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(54) **A NOISE BARRIER**

(57) The present inventive concept relates to a noise barrier, comprising a front wall, a rear wall, and two opposite and spaced apart side walls which extend from the front wall to the rear wall. A compartment is enclosed by at least the front wall, the rear wall and the side walls. A channel is located spaced apart from the enclosed compartment, wherein the channel has an inlet for enabling a part of an approaching sound wave to enter and propagate through the channel, and an outlet through which said part of the sound wave is enabled to leave the channel so as to interfere with the original part of the sound wave that propagates above the noise barrier. The inlet is located in the front wall and faces a noise source area. The outlet is located at a vertically higher level than the inlet and rearward of the front wall.

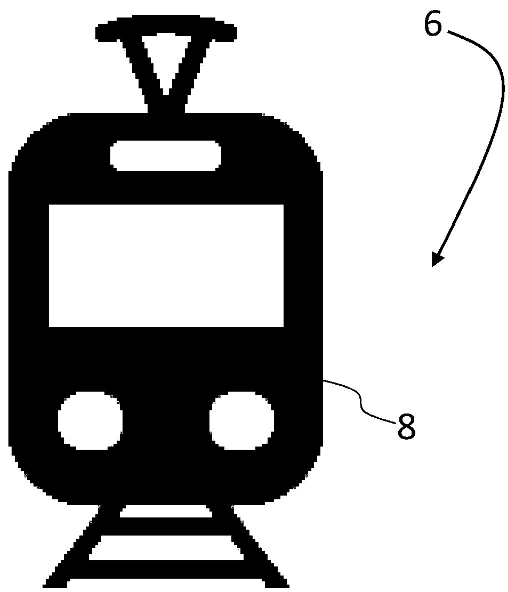

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a noise barrier. The present disclosure also relates to a sound-arresting arrangement comprising a plurality of such noise barriers.

BACKGROUND ART

[0002] Sound-arresting walls are used to reduce environmental noise. Noise originating from rail and road traffic, the frequencies of which are mainly between 400-4000 Hz (which originates from the contact from the rolling wheel on the underlying surface or rail), present a growing environmental issue. The effect of noise reduction is, for a sound-arresting wall, mainly dependent on the height of the wall. For various reasons, e.g. aesthetical or practical, the height of the wall may be limited.

[0003] WO 2020/115004 relates to an interference noise-control unit which is intended to be mounted to the back of an already existing sound-arresting wall. When mounted to the sound-arresting wall, the interference noise-control unit will provide an additional noise-reducing effect. Channels in the interference noise-control unit guides sound waves so that they interfere with the sound waves passing over the wall, thereby achieving an additional noise-reduction.

[0004] Although WO 2020/115004 provides a very effective solution to the challenge of improved noise-reduction, the overall structure becomes bulkier. Furthermore, different traffic environments and different vehicles may generate different types of noises. For instance, noise from cars at lower speeds and heavy-duty vehicles such as trucks where the engine noise is more dominant will be different from that of trains at speeds lower than 250 km/h. Other examples are high-speed trains (> 250 km/h), from which noise is not only generated at the ground level at the wheel/rail or wheel/road interface, respectively, but also aerodynamic noise coming from vertically higher located parts of a high-speed train, such as a pantograph. Such additional noises typically lie in a low frequency area around 80-125 Hz. Although the prior art interference noise-control unit could advantageously be used also for damping such low frequencies, it would be provided as an even larger and bulkier structure to make room for longer channels that would be appropriate for successfully reducing such low frequency noise.

[0005] In view of the above, it would be desirable to provide a noise-reduction solution which can be adapted to different traffic environments and frequency areas, without affecting its overall size and aesthetic appearance.

SUMMARY OF THE INVENTION

[0006] An object of the invention is to at least part alleviate the above-mentioned drawbacks of the prior art. This and other objects, which will become apparent in the following disclosure, are accomplished by a noise barrier as presented in the accompanying independent claim. Some non-limiting exemplary embodiments are presented in the dependent claims.

[0007] The present invention is based on the realization that by integrating a sound wave guiding channel into a double-walled construction, the length of the channel may be appropriately adapted to the frequency area of the noise generated at the location where the double walled construction is to be placed. Thus, rather than mounting differently sized attachments onto walls, the inventor has realized that the channels may instead be provided inside such walls, thereby allowing the overall outer dimension of the construction to be independent of the frequency area to be dampened, while enabling the damping of different frequency areas as desired by selecting appropriate channel length. The invention will now be discussed in more detail below, including various non-limiting exemplary embodiments.

[0008] According to a first aspect of the invention there is provided a noise barrier, comprising:

- a front wall which defines a first exterior surface of the noise barrier, the first exterior surface being configured to face a noise source area,
- a rear wall which defines a second exterior surface of the noise barrier, the second exterior surface being configured to face away from the noise source area,
- two opposite and spaced apart side walls which extend from the front wall to the rear wall,
- a compartment enclosed by at least the front wall, the rear wall and the two side walls,
- a channel located spaced apart from the enclosed compartment,

wherein the channel has an inlet for enabling a part of an approaching sound wave to enter and propagate through the channel, and an outlet through which said part of the sound wave is enabled to leave the channel so as to interfere with the original part of the sound wave that propagates above the noise barrier,

wherein the inlet is located in the front wall and faces the noise source area,
wherein the outlet is located at a vertically higher level than the inlet and rearward of the front wall.

[0009] This is highly advantageous as such noise barrier may be manufactured for different noise environments, and still be manufactured with the same overall outer dimension. The adaptation to different noise environments is instead achieved internally of the noise barrier.

[0010] As can be understood from above, the noise barrier can be regarded as a double-walled noise screen, which is substantially shaped as a box. The disposition and dimensioning of the channels and the spaced apart compartment can be adapted during manufacturing of the noise barrier depending on what noise frequencies it will be intended for. For instance, if there is a desire to make long channels for handling low frequency noise, the size of the compartment may be made smaller. Conversely, if there is a desire to make shorter channels for handling noise of higher frequencies, the size of the compartment may be made larger. The double-walled construction itself also provides increased sound insulation properties reducing transmitted noise. If desired, the compartment, which is separate from the channel, may be provided with acoustic absorption material for resistive damping, for reducing reflexes and multiple reflexes for additional sound damping.

[0011] From the above it can be understood that noise barrier of the present disclosure may have multiple acoustical functions.

[0012] In this disclosure various directional terms are used. As should be understood from above, the front wall is intended to be closer to the noise source than the rear wall. Conversely, the rear wall should compared to the front wall be closer to the area for which it is intended to reduce the sound. In other words, the noise barrier is intended to be installed such that the noise from the noise source reaches the front wall first. As such the front wall is located forwardly of the rear wall. Furthermore, the front wall has a forward facing exterior surface, while the rear wall has a rearward facing exterior surface. The term up, upwards, down, downwards, higher, lower, above and below, etc. have their ordinary meaning. The top of the sound barrier is located higher up than the bottom of the sound barrier. The bottom of the sound barrier will normally be fixed to ground or some other base structure, while the top of the sound barrier will normally be located higher up and freely in the air.

