupling device with the flanges of the H shaped upright.

[0017] In other embodiments, the noise barrier further comprises a plate in turn comprising a flat base and a flat surface substantially parallel but spaced from the base, to which the rear face of a sound-absorbing module can be constrained, wherein the plate is configured to be fixed to an upright in a removable way.

[0018] In embodiments, the noise barrier further comprises one or more spacers for maintaining a non-zero distance between the rear face of at least one sound-absorbing module and a wall element.

[0019] In embodiments, a first plurality of sound-absorbing modules are mounted at a first face of the wall elements and a second plurality of sound-absorbing modules are mounted at an opposite face of the wall elements. The noise barrier may also comprise an upper closure cap positioned to partially cover the top of the

noise barrier.

[0020] According to another aspect, the invention provides a method for assembling a noise barrier, comprising: providing a plurality of support uprights and a plurality of wall elements supported by the support uprights, providing a plurality of sound-absorbing modules of the aforementioned type and fastening the sound-absorbing modules to respective support uprights so that at least one sound-absorbing module is supported by a single support upright, the rear face of at least one sound-absorbing module is at a non-zero distance from the support upright and the sound-absorbing modules are superimposed at least partially on the wall elements.

[0021] In embodiments, the step of fastening the sound-absorbing modules comprises the step of inserting from above each sound-absorbing module while maintaining the engagement of the coupling device with a support upright.

[0022] In embodiments, the step of constraining the sound-absorbing modules comprises the steps of providing a plate comprising a flat base and a flat surface substantially parallel to but spaced from the base, constraining the flat base of the plate to an upright and constraining the flat surface of the plate to the rear face of a sound-absorbing module.

[0023] In embodiments, provision is made for mounting a first plurality of sound-absorbing modules at a first face of the wall elements and a second plurality of sound-absorbing modules at an opposite face of the wall elements.

[0024] In embodiments, it is provided to mount an upper closure cap to partially cover the top of the noise barrier.

BRIEF DESCRIPTION OF THE FIGURES

[0025] The present invention will become entirely clear from the following detailed description, provided purely by way of a non-limiting example, to be read with reference to the attached sets of drawings in which:

- Figs. 1.1 - 1.6 show schematic views of possible configurations of a noise barrier according to the present invention;
- Figs. 2.1 - 2.3 are schematic views of a sound-insulating wall section of the known noise barrier to which the sound-absorbing panels according to the present invention may be fastened, in the region of the uprights;
- Fig. 3 is an axonometric rear view of an example of a module of a sound-absorbing panel according to an embodiment of the invention;
- Fig. 4 is a front axonometric view of the same example of a module according to Fig. 3;
- Fig. 5 is an exploded axonometric view of the same example of a module according to Figures 3 and 4;
- Fig. 6 shows a mode of coupling the example of a module to the upright;
- Fig. 7 shows the mounting of a plurality of examples of sound-absorbing modules which form a sound-absorbing panel onto a sound-insulating wall section in order to form a noise barrier according to the invention;
- Fig. 8 shows the rear side of the noise barrier according to Fig. 7;
- Figs. 9.1 - 9.6 show in schematic form a possible composition of the noise barrier according to the present invention;
- Figs. 10.1 - 10.4 show how a logo may be inserted in the sound-absorbing panels of the noise barrier according to the invention;
- Figs. 11.1 and 11.2 show a plate for connecting a sound absorbing panel to an upright.

DETAILED DESCRIPTION

[0026] The various Figures 1 show in schematic form a noise barrier section 10 according to an embodiment of the present invention.

[0027] The noise barrier 10 of the present invention comprises a sound-insulating wall 20 and one or more sound-absorbing panels 50.

[0028] As will become clear below, the noise barrier 10 according to the present invention may assume different configurations. Each configuration may be different for various reasons.

[0029] For example, the difference may be due to the material of the sound-insulating wall 20 and/or the colour of the sound-insulating wall and/or the surface finish of the sound-insulting wall.

[0030] Alternatively and/or in addition to that indicated above in connection with the sound-insulating wall, the difference may be due to the material of the sound-absorbing panels, the form and/or the arrangement of the sound-absorbing panels, the surface finish of the sound-absorbing panels and/or the colour of the sound-absorbing panels.

[0031] According to embodiments, the sound-absorbing wall 20 may comprise wall elements 22 and support uprights 24.

[0032] The support uprights 24 may be metal uprights placed at a predetermined distance from each other. Advantageously, the support uprights 24 are arranged in a vertical position and may be stably fixed to the ground, for example to a concrete base.

[0033] According to embodiments, the metal uprights 24 are iron or steel sections with an "I" (or double "T") cross-section of the type HEB 160, 180 or 200.

[0034] According to embodiments, the wall elements 22 are rectangular elements with a thickness, at least along their short sides, such that they can be inserted between the flanges of the HEB 24 upright.

[0035] The wall elements 22 may be made of any type of material, such as concrete, wood, polymethyl methacrylate (PMMA) and steel.

[0036] As will become clear below, the sound-absorb-

ing panels 50 may be made of various materials and assume various forms. Fig. 1 shows, by way of example, six different configurations. For clearer illustration, each configuration shows the front face with the associated sound-absorbing panels 50 while the sound-absorbing panels 50 of the rear face are shown above the view of the front face, these forming a single panel. In all the examples of the configurations six uprights 24 and five sound-insulating walls 22 supported by the uprights 24 are shown. At the front, six sound-absorbing panels 50 are visible, each of these having a different trapezoidal shape. At the rear face, there are six sound-absorbing and/or sound-insulating panels 50.

[0037] Each sound-absorbing panel 50 may be formed as one piece or may comprise a plurality of parts or separate modules (50a, 50b, 50c, ...).

[0038] The panel may assume different forms depending on the geometry of the single modules which form it. In turn the modules may be made with any shape and/or size. However, some of the rear sound-absorbing panels 50 may extend only over the top part of the noise barrier 10, or not over the entire height of the upright 24.

[0039] The noise barrier 10 according to Fig. 1.1 comprises wall elements 22 made of concrete and sound-absorbing panels 50 with the outer side made of expanded sheet steel.

[0040] The noise barrier 10 according to Fig. 1.2 comprises wall elements 22 made of concrete and sound-absorbing panels 50 with the outer side made of Krion™.

[0041] The noise barrier 10 according to Fig. 1.3 comprises wall elements 22 made of wood and sound-absorbing panels 50 with the outer side made of expanded sheet steel.

[0042] The noise barrier 10 according to Fig. 1.4 comprises wall elements 22 made of wood and sound-absorbing panels 50 with the outer side made of Krion™.

[0043] The noise barrier 10 according to Fig. 1.5 comprises wall elements 22 made of PMMA and sound-absorbing panels 50 with the outer side made of expanded sheet steel.

[0044] The noise barrier 10 according to Fig. 1.6 comprises wall elements 22 made of PMMA and sound-absorbing panels 50 with the outer side made of Krion™.

[0045] Figures 2.1, 2.2 and 2.3 show only the uprights 24 and the wall elements 22 which are, respectively, made of concrete, wood or PMMA.

[0046] Each wall element 22 may be made as one piece or consist of two or more modules.

[0047] Figures 3, 4 and 5 show, by way of example, an example of a module (50a) of a sound-absorbing panel of the noise barrier according to the present invention. In particular, the sound-absorbing panel module shown and described by way of example has the form of an isosceles trapezium. It may be used, in combinations with other modules (50b, 50c, 50d, ...) having the form of an isosceles trapezium to form a sound-absorbing panel such as the panel shown in Fig. 1.1 (as well as in the other Figures 1.2, ...). The modules can also be rhomboid, rectangular, or in the shape of any regular or irregular polygon.

[0048] The module 50a comprises, by way of example, a box-like body 51, a layer 60 of sound-absorbing material inside the box-like body 51 and a coupling device 70 for coupling the module 50a to an upright 22.