[0013] According to at least one exemplary embodiment, the channel is located vertically above the compartment. By letting the channel be vertically separated from the compartment, a simple manufacturing is achieved. This also allows full utilization of the available distance between the front wall and the rear wall for housing the channel. This may, for instance, be advantageous if it is desired to divide the channel into a plurality of parallel sub-channels. Using the full width between the front wall and the rear wall may provide room for several parallel sub-channels. However, in other exemplary embodiments, the compartment may extend higher up. For instance, if the channel is made relatively narrow, then a portion of the compartment may extend rearward of the channel and another portion of the compartment may extend below the channel.

[0014] According to at least one exemplary embodiment, the channel is separated from the compartment by a dividing wall extending from the front wall to the rear wall, wherein the dividing wall defines an upper end of the compartment. Analogously, according to at least one exemplary embodiment, the dividing wall defines a lower end of the channel. By appropriately selecting the placement of the dividing wall the available space, and thus the potential length of the channels may be appropriately selected. The dividing wall may suitably extend substantially horizontally, however, other directions of extensions are also conceivable. For instance, the dividing wall may be inclined or be curved, e.g. presenting a U-shaped cross-section, etc.

[0015] According to at least one exemplary embodiment, the channel may be partly defined by the rear wall. Similarly, according to at least one exemplary embodiment the channel may be partly defined by the front wall. Thus, by using the rear wall and/or the front wall for creating the path of the channel fewer additional components may be required, and the available space between the front wall and rear wall may be efficiently used. It should however be understood that other structures may be provided to define the extension of the channel, and the general inventive concept is by no means limited to using the front wall and/or the rear wall for creating the path presented by the channel.

[0016] According to at least one exemplary embodiment, the outlet may be located at the top of the noise barrier and may be facing vertically upwardly. By directing the diverted part of the sound wave upwardly, it will efficiently interfere with the original part of the sound wave that propagates above the noise barrier.

[0017] According to at least one exemplary embodiment, the noise barrier may comprise a cover wall which extends from an upper end of the front wall diagonally upwards and rearwards, wherein the outlet is located between the cover wall and the rear wall. The advantage of having a cover wall is that it may act as a roof protecting the interior of the noise barrier. For instance, the risk of rain and snow falling into the channel may be greatly reduced. However, since it is desirable to direct the exiting sound wave at least partly upwards, the cover wall is suitably inclined to achieve that. It should be noted that using a cover wall is not at all necessary, but may be implemented in exemplary embodiments. Instead of using a cover wall, and an upwardly open outlet is also conceivable. In such, case the noise barrier may, if desired, be provided with any suitable type of draining means, such as grooves and or holes or by angling the channel downwards outwards at the inlet, to reduce any negative effect of precipitation. The provision of an angled channel is at least partly reflected in one exemplary embodiment, according to which the channel extends diagonally upwardly from the inlet in order to enable liquid in the channel to, by the effect of gravity, exit the channel via the inlet.

[0018] According to at least one exemplary embodiment, the channel may guide the entered part of the sound wave along a substantially L-shaped path from the inlet to the outlet. Thus, the part of the sound wave that enters the inlet of the noise barrier, may suitably be diverted and propagated in a substantially L-shaped path. An L-shaped allows for a simple and short propagation path, and may advantageously be used for improving the damping effect on noise of relatively high frequencies. However, by appropriately selecting the vertical level of the inlet along the height of the front wall, the total length of extension of the channel may be made longer in case the intention is to improve the damping noise of relatively lower frequencies. It is also possible to select a vertical level of the inlet which is closer to the main noise radiation area.

[0019] According to at least one exemplary embodiment, downstream of the inlet, the channel may guide the entered part of the sound wave along a substantially U-shaped path to the outlet. Diverting the sound wave along a U-shaped path allows for a longer channel length than for an L-shaped path (if the inlet is provided at the same vertical level in both cases). A U-shaped path can be made such that downstream of the inlet the path extends downwardly before turning upwardly towards the outlet. While it is possible to make longer paths also based on an L-shape, e.g. as exemplified above by placing the inlet at a lower vertical level, the U-shape allows the inlet to be placed at a high level and still achieve a long channel length. This may be advantageous for noise sources located at an elevated level, such as aerodynamic noise coming from higher located parts of a high-speed train, such as a pantograph.

[0020] According to at least one exemplary embodiment, the channel may be provided with at least one baffle member dividing said channel into at least two parallel sub-channels extending from the inlet to or towards the outlet. By providing parallel sub-channels, various different dimensions may be designed for the individual sub-channels and a spectrum of frequencies may be targeted.

[0021] According to at least one exemplary embodiment a first one of the sub-channels may have a first channel height and a first channel length, wherein a second one of the sub-channels may have a second channel height and a second channel length, wherein the first channel height is larger than the second channel height, and wherein the first channel length is larger than the second channel length. This provides a broader spectrum of targeted frequencies compared to having uniform sub-channels. The channel length determines the fundamental frequency and its harmonics and the channel height influences when the effect of the noise begins to decline. An increase of the channel height makes the declination of noise reduction start at lower frequencies. Moreover, the channel height increases the amplitude of the interfering sound wave such that a more effective noise reduction may be achieved by increasing the channel height of one sub-channel relative to the other. Since the sub-channels will change direction as they extend from the inlet to the outlet, the "channel height" should be understood as the height measured at the inlet, i.e. the vertical extension of the respective sub-channel at the inlet.

[0022] As already hinted previously, according to at least one exemplary embodiment, at least a part of the volume of the compartment may be filled with acoustic absorption material for resistive damping of sound. Thus, apart from the structural blocking effect of the noise barrier as such, and in addition to the integrated destructive sound interference technology provided by the channel inside the noise barrier, the provision of absorption material may further improve noise reduction. It should also be understood that other sound-reducing features may be provided. For instance, in some exemplary embodiments, the outer surface of the front wall may suitably be a reflecting or absorbing surface for providing a desired noise-reducing function.

[0023] According to at least one exemplary embodiment, the noise barrier is configured to stand on the ground. This is advantageous, as the noise barrier does not need to be mounted or hung to a different structure, but can function as a stand-alone noise barrier. In this connection, it should be understood that "stand alone" does not imply that it should not be combined with other such noise barriers. Rather it should be understood that its intended functionality is achieved without needing any other type of sound-arresting structures. The noise barrier may, however, indeed be provided together with other noise barriers of the same type. For instance, rather than making the noise barrier as one continuous elongated structure along an extended part of a road or railroad, the noise barrier may suitably be made as a modular element which may be placed next to each another such modular element to form a long combined barrier. This is at least partly reflected by a second aspect of the invention.

[0024] Thus, according to a second aspect of the invention, there is provided a sound-arresting arrangement, comprising a plurality of noise barriers according to the first aspect, including any embodiment thereof, wherein the noise barriers are arranged side by side such that side walls of adjacent noise barriers are in contact with each other. The advantages of the sound-arresting arrangement of the second aspect largely correspond to the advantages of the noise barrier of the first aspect, including any embodiment thereof. Furthermore, it since the noise barriers may be provided as modular elements, they may be combined as desired. For instance, the sound-arresting arrangement may be provided in such way that along a first extension of the road or railway the noise barriers have relatively short channels, and along a second extension of the road or railway the noise barriers have relatively long channels, i.e. the sound-arresting arrangement may be assembled to target different noise frequencies at different locations. Even if the inside of the noise barriers of the sound-arresting arrangements may differ, their overall external size may be the same.

[0025] Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the part, portion, element, component, arrangement, device, etc." are to be interpreted openly as referring to at least one instance of the part, portion, element, apparatus, component, arrangement, device, etc., unless explicitly stated otherwise. Further features of, and advantages with, the present inventive concept will become apparent when studying the appended claims and the following description. The skilled person realizes that different features of the present inventive concept may be combined to create embodiments other than those described in the following, without departing from the scope of the present inventive concept.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

Fig. 1 is a schematic illustration of a noise barrier according to at least one exemplary embodiment of the present inventive concept.

Fig. 2 is a schematic illustration of a noise barrier according to at least another exemplary embodiment of the present inventive concept.

Fig. 3 is a schematic illustration of a noise barrier according to at least another exemplary embodiment of the present inventive concept.

Fig. 4 is a schematic illustration of a sound-arresting arrangement according to at least one exemplary embodiment of the present inventive concept, wherein the sound-arresting arrangement comprises a plurality of noise barriers such as the ones illustrated in Fig. 2 and/or Fig. 3.

Fig. 5 is a schematic illustration of a sound-arresting arrangement according to at least another exemplary embodiment of the present inventive concept.

Fig. 6 is a schematic illustration of a noise barrier according to yet another exemplary embodiment of the present inventive concept.

Fig. 7 is a schematic illustration of a sound-arresting arrangement according to yet another exemplary embodiment of the present inventive concept, wherein the sound-arresting arrangement comprises a plurality of noise barriers such as the one illustrated in Fig. 6.

DETAILED DESCRIPTION

[0027] The present inventive concept will now be described more fully hereinafter with reference to the accompanying drawings, in which certain aspects of the present inventive concept are shown. The present inventive concept may, however, be embodied in many different forms and should not be construed as limited to the embodiments and aspects set forth herein; rather, the embodiments are provided by way of example so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Accordingly, it is to be understood that the present inventive concept is not limited to the embodiments described herein and illustrated in the drawings; rather, the skilled person will recognize that many changes and modifications may be made within the scope of the appended claims. Like reference numerals refer to like elements throughout the description.

[0028] Fig. 1 is a schematic illustration of a noise barrier 1 according to at least one exemplary embodiment of the present inventive concept. The noise barrier 1 comprises a front wall 2 which defines a first exterior surface 4 of the noise barrier 1. The first exterior surface 4 is configured to face a noise source area 6. In Fig. 1 a train 8 is illustrated as an example of a noise source, however, it should be understood that the noise barrier 1 may be used to reduce noise from other sources as well, such as e.g. cars, trucks, boats, and other machines.

[0029] The noise barrier 1 also comprises a rear wall 10 which defines a second exterior surface 12 of the noise barrier 1. The second exterior surface 12 is configured to face away from the noise source area 6. The area on the other side of the noise barrier 1 may be referred to as a receiver area 14. Thus, a person located in the receiver area 14 will perceive less noise than what would be the case without the noise barrier 1 being present.

[0030] The noise barrier 1 also comprises two opposite and spaced apart side walls. They have, however, been removed from this schematic cross-sectional illustration for clarity purposes. Nevertheless, the each side wall extends from the front wall 2 to the rear wall 10. A side wall 16 is illustrated in each one of Figs. 4, 5 and 7 in which a plurality of noise barriers have been arranged next to each other. These drawings will be discussed in more detail later on. The width of a side wall 16, or the distance between the first exterior surface 4 and the second exterior surface 12 shown in Fig 1 may, for instance, be in the range of approximately 150 mm - 500 mm.

[0031] Turning back to Fig. 1, the noise barrier 1 comprises a compartment 18 which is enclosed by at least the front wall 2, the rear wall 10 and the two side walls 16 (side walls 16 not shown in Fig. 1). In this example, the compartment 18 is also enclosed by a dividing wall 20 which extends from the front wall 2 to the rear wall 10. More specifically, the dividing wall 20 extends between two interior surfaces 22, 24 of the noise barrier 1, the interior surfaces 22, 24 being defined by the front wall 2 and rear wall 10, respectively. Thus, in this illustration, the dividing wall 20 defines an upper end of the compartment 18. It should, however, be noted that, although the compartment 18 is here illustrated as having a substantially rectangular cross-section, other shapes are also conceivable, such as for instance, an L-shaped compartment wherein the compartment has a longer extension near the rear wall 10 compared to the front wall 2.

[0032] The noise barrier 1 further comprises a channel 26. The channel 26 is located spaced apart from the enclosed compartment 18. In the illustrated example, the channel 26 is spaced apart from the compartment 18 by means of the dividing wall 20. In this example, the channel 26 is located vertically above the entire compartment 18. However, in other exemplary embodiments, it may be conceivable that the channel 26 is located vertically above only a portion of the compartment 18. As can be seen in Fig. 1, in this example the dividing wall 20 defines a lower end of the channel 26.

[0033] The channel 26 has an inlet 28 for enabling a part of an approaching sound wave (illustrated by the small horizontal arrow) to enter and propagate through the channel 26. The channel 26 has an outlet 30 through which said part of the sound wave is enabled to leave the channel 26 (illustrated by the vertical arrow). Said part of the sound wave that has propagated through the channel 26 and leaves the channel 26 through the outlet 30 will interfere with the original part of the sound wave (illustrated by the large horizontal arrow) that propagates above the noise barrier 1. Thus, a destructive sound interference is achieved and therefore additional noise-reduction is provided for the receiving area 14, in addition to any absorbing/reflecting/insulation noise-reduction function provided by the walls of the noise barrier 1. In other words, the noise barrier 1 of the present invention integrates at least two different physical principles for reducing noise into one common noise-reducing unit, one of said physical principles being sound interference technology.

[0034] The material of the front wall 2, the rear wall 10 and the side walls may suitably be made in wood, concrete, metal, rubber, plastic, or any other appropriate material, as well as the channel 26. The front wall 2 may suitably present a sound-reflecting or sound-absorbing exterior surface 4.

[0035] The inlet 28 is located in the front wall 2 and faces the noise source area 6. In this exemplary embodiment, the inlet 28 is located at a relatively high level, and is therefore particularly suitable for receiving noise that is transmitted from an elevated source, such as for example noise from a pantograph of a train (or any other device/engine/machine part, etc.). Purely as an example, the total height of the noise barrier 1 may, for instance, be in the range of 500 - 5000 mm, or even higher. The inlet 28 may, for instance, be located at a distance of 50 mm from the top of the noise barrier 1. However, it should be understood that, other locations of the inlet 28 are also conceivable. For instance, the inlet 28 may be located at a larger distance from the top. In fact, the inlet may even be located at or near the lower end of the front wall 2.

[0036] The outlet 30 is located at a vertically higher level than the inlet 28 and is located rearward of the front wall 2. Thus, said part of the sound wave enters the channel 26 from the front (exterior) side of the front wall 2 by means of the inlet 28, and exits the channel 26 behind the rear (interior) side of the front wall 2 by means of the outlet 30.