[0049] The box-like body 51 typically comprises a rear face 52, which is preferably substantially closed, for example consisting of a suitably shaped metal sheet. The box-like body 51 preferably comprises side walls 53, 54 and a top closing part 55 and bottom closing part 56. According to preferred embodiments, the top closing part 55 forms a step, visible in Figures 3 and 4. According to preferred embodiments, the bottom closing part 56 forms a complementary step (or step matching the step of the top closing part), visible in Figure 3. According to preferred embodiments, the box-like body 51 comprises reinforcing partitions 57.

[0050] The sound-absorbing material 60 may comprise a layer of natural and/or synthetic sound-absorbing material with a thickness which is suitable for the desired absorption characteristics. For example, the sound-absorbing material may comprise a material such as rock-wool, polystyrene or polyester. According to embodiments, the thickness of the sound-absorbing material 60 may be between 50 mm and 200 mm.

[0051] According to the embodiment shown in Figures 3, 4 and 5, the front face 58 comprises an expanded metal sheet made of steel or a mesh. According to embodiments, the holes in the expanded metal sheet or mesh are substantially hexagonal, circular, rhombus-shaped or oval. According to other embodiments, the front face 58 of the sound-absorbing panel module 50 comprises a metal sheet suitably perforated with a predefined pattern.

[0052] The coupling device 70 is configured to couple the sound-absorbing panel module 50 to an upright 22. Preferably, each sound-absorbing panel module is coupled to an upright 22 by inserting it from above and engaging the flanges of the upright 22. Basically, the coupling device 70, once assembled, forms a kind of channel 78. More particularly, by way of example, the coupling device 70 comprises a first profile 71 and a second profile 72 which are both to be fixed to the rear face 52 of the module 50a of the sound-absorbing panel 50. The first profile 71 comprises a first central strip 71c and the second profile 72 comprises a central strip 72c which, in the assembled configuration, overlaps at least partly the central strip 71c of the first profile 71. The two profiles 71, 72 can be joined together by means of screws which pass through holes 71f and slots 72g in the central strips 71c,72c (or can be joined together in another way, for example by means of a weld). A third L-shaped profile 73 and a fourth L-shaped profile 74 are associated with the first and second profiles 71, 72, respectively. A distance substantially corresponding to the thickness of the flanges of the upright 22 is created between the central strips 71c and 72c connected together and the legs of

the two L-shaped profiles 73.

[0053] Fig. 6 shows, in schematic form, a sound-absorbing panel module 50 with the coupling device 70 which is engaged with the flanges of an upright 22. For greater clarity, the wall elements have not been shown.

[0054] Fig. 7 shows a noise barrier 10 according to an embodiment of the present invention. In particular it shows an upright 24 with two wall elements 22.

[0055] Fig. 7 also shows four modules 50a, 50b, 50c and 50d of a sound-absorbing panel to be mounted at the front and a module 50e of a sound-absorbing and/or sound-insulating panel to be mounted at the rear. In the example shown in Fig. 7 the sound-absorbing panel modules all have the form of an isosceles trapezium, with dimensions decreasing from the top towards the bottom. Preferably, they have a coupling device which allows the modules to be inserted from above and to engage with the flanges of the upright 24.

[0056] In the embodiment shown by way of example, with the rear face of the wall elements 22 there is instead associated only a single sound-absorbing and/or sound-insulating panel module 50e, preferably with a shape and size corresponding to those of the first sound-absorbing panel module 50a situated at the front. Fig. 8 shows the noise barrier section from the rear side, with the single sound-absorbing panel module 50e.

[0057] Figures 7 and 8 also show a top closing cover-piece 80 for forming a closure between the front sound-absorbing panel module 50a and the rear sound-absorbing panel module 50e. The closing cover-piece 80 may be made of sheet metal and may be inclined to form one or two flaps.

[0058] According to embodiments (as shown in Fig. 7), the sound-absorbing panel modules may also be (in addition) fixed to the wall elements by means of screws 59 in the vicinity of their lateral ends. This prevents any possible fluttering of the sound-absorbing module, which otherwise is fastened centrally only to the upright 24.

[0059] Figures 9.1 - 9.6 shows the sequence of steps used for assembly of the barrier section 10 shown in Figures 7 and 8, starting from the configuration in which the two wall elements 22 are associated on opposite sides with an upright 24.

[0060] Fig. 9.1: the first sound-absorbing panel module 50d is inserted from above so as to engage with the front flanges of the upright 24.

[0061] Fig. 9.2: the second sound-absorbing panel module 50c is also inserted from above so as to engage with the front flanges of the upright 24. The second module 50c is superimposed on the first module 50d.

[0062] Fig. 9.3: the third sound-absorbing panel module 50b is also inserted from above so as to engage with the front flanges of the upright 24. The third module 50b is superimposed on the second module 50c.

[0063] Fig. 9.4: the fourth sound-absorbing panel module 50a is also inserted from above so as to engage with the front flanges of the upright 24. The fourth module 50a is superimposed on the third module 50b.

[0064] Fig. 9.5: the fifth sound-absorbing panel module 50e is also inserted from above so as to engage with the rear flanges of the upright 24. The fifth module 50e is locked in the top position.

[0065] Fig. 9.6: the closing cover-piece 80 is screwed onto the top edge of the fourth (front) module 50a and onto the edge of the fifth (rear) module 50e.

[0066] As an alternative to the coupling device 70 shown in Figures 3, 5 and 6, a sound-absorbing panel module can be fastened to an upright 24 by means of a suitably shaped plate. A shaped plate 90 configured to constrain a panel module to a post is shown in Figures 11.1 and 11.2.

[0067] The plate 90 comprises a flat base 91 and a flat surface 93 substantially parallel but spaced from the base 91, to which the rear face 52 of a sound-absorbing module 50 can be constrained. The plate 90 is configured to be fixed to an upright 24 in a removable way, for example with screws passing through holes 92 made in the flat base 91. The aforementioned flat surface 93 can also be provided with through holes 94, preferably of an elongated shape. and not circular to compensate for any mounting inaccuracies.

[0068] As will be clear from the description above, the noise barrier 10 according to the present invention, compared to the known noise barriers, has the particular feature that, geometrically speaking, it has a novel design owing to the combination, on two different levels, of a sound-insulating base wall and sound-absorbing panels which are superimposed thereon. This twin-panel superimposed arrangement gives the noise barrier a three-dimensional appearance on the road.

[0069] The sound-absorbing panels 50 according to the invention may be installed, if necessary, also on a barrier already present along the road, without resulting in any structural deterioration thereof.

[0070] Depending on the surrounding landscape in the which the barrier must be inserted, a basic material which best characterizes the surroundings may be chosen.

[0071] The noise barrier according to the invention is intended for applications in which a partial or total sound-absorbing performance is required: the different levels of sound absorbance may be achieved depending on both the type of sound-insulating base wall which is chosen and on the geometrical dimensions of the sound-absorbing panels as well as on the type and thickness of the sound-absorbing material.

[0072] In the case where the modules 58 which form the sound-absorbing panel 50 are made of Krion™ material, the texture is realized by means of the differently sized perforations arranged in a diamond shape, expressly designed in order to increase the sound-absorbing properties.

[0073] This novel design of the noise barrier has the special feature that it has been developed specifically for the receiver, providing not only protection from road noise but also a visually comfortable appearance. The noise barrier, in fact, where necessary, may be composed of

sound-absorbing and/or sound-insulating panels, also at the rear, so as to create a usable space for the residents of the acoustically improved area, open spaces, electric car charging points at junctions, etc.

[0074] The strong visual identity represented by the design of the barriers according to the invention is increased by the possibility of including a company logo in its various formulations and sizes (Figs. 10.1-10.4), for example by means of insertion of the said logo underneath the expanded steel sheet. In the case of a Krion panel, the logo may be formed by making use of the different configuration of the base perforations used to make the panel of the sound-absorbing type

[0075] When used on roads managed by different operators, the logos of the different companies may be displayed depending on their role.

Claims

1. A noise barrier (10) comprising a plurality of support uprights (24) and a plurality of wall elements (22) supported by said support uprights (24), further comprising sound-absorbing modules (50, 50a, 50b, 50c, 50d,...) supported by said support uprights (24) and at least partially superimposed on said wall elements (22), wherein at least one sound-absorbing module (50, 50a, 50b, 50c , 50d,...) is supported only by a support upright (24), and wherein the rear face (52) of at least one sound-absorbing module (50, 50a, 50b, 50c , 50d,...) is at a non-zero distance from the support upright (24).

2. The noise barrier (10) of claim 1, wherein at least one of said sound-absorbing modules (50, 50a, 50b, 50c, 50d, ...) comprises a substantially flat surface exposed to a noise source.

3. The noise barrier (10) of claim 1 or 2, wherein at least one of said sound-absorbing modules (50, 50a, 50b, 50c, 50d,...) comprises a layer (60) of sound-absorbing material.

4. The noise barrier (10) of claim 3, wherein at least one of said sound-absorbing modules (50, 50a, 50b, 50c, 50d, ...) comprises a box-like body (51).

5. The noise barrier (10) of claim 4, wherein the layer (60) of sound-absorbing material is arranged inside the box-like body (51).

6. The noise barrier (10) of claim 2, wherein the substantially flat surface exposed to a noise source is perforated and/or comprises an expanded metal sheet and/or comprises a mesh or the like.

7. The noise barrier (10) of any one of the preceding claims, wherein at least one of the support uprights (24) comprises an H shaped section and wherein at least one of said sound-absorbing modules (50, 50a, 50b, 50c, 50d, ...) comprises a coupling device (70) on a rear face of the sound-absorbing module for fastening the at least one sound-absorbing module to the support upright (24) by means of engagement of the coupling device (70) with the flanges of the H shaped upright.

8. The noise barrier (10) of any one of claims 1-6, further comprising a plate (90) in turn comprising a flat base (91) and a flat surface (93) substantially parallel but spaced from the base (91), to which the rear face (52) of a sound-absorbing module can be constrained, wherein the plate (90) is configured to be fixed to an upright (24) in a removable way.

9. The noise barrier (10) of any one of the preceding claims, further comprising one or more spacers for maintaining a non-zero distance between the rear face (52) of at least one sound-absorbing module (50, 50a, 50b, 50c, 50d, ...) and a wall element (22).

10. The noise barrier (10) of any one of the preceding claims, wherein a first plurality of sound-absorbing modules are mounted at a first face of the wall elements and a second plurality of sound-absorbing modules are mounted at an opposite face of the wall elements, wherein the noise barrier may also comprise an upper closure cap (80) positioned to partially cover the top of the noise barrier (10).

11. A method for assembling a noise barrier (10), comprising: providing a plurality of support uprights (24) and a plurality of wall elements (22) supported by the support uprights (24), providing a plurality of sound-absorbing modules (50, 50a, 50b, 50c, 50d, ...) according to any one of claims 1-9 and fastening the sound-absorbing modules (50, 50a, 50b, 50c, 50d, ...) to respective support uprights (24) in such a way that at least one sound-absorbing module (50, 50a, 50b, 50c, 50d, ...) is supported by a single support upright (24), the rear face (52) of at least one sound-absorbing module (50, 50a, 50b, 50c, 50d, ...) is at a non-zero distance from the support upright (24) and the sound-absorbing modules (50, 50a, 50b, 50c, 50d, ...) are superimposed at least partially on the wall elements (22).

12. The method of claim 11, wherein the step of fastening the sound-absorbing modules (50, 50a, 50b, 50c, 50d, ...) comprises the step of inserting each sound-absorbing module from above while maintaining the engagement of a coupling device (70) with a support upright (24).

13. The method of claim 11, wherein the step of constraining the sound-absorbing modules (50, 50a,

50b, 50c, 50d, ...) comprises the steps of providing a plate (90) comprising a flat base (91) and a flat surface (93) substantially parallel to but spaced from the base (91), constraining the flat base (91) of the plate (90) to an upright (24) and constraining the flat surface of the plate to the rear face (52) of a sound-absorbing module.

14. The method of claim 11, comprising the step of mounting a first plurality of sound-absorbing modules at a first face of the wall elements and the step of mounting a second plurality of sound-absorbing modules at an opposite face of the wall elements.

15. The method of claim 14, further comprising the step of arranging an upper closure cap (80) to partially cover the top of the noise barrier (10).