[0037] In this exemplary embodiment, the outlet 30 is located at the top of the noise barrier 1 and is facing upwardly. Furthermore, in this exemplary embodiment, the outlet 30 may be defined by the upper ends of the front wall 2 and rear wall 10 (and the upper ends of the two side walls). However, in other exemplary embodiments, the outlet 30 may be spaced apart from the front wall 2, for example partly defined by another structure that extends from the front wall 2.

[0038] Due to the placement of the inlet 28 and the channel 26, the noise barrier 1 illustrated in Fig. 1 has a channel 26 with a relatively short path for guiding the entered part of the sound wave. In other exemplary embodiments, however, the path may be considerably longer. Purely as an illustrative numerical, but non-limiting, example, the path may extend along a distance in the range of 200 - 3500 mm.

[0039] As can be seen in Fig. 1, the channel 26 is partly defined by the rear wall 10 and partly defined by the front wall 2. The bottom part of the channel 26 is defined by the dividing plate 20. It should, however, be understood that other channel-defining structures may be provided. For instance, as mentioned previously, the compartment 18 may have a different extension along the rear wall 10. In such case, a vertical compartment wall could define a rear part of the channel 26.

[0040] In Fig. 1, the channel 26 guides the entered part of the sound wave along a substantially L-shaped path from the inlet 28 to the outlet 30. As will be discussed in connection with Fig. 3, other shapes are however conceivable. The relatively short path shown in Fig. 1 is suitable for destructive interference of medium to high frequency noise. For lower noise frequencies, such as for noise from heavy-duty vehicles, cars at low speeds, high-speed trains, etc., a longer channel is suitably provided in the noise barrier 1.

[0041] Fig. 2 is a schematic illustration of a noise barrier 1a according to at least another exemplary embodiment of the present inventive concept. The noise barrier 1a illustrated in Fig. 2 is quite similar to the noise barrier 1 in Fig. 1, however, some additional features are included in the noise barrier 1a in Fig. 2. More specifically, the channel 26 may be provided with at least one baffle member to divide the channel 26 into at least two parallel sub-channels extending from the inlet 28 to or towards the outlet 30. In the example in Fig. 2, the channel 26 is provided with two baffle members 32 dividing the channel 26 into three parallel sub-channels 26a, 26b, 26c extending from the inlet 28 to the outlet 30. The baffle members 32 are of two different sizes and have an L-shaped cross-section to form three parallel L-shaped paths. As can be seen in Fig. 2, the three sub-channels 26a, 26b, 26c each have different channel heights and different channel lengths. The longest sub-channel 26a is also the widest sub-channel 26a (i.e. having the largest height). The shortest sub-channel 26c is also the narrowest sub-channel 26c (i.e. having the smallest height). The provision of differently dimensioned sub-channels 26a, 26b, 26 results in sound wave parts of different amplitudes and wavelengths, and therefore a more efficient interference can be made and a broader noise frequency spectrum can be targeted.

[0042] A further difference between the noise barrier 1a in Fig. 2 and the noise barrier 1 in Fig. 1 is that at least a part of the volume of the compartment 18 in Fig. 2 has been filled with acoustic absorption material 34 for resistive damping of sound. It should, however, be understood that such acoustic absorption material 34 may also be provided in the compartment 18 of the noise barrier 1 in Fig. 1. Furthermore, in other exemplary embodiments, the acoustic absorption material 34 may be omitted from the noise barrier 1a in Fig. 2. Any standard acoustic absorption material may be used, such as various types of fibres, foams, glass mineral wools, etc.

[0043] Fig. 3 is a schematic illustration of a noise barrier 1b according to at least another exemplary embodiment of the present inventive concept. Similarly, to the noise barrier 1a in Fig. 2, the noise barrier 1b in Fig. 3 is illustrated as having a plurality of sub-channels 26a, 26b, 26c . As can be seen in Fig. 3, shortly after the inlet 28, i.e. downstream of the inlet 28, each sub-channel 26a, 26b, 26c will guide its respective received part of the sound wave along a substantially U-shaped path to the outlet 30. The U-shape enables a longer path to be created even though the inlet 28 is at the same vertical level as in the examples of Fig. 1 and Fig. 2. Such a longer path is suitable for destructive interference with low frequency noise, such as frequencies from 50 Hz and upwards. Low frequency noise at approximately 50 Hz is common traffic noise generated from heavy-duty vehicles (e.g. trucks and buses) and low-speed car traffic.

[0044] It should be noted that the U-shaped path can also be achieved without sub-channels. Thus, in general terms, according to at least some exemplary embodiments, the channel of a noise barrier may guide the entered part of the sound wave along a substantially U-shaped path to the outlet (regardless of it being configured as a single path or a plurality of sub-channel paths).

[0045] As should be clear from this disclosure, each one of the Figs. 1-3 illustrates the that a noise barrier 1, 1a, 1b according to the present disclosure may suitably be configured to stand on the ground 36 by any appropriate founding method.

[0046] Fig. 4 is a schematic illustration of a sound-arresting arrangement 100 according to at least one exemplary embodiment of the present inventive concept, wherein the sound-arresting arrangement 100 comprises a plurality of noise barriers such as the noise barriers 1a, 1b illustrated in Fig. 2 and/or Fig. 3. The noise barriers are arranged side by side such that side walls 16 of adjacent noise barriers are in contact with each other. In this example six noise barriers are illustrated, however, it should be understood that this is just an example. A sound-arresting arrangement of the present disclosure may comprise fewer or more barriers according to local needs. The sound barriers are provided as modules and may be connected to each other by means of any suitable standard connecting method in order to obtain a sound-arresting arrangement of a desired total length. Since the inlets 28 in Fig. 2 and 3 are at the same level, the overall outer appearance will be the same for the individual noise barriers 1a, 1b and for a sound-arresting arrangement 100 such as the one in Fig. 4.

[0047] As understood above, Fig. 4 represents a sound-arresting arrangement 100 which may contains internal sub-channels such as the sub-channels 26a, 26b, 26c illustrated in Fig. 2 or Fig. 3 (or even a combination, such that some of the plurality of noise barriers in Fig. 4 are designed according to Fig. 2 and some are designed according to Fig. 3). However, it should be understood that a sound-arresting arrangement may also be provided with noise barriers according to the single channel design in Fig. 1. Regardless of which combination or selection of internal channels or sub-channels that are selected for a noise barrier, it is clear that it does not need to affect the overall outer dimension of the individual noise barrier, nor the overall outer dimension of the sound-arresting arrangement. Indeed the present inventive concept may be used to target different frequency areas without affecting the overall dimension of the product. For instance, if we assume that the sound-arresting arrangement 100 in Fig. 4 only comprises noise barriers 1a according to Fig. 2, i.e. relatively short sub-channels intended to target relatively high frequency areas, then this can be compared with another sound-arresting arrangement 200 shown in Fig. 5. The overall outer size is the same for the sound-arresting arrangement 200 in Fig. 5 as the sound-arresting arrangement 100 in Fig. 4. However, if the sound-arresting arrangement 200 in Fig. 5 also comprises L-shaped sub-channels, such sub-channels will (due to the lower vertical placement of the inlet 28) have relatively long extensions and therefore suitable to target relatively lower frequencies.