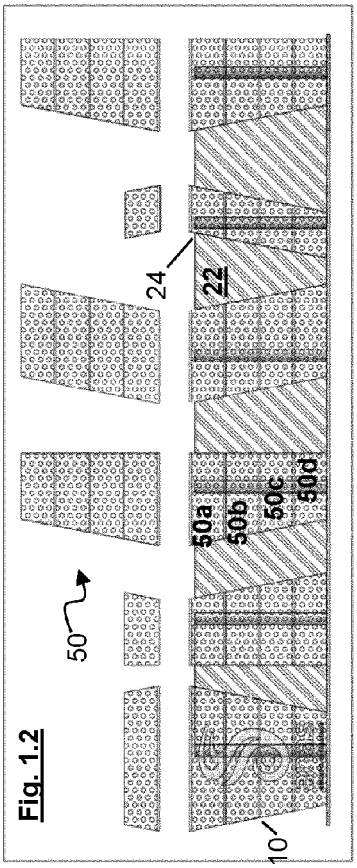
Fig. 1.2
50
24
22
50a
50b
50c
50d
10

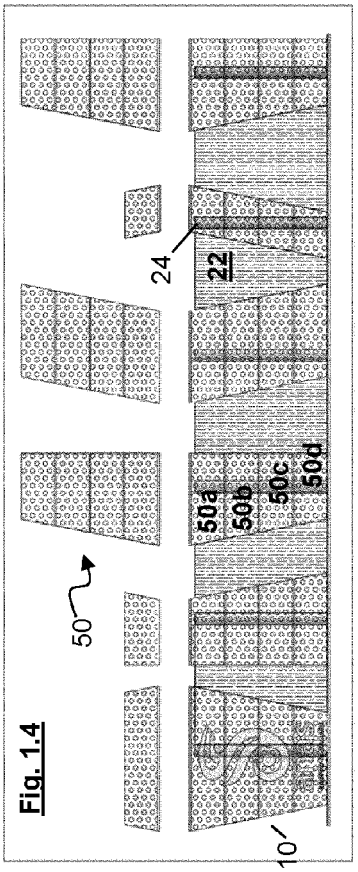
Fig. 1.4
50
24
22
50a
50b
50c
50d
10

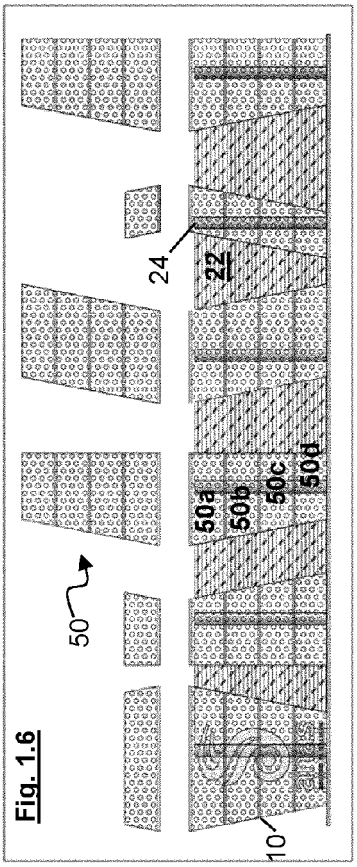
Fig. 1.6
50
24
22
50a
50b
50c
50d
10

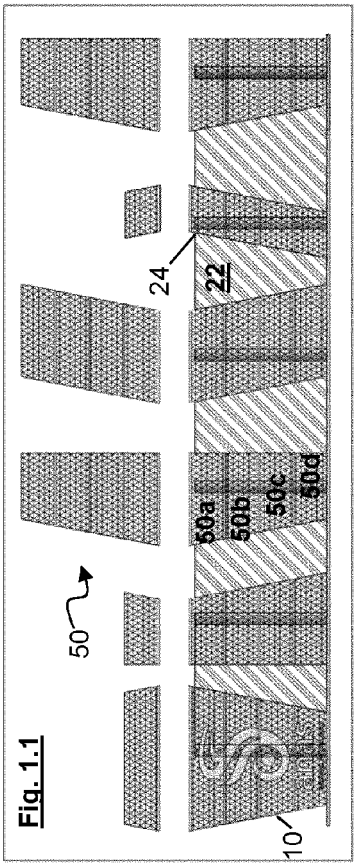
Fig. 1.1
50
24
22
50a
50b
50c
50d
10

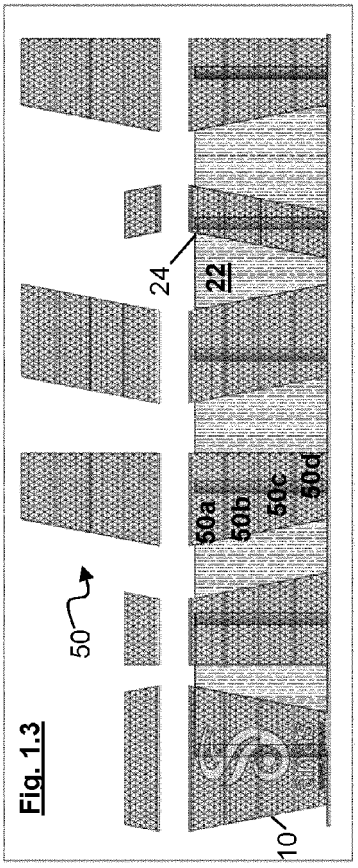
Fig. 1.3
50
24
22
50a
50b
50c
50d
10

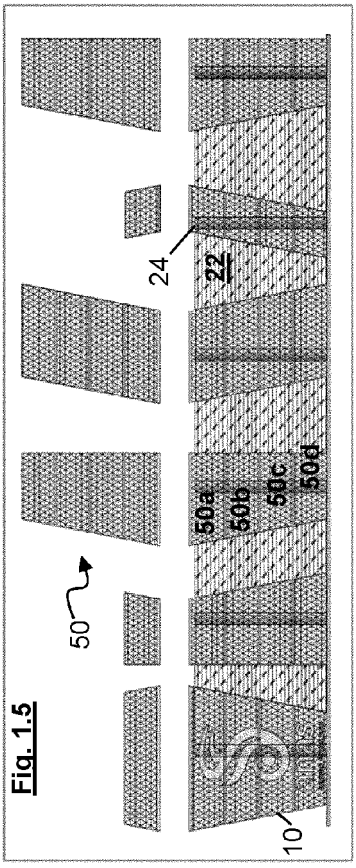
Fig. 1.5
50
24
22
50a
50b
50c
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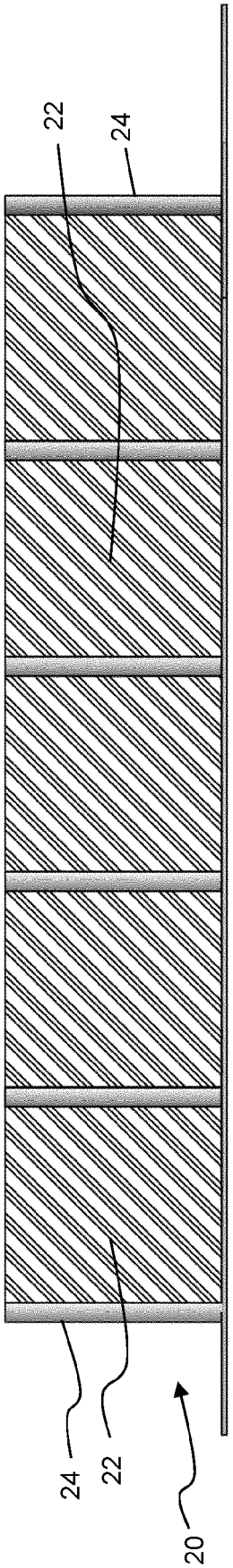

Fig. 2.1

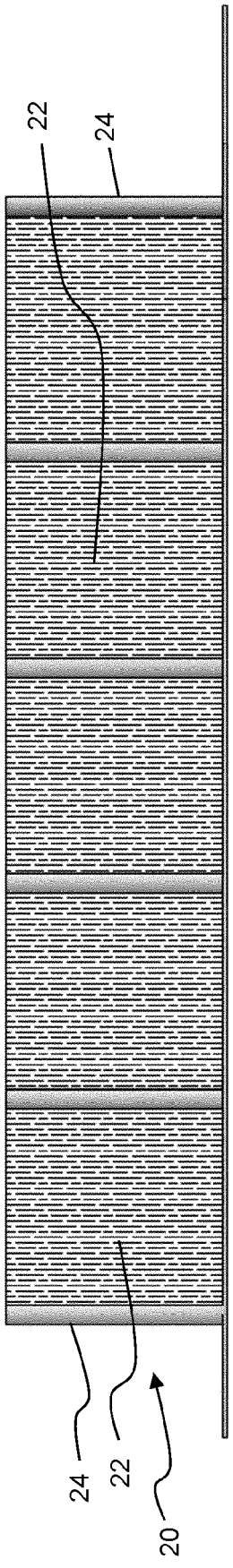

Fig. 2.2

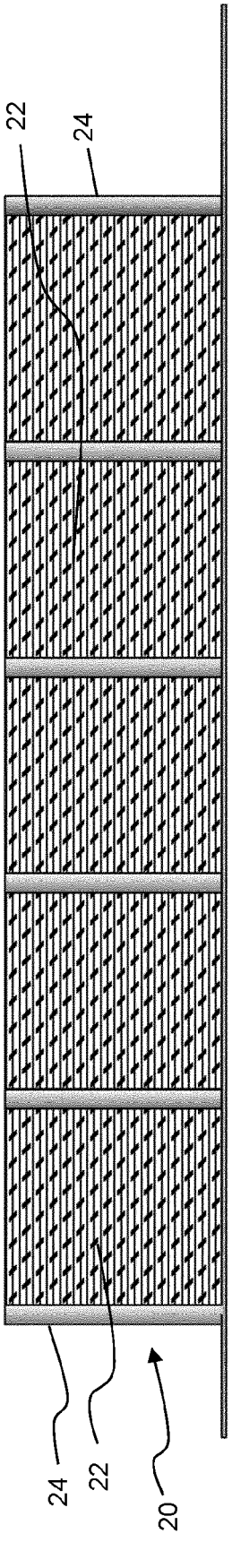

Fig. 2.3

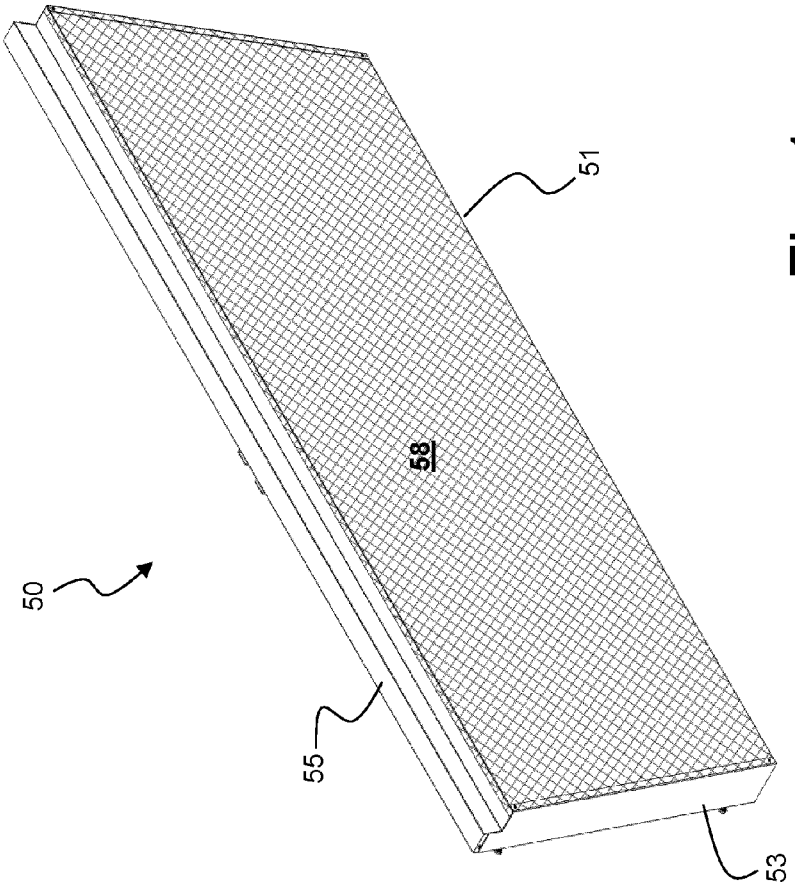

Fig. 4

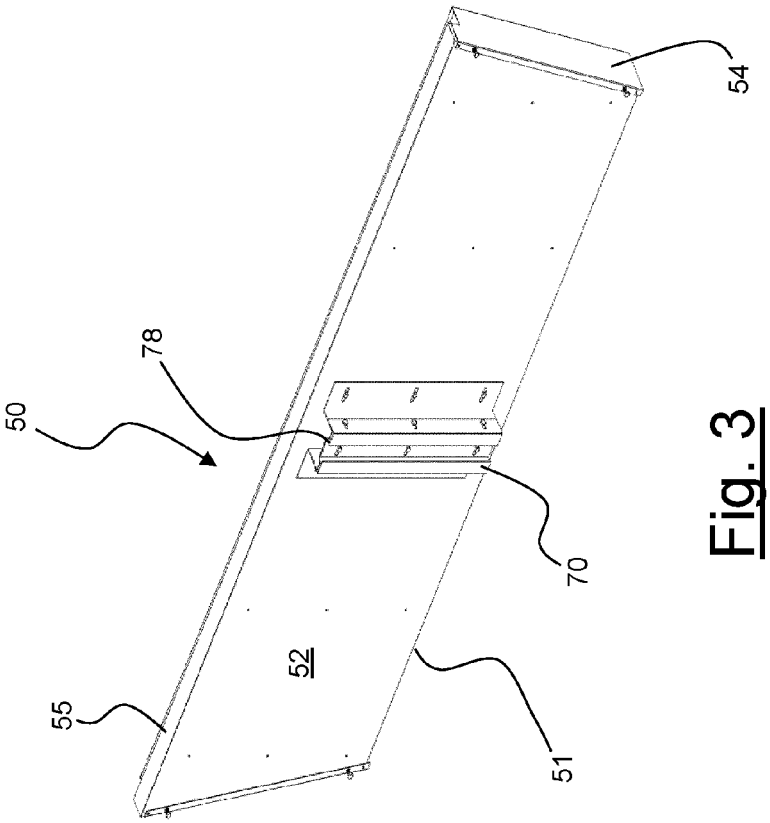

Fig. 3

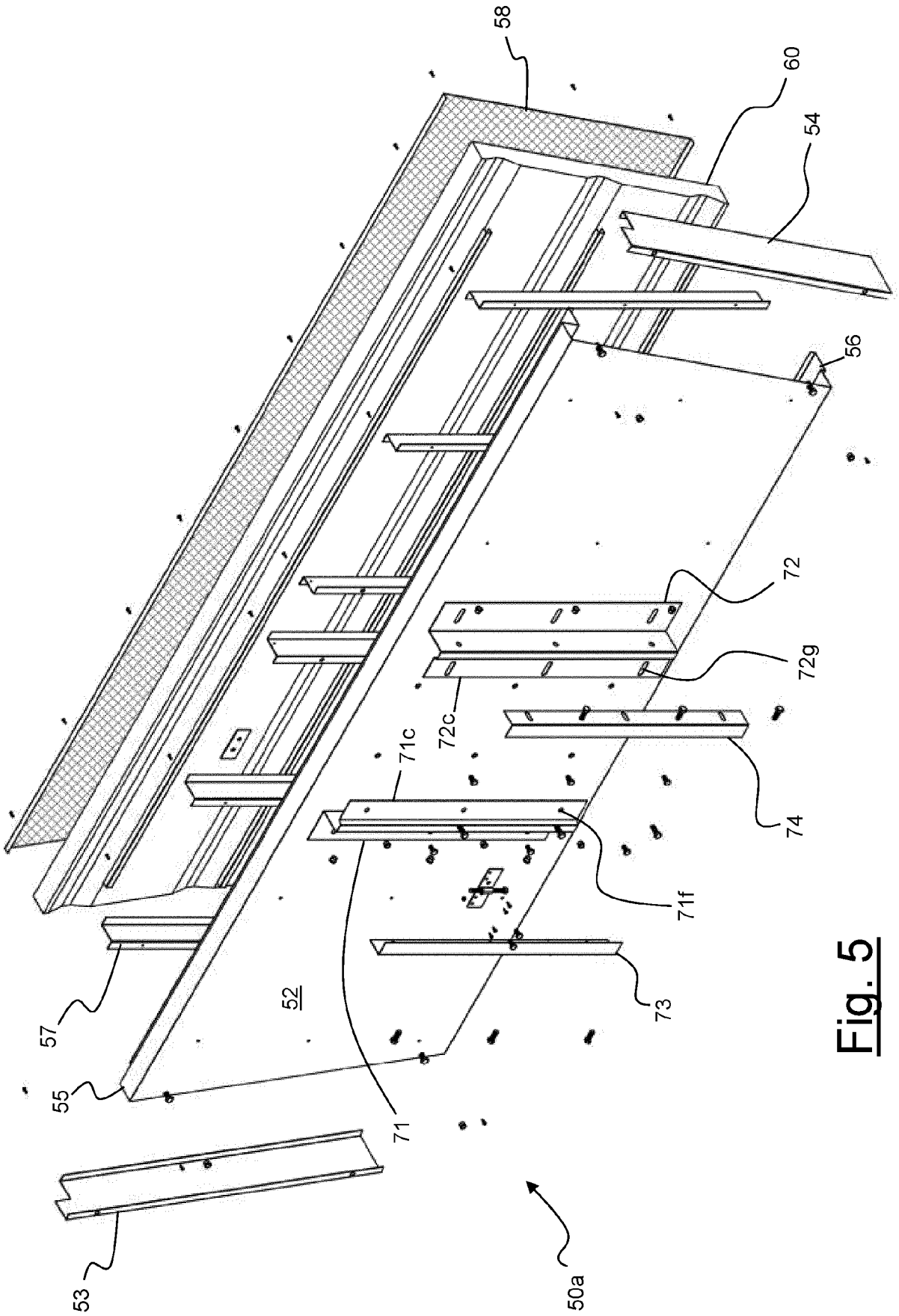

Fig. 5

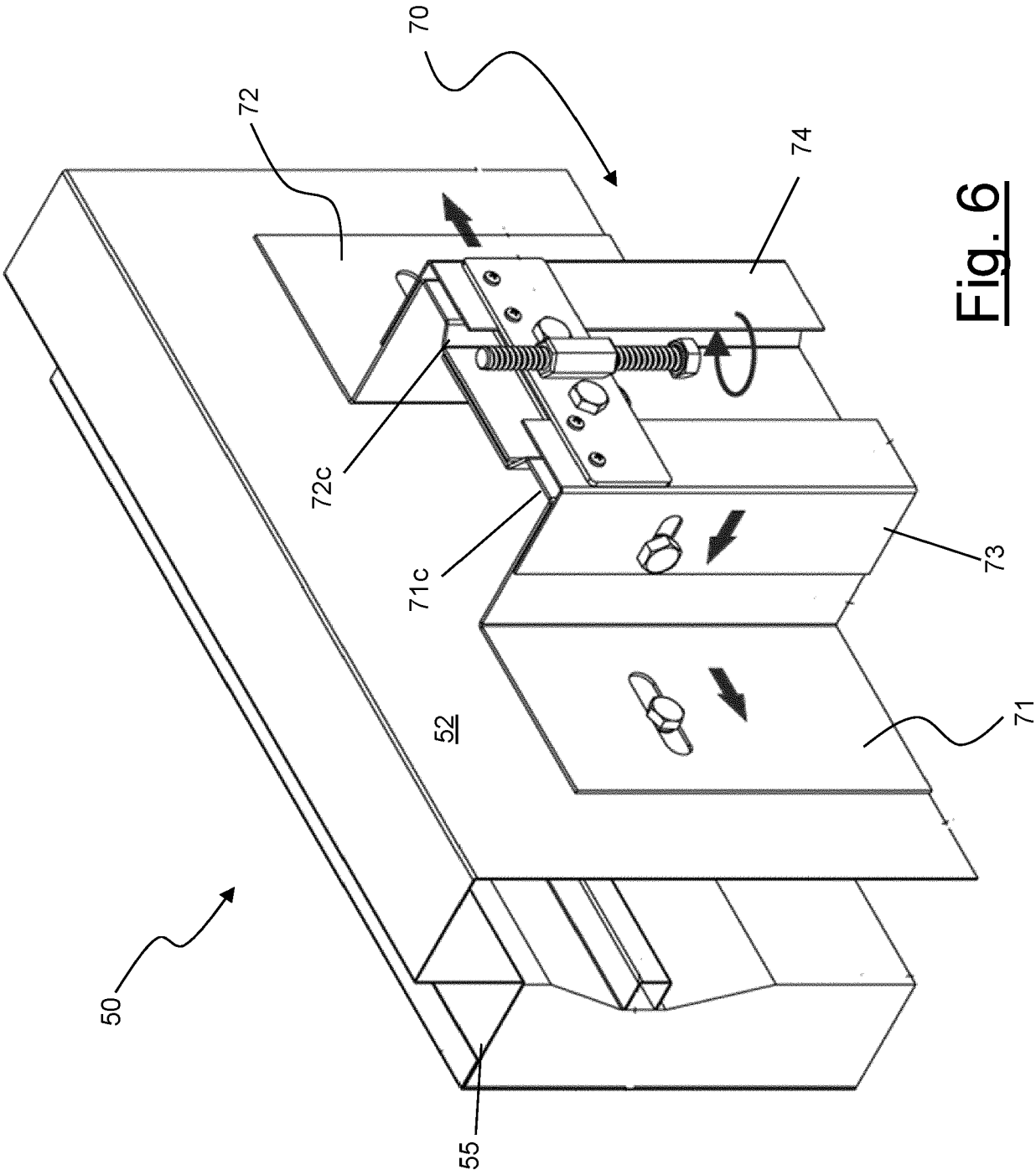

Fig. 6

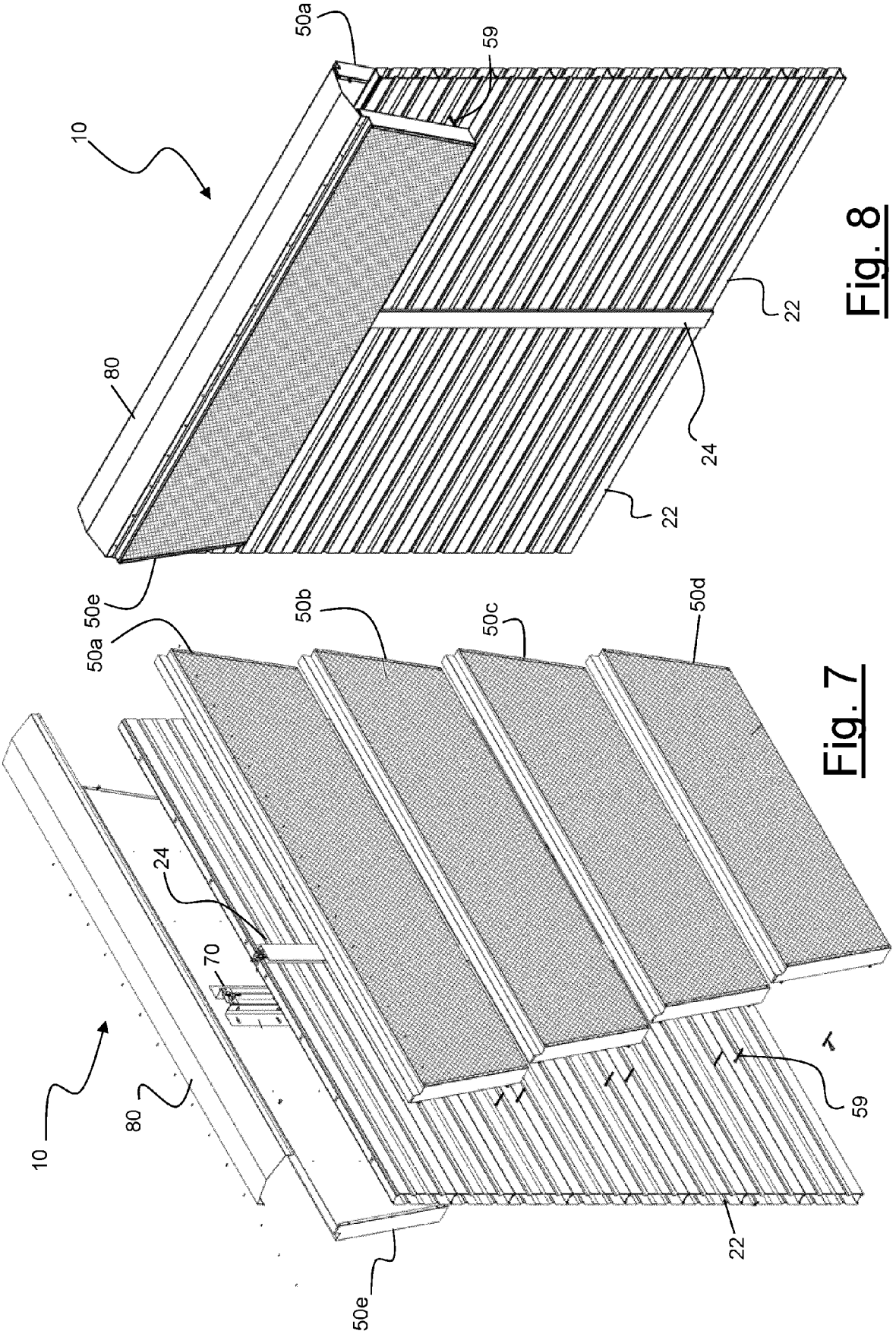