[0048] Fig. 6 is a schematic illustration of a noise barrier 1c according to yet another exemplary embodiment of the present inventive concept. Fig. 7 is a schematic illustration of a sound-arresting arrangement 300 according to yet another exemplary embodiment of the present inventive concept, wherein the sound-arresting arrangement 300 comprises a plurality of noise barriers 1c such as the one illustrated in Fig. 6. With reference to both Fig. 6 and Fig. 7, in these examples, a cover wall 38 extends from an upper end of the front wall 2 diagonally upwards and rearwards. This provides improved protection against for example rain and snow. Instead of using a cover wall 38, a noise barrier may be provided with drainage means. However, if the noise barrier is intended to be installed in a dry climate area, then such drainage means may be omitted. Continuing with Fig. 6, the outlet 30 of the channel 26 is located between the cover wall 38 and the rear wall 10. In this illustration, two L-shaped baffles 32 are provided to create sub-channels 26a, 26b, 26c. The sub-channels 26a, 26b, 26c extend from the inlet 28 towards the outlet 30. It should be noted that a diagonal cover wall 38 as illustrated in Fig. 6 could also be added to the single-channel embodiment of Fig. 1. The inclination of the cover wall 38 may, for instance, be in the range of 20° - 45° relative to the vertical. The length of the cover wall 38 may, for instance, be in the range of 200 - 600 mm. The cover wall 38 pushes the sound waves from the direct sound upwards (illustrated by the long arrow having a horizontal and an inclined portion) and together with the sound interference created by the sub-channels 26a, 26b, 26c, decreases the noise diffraction and increases the noise reduction in the receiver area 14 behind the noise barrier 1c.

Claims

1. A noise barrier, comprising:

- a front wall which defines a first exterior surface of the noise barrier, the first exterior surface being configured to face a noise source area,
- a rear wall which defines a second exterior surface of the noise barrier, the second exterior surface being configured to face away from the noise source area,
- two opposite and spaced apart side walls which extend from the front wall to the rear wall,
- a compartment enclosed by at least the front wall, the rear wall and the two side walls,
- a channel located spaced apart from the enclosed compartment,

wherein the channel has an inlet for enabling a part of an approaching sound wave to enter and propagate through the channel, and an outlet through which said part of the sound wave is enabled to leave the channel so as to interfere with the original part of the sound wave that propagates above the noise barrier,

wherein the inlet is located in the front wall and faces the noise source area,
wherein the outlet is located at a vertically higher level than the inlet and rearward of the front wall.

2. The noise barrier as claimed in claim 1, wherein the channel is located vertically above the compartment.

3. The noise barrier as claimed in any one of claims 1-2, wherein the channel is separated from said compartment by a dividing wall extending from the front wall to the rear wall, wherein the dividing wall defines an upper end of the compartment.

4. The noise barrier as claimed in claim 3, wherein the dividing wall defines a lower end of the channel.

5. The noise barrier as claimed in any one of claims 1-4, wherein the channel is partly defined by the rear wall.

6. The noise barrier as claimed in any one of claims 1-5, wherein the channel is partly defined by the front wall.

7. The noise barrier as claimed in any one of claims 1-6, wherein the outlet is located at the top of the noise barrier and is facing vertically upwardly.

8. The noise barrier as claimed in any one of claims 1-6, comprising a cover wall extending from an upper end of the front wall diagonally upwards and rearwards, wherein the outlet is located between the cover wall and the rear wall.

9. The noise barrier as claimed in any one of claims 1-8, wherein the channel guides the entered part of the sound wave along a substantially L-shaped path from the inlet to the outlet.

10. The noise barrier as claimed in any one of claims 1-8, wherein, downstream of the inlet, the channel guides the entered part of the sound wave along a substantially U-shaped path to the outlet.

11. The noise barrier as claimed in any one of claims 1-10, wherein said channel is provided with at least one baffle member dividing said channel into at least two parallel sub-channels extending from the inlet to or towards the outlet.

12. The noise barrier as claimed in claim 11, wherein a first one of said sub-channels has a first channel height and a first channel length, wherein a second one of said sub-channels has a second channel height and a second channel length, wherein the first channel height is larger than the second channel height, and wherein the first channel length is larger than the second channel length.

13. The noise barrier as claimed in any one of claims 1-12, wherein at least a part of the volume of the compartment is filled with acoustic absorption material for resistive damping of sound.

14. The noise barrier as claimed in any one of claims 1-13, wherein the noise barrier is configured to stand on the ground.

15. A sound-arresting arrangement, comprising a plurality of noise barriers as claimed in any one of claims 1-14, wherein the noise barriers are arranged side by side such that side walls of adjacent noise barriers are in contact with each other.