Fig. 8

Fig. 7

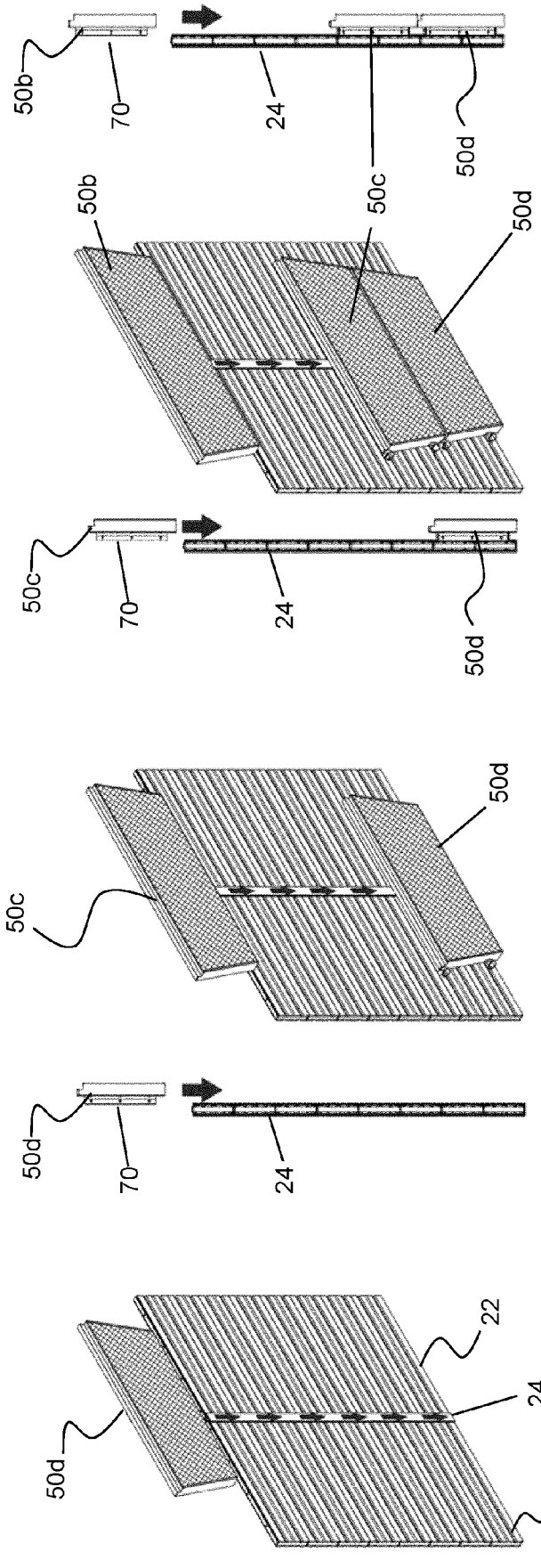

Fig. 9.3

Fig. 9.2

Fig. 9.1

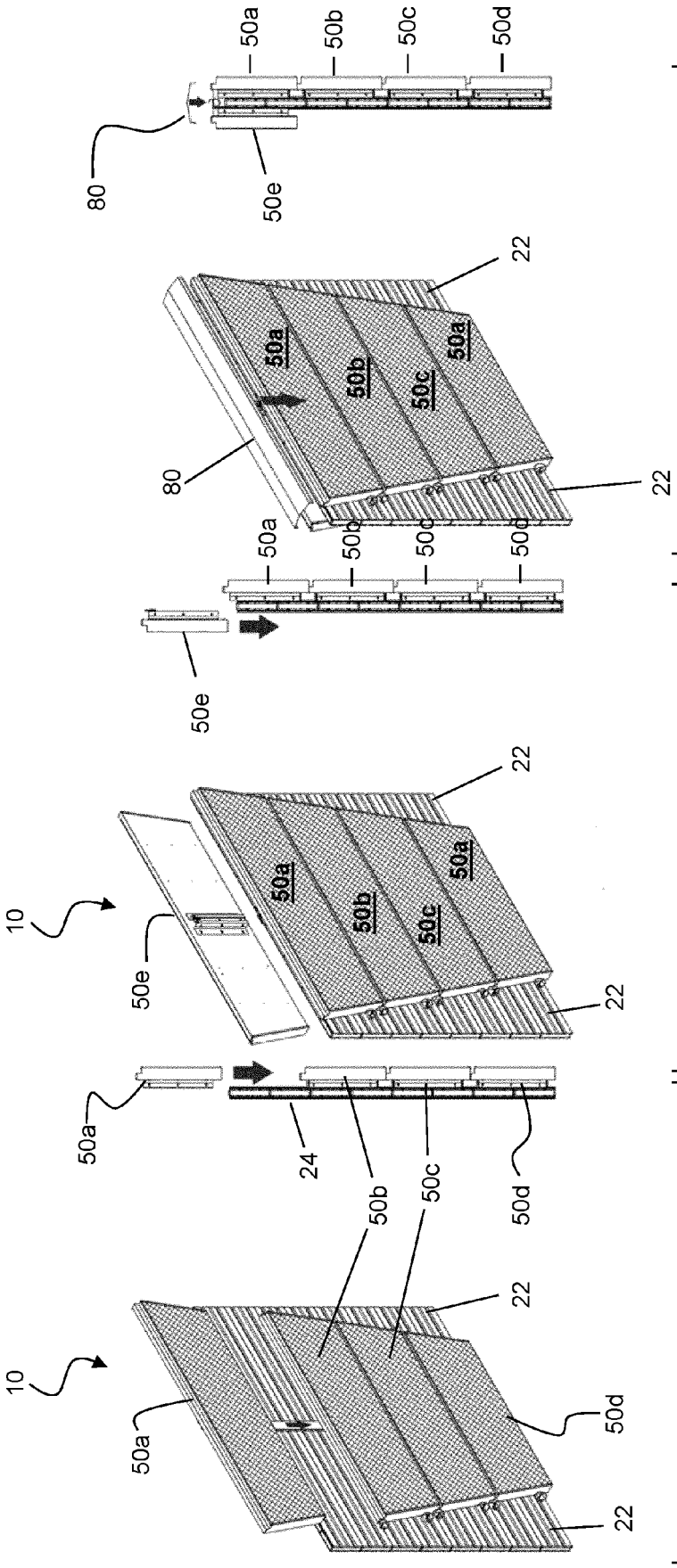

Fig. 9.4

Fig. 9.5

Fig. 9.6

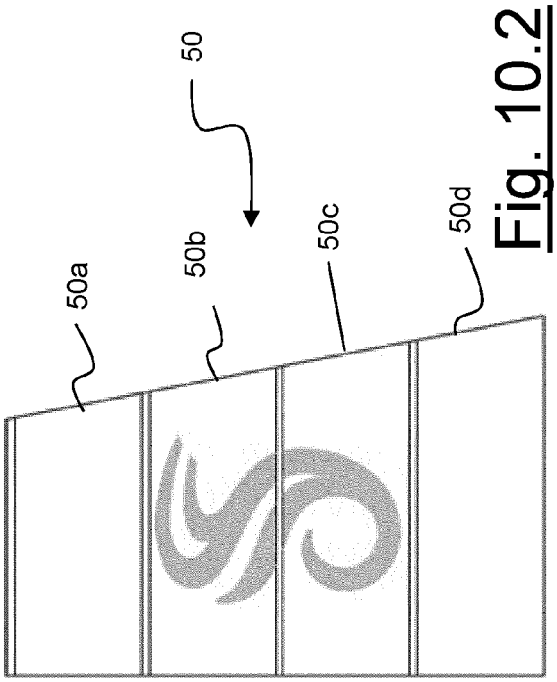

Fig. 10.2

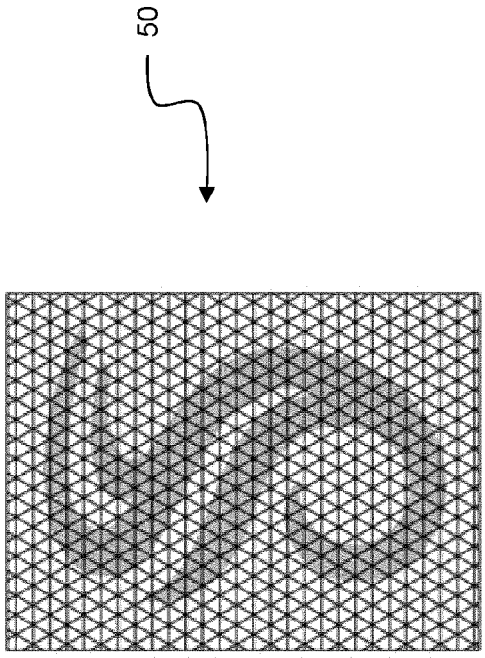

Fig. 10.4

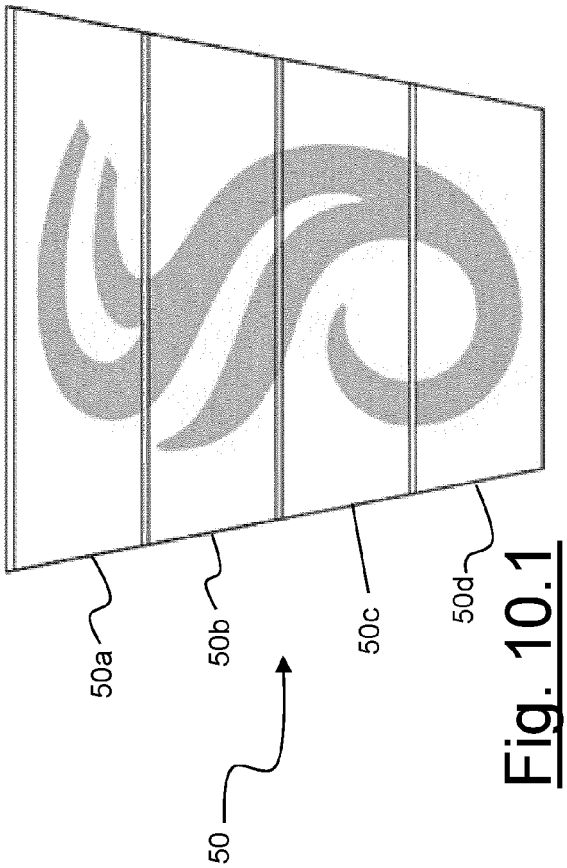

Fig. 10.1

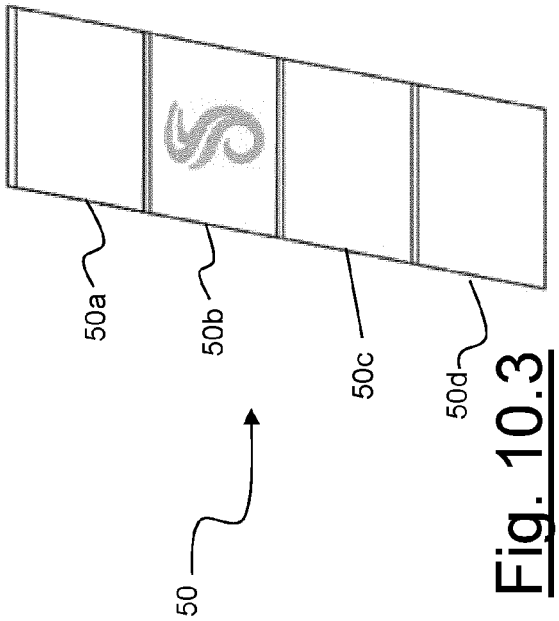