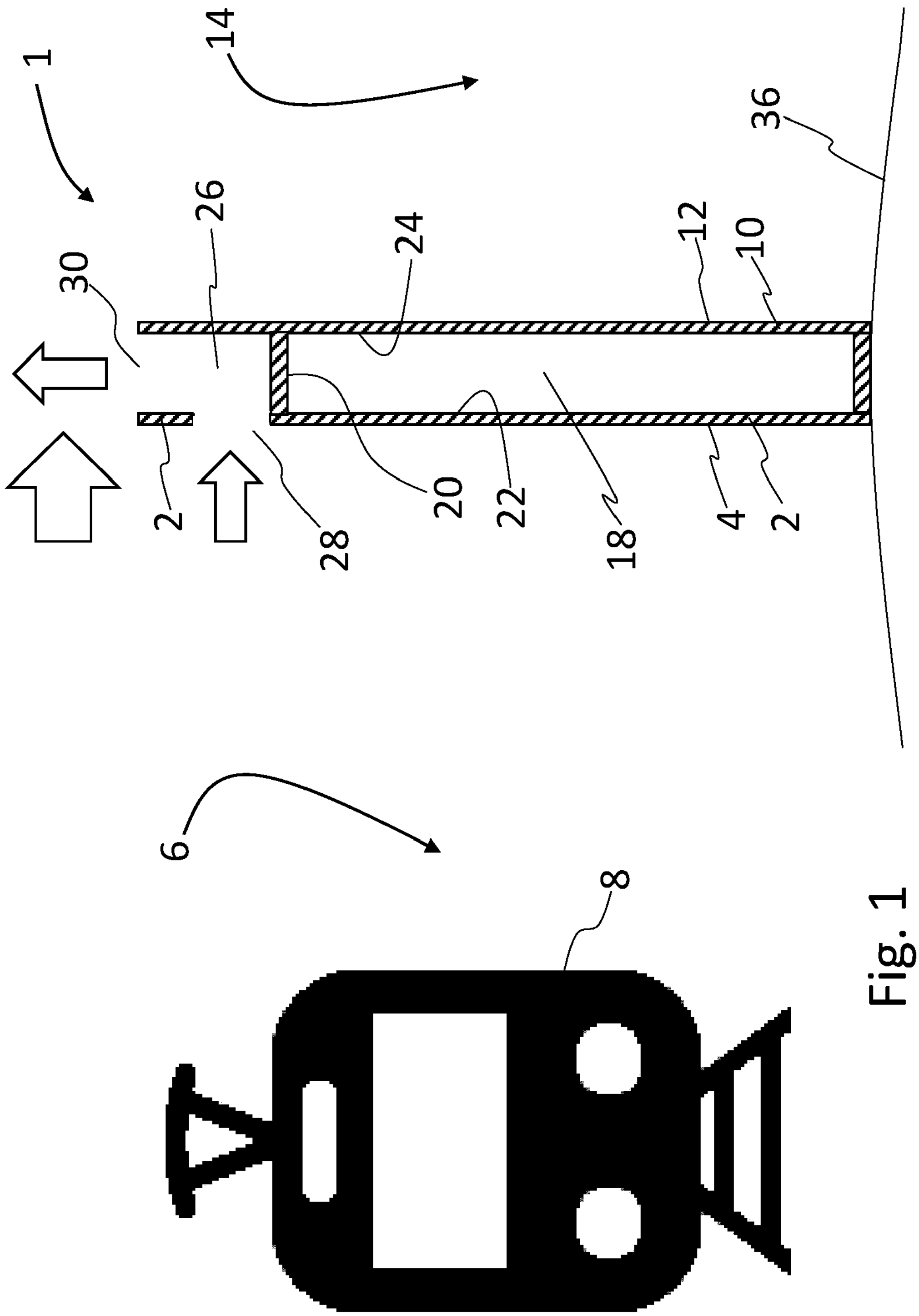

Fig. 1

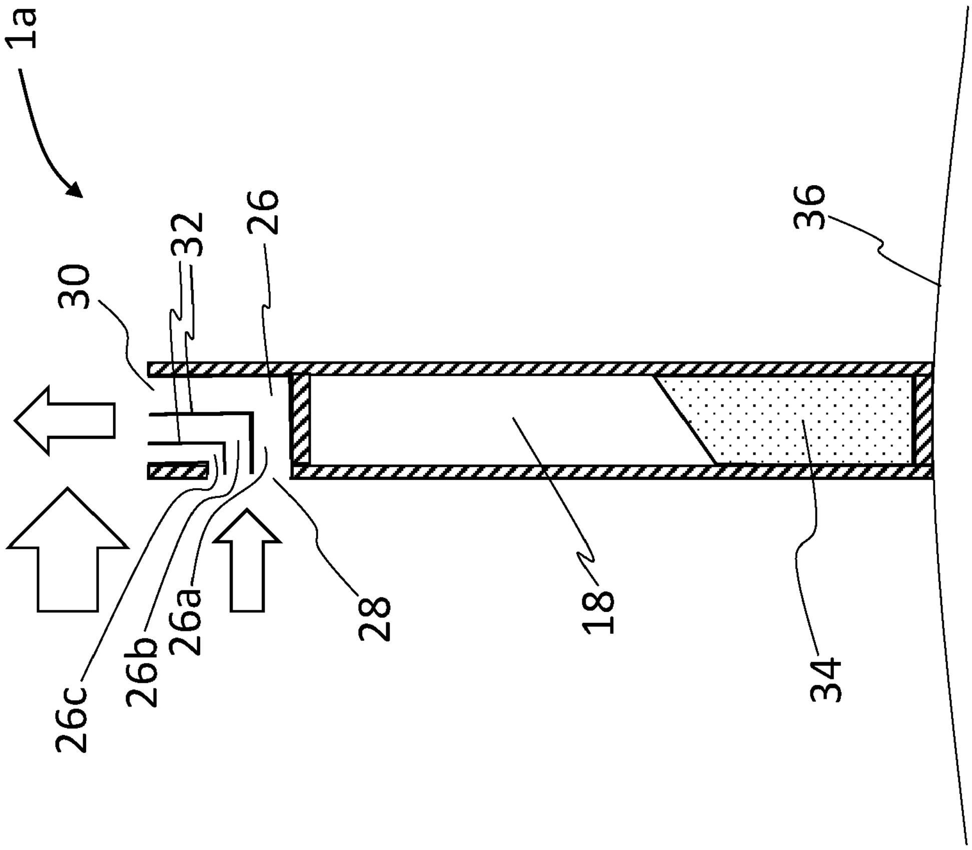

Fig. 2

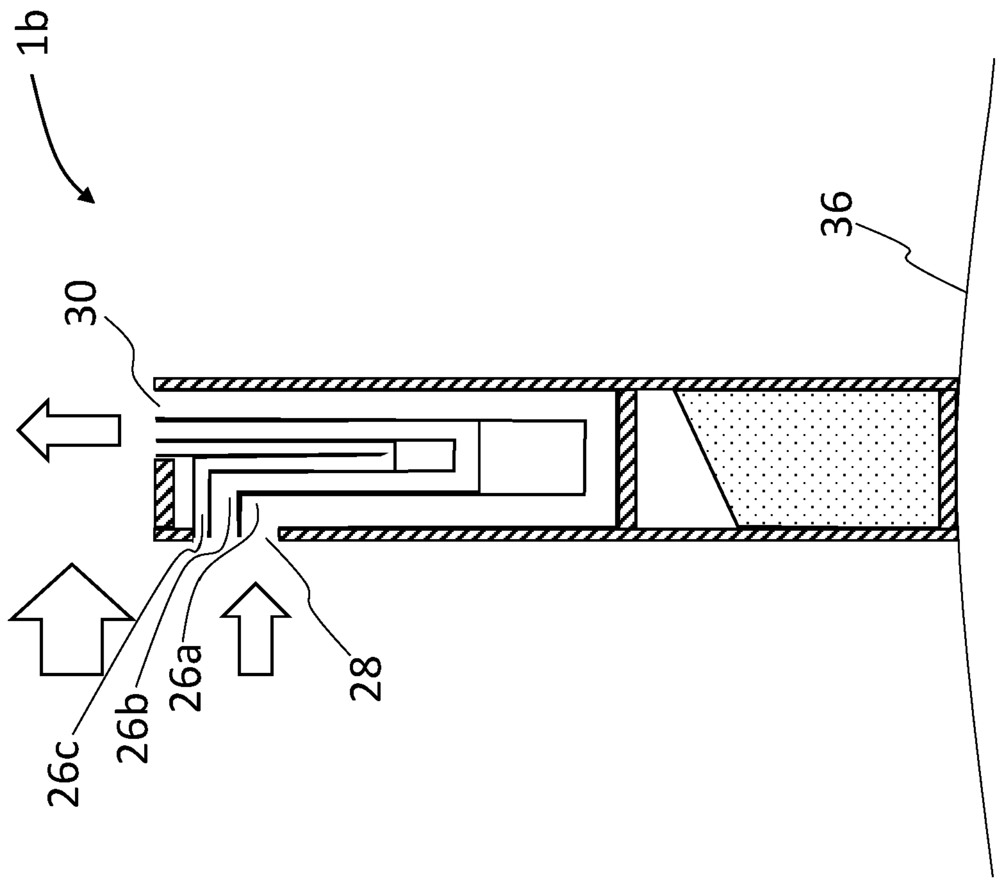

Fig. 3

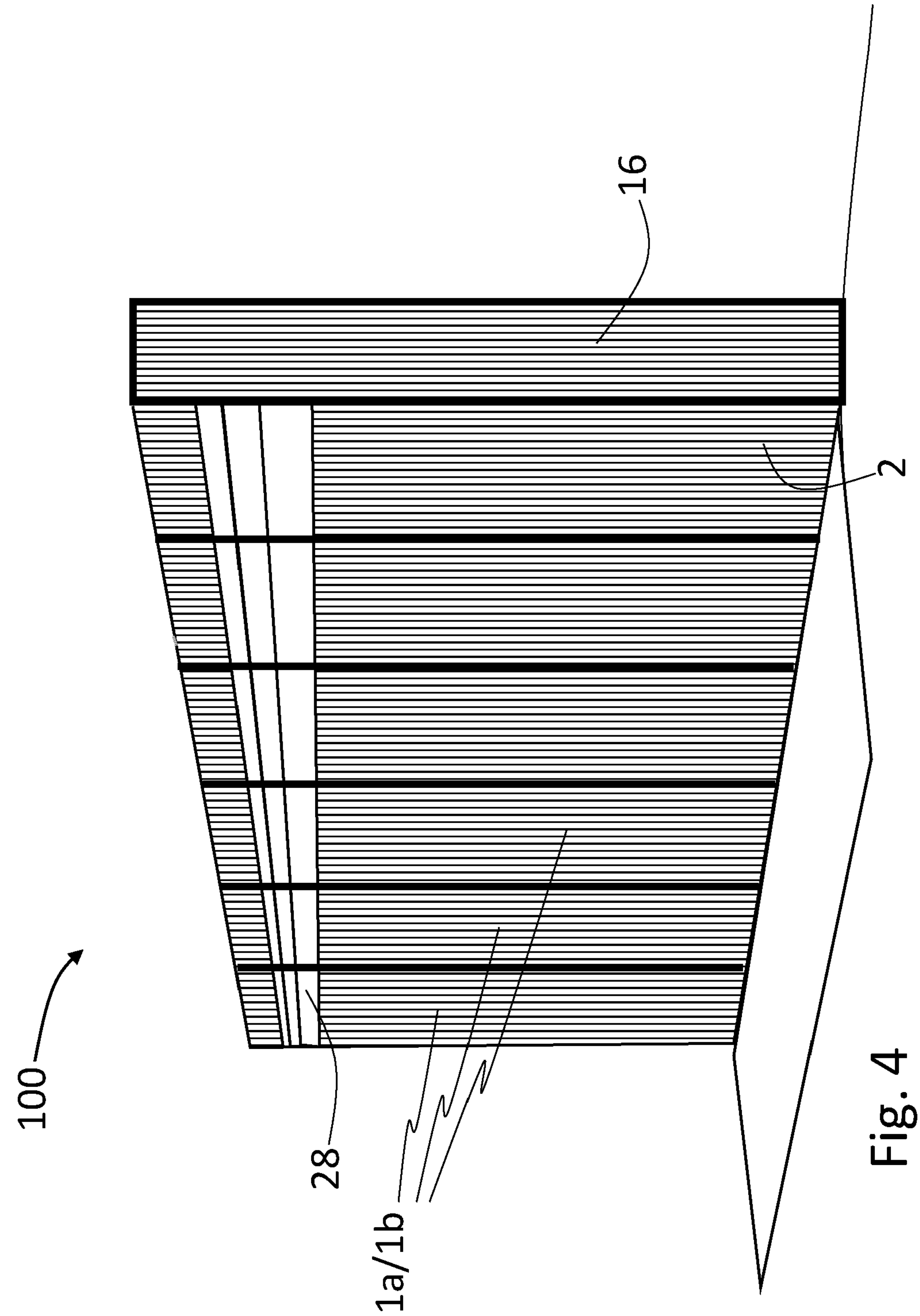

Fig. 4