Fig. 10.3

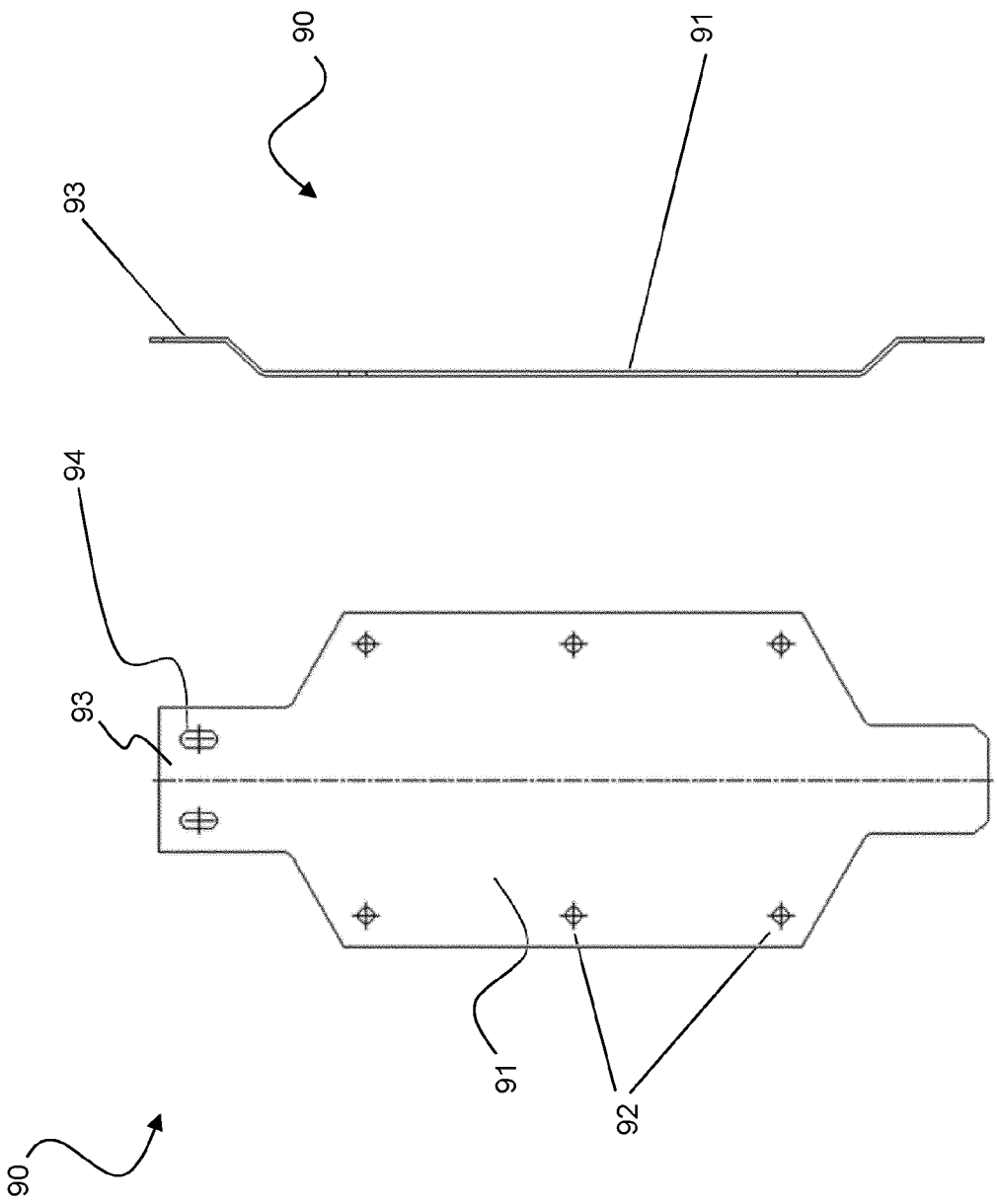

Fig. 11.2

Fig. 11.1

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EUROPEAN SEARCH REPORT

Application Number
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X	KR 2013 0036684 A (PARK HYUN SUK [KR]; JEONG JONG SANG [KR]) 12 April 2013 (2013-04-12) * the whole document *	1-15	INV. E01F8/00
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A	WO 2010/092606 A1 (URBANTECH S R L [IT]; TIZZONI GIAMPAOLO [IT]) 19 August 2010 (2010-08-19) * page 7, line 33 - page 10, line 19; figures 1-4 *	1-15	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 August 2022	Flores Hokkanen, P

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