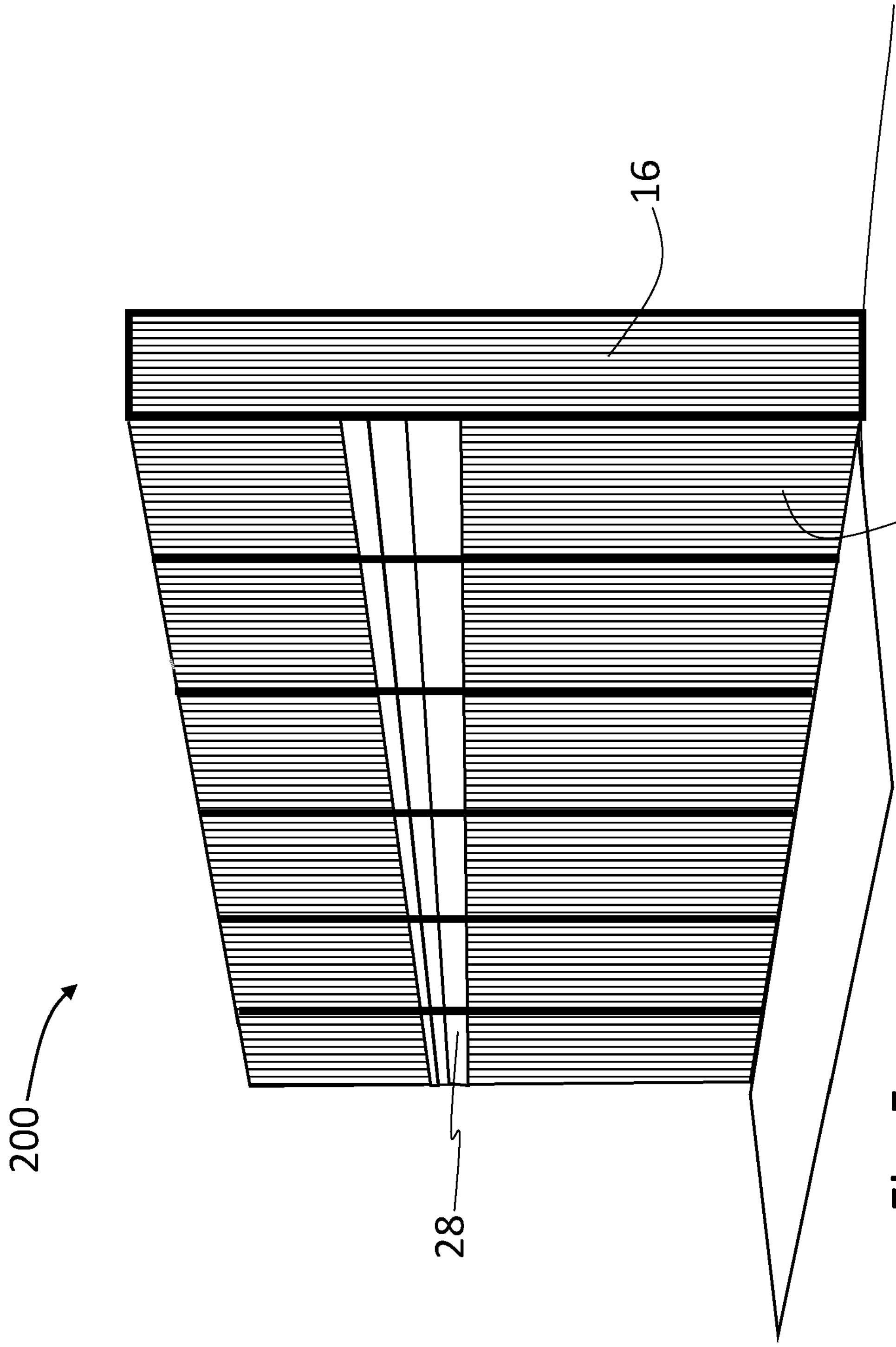

Fig. 5

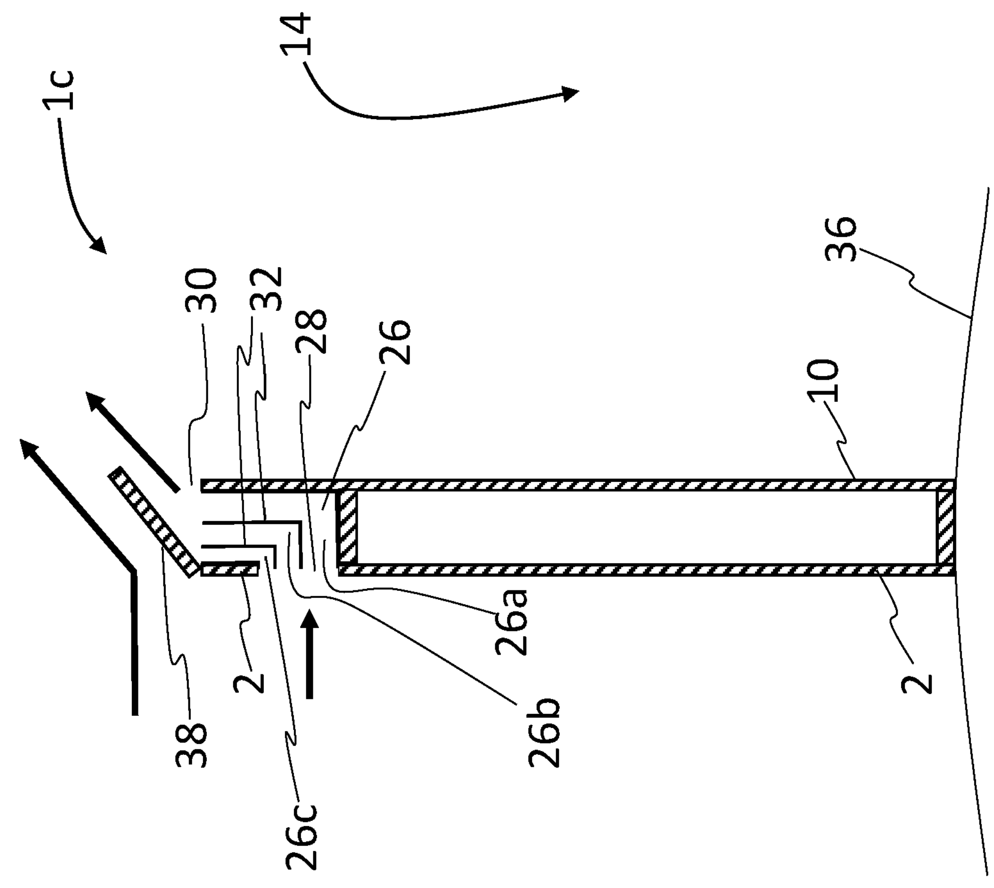

Fig. 6

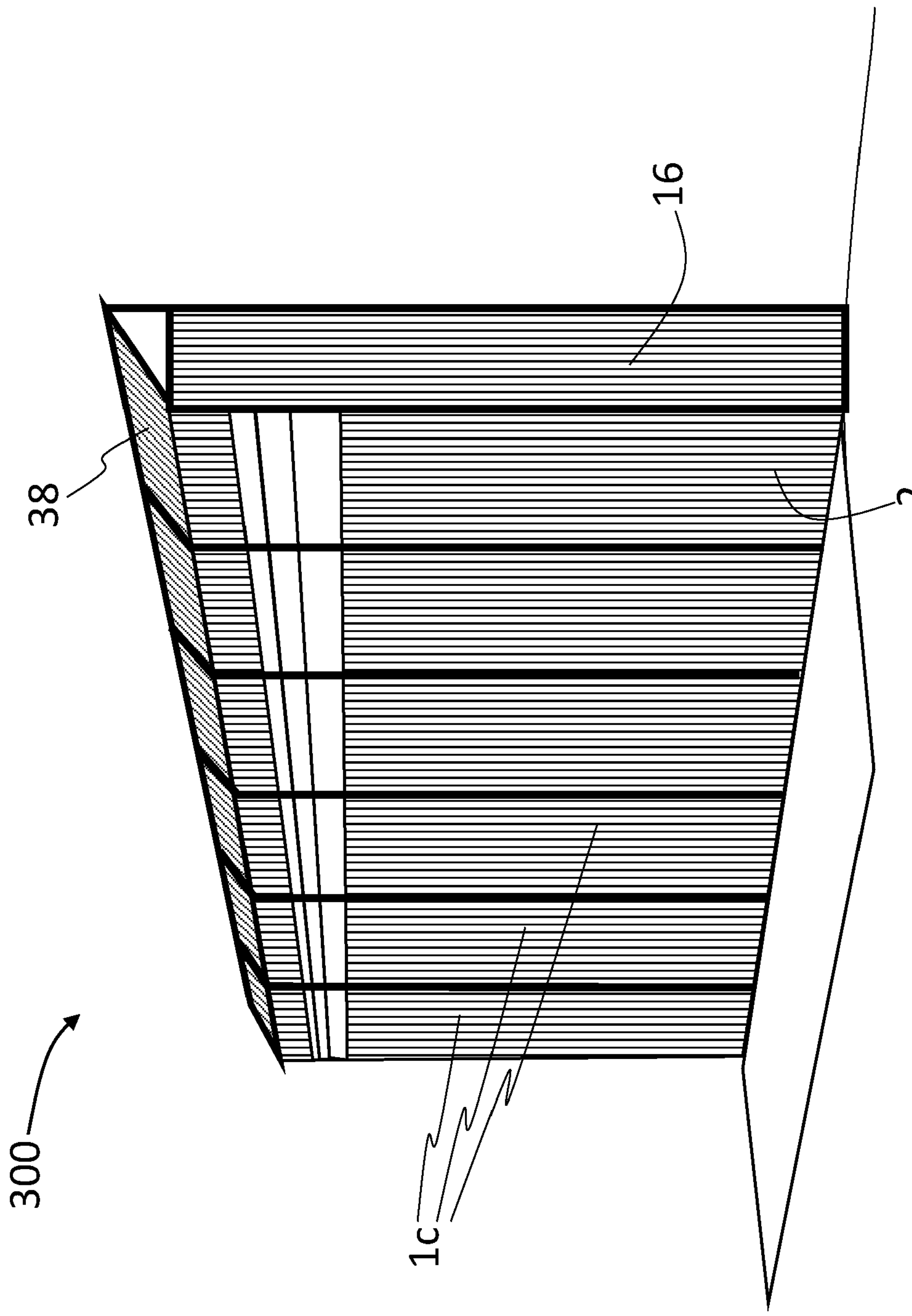

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 22 16 9778

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E01F

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	6 October 2022	Flores Hokkanen, P

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