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(54) **VENTILATION PANEL**

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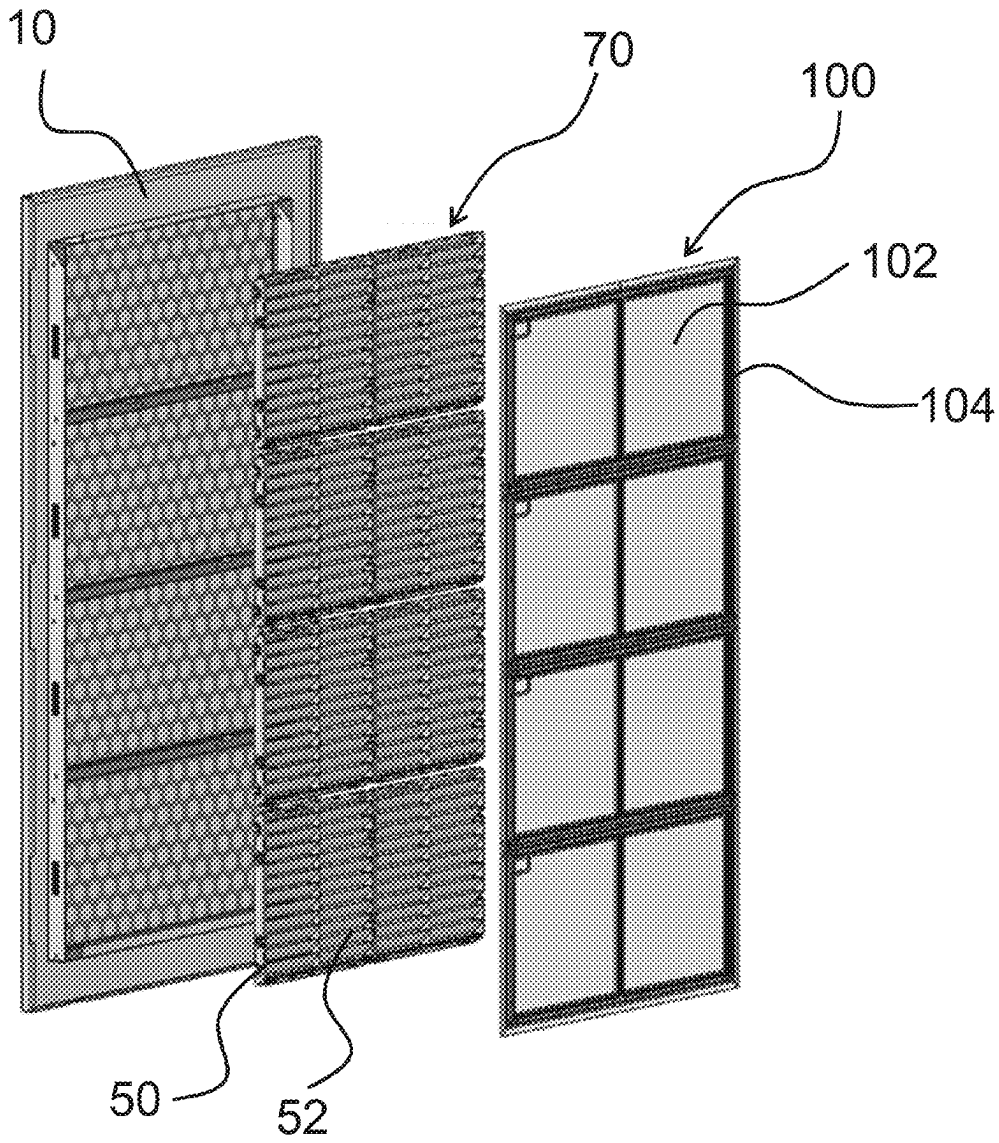
(57) **ABSTRACT**

The present disclosure relates to a ventilation panel for a charging station, particularly an electric vehicle charging station, wherein the ventilation panel comprises a louver support, and a plurality of louver blades supported by the louver support. The louver blades have a sheet-like shape with a downstream trailing edge portion and an upstream leading edge portion. The louver blades additionally have a bent shape in a cross-sectional side view, wherein the louver blades are supported such that the louver blades define a louver plane and a normal direction being orthogonal to the louver plane. In the cross-sectional side view, the upstream leading edge portion defines a smaller angle with respect to the normal direction than the downstream trailing edge portion.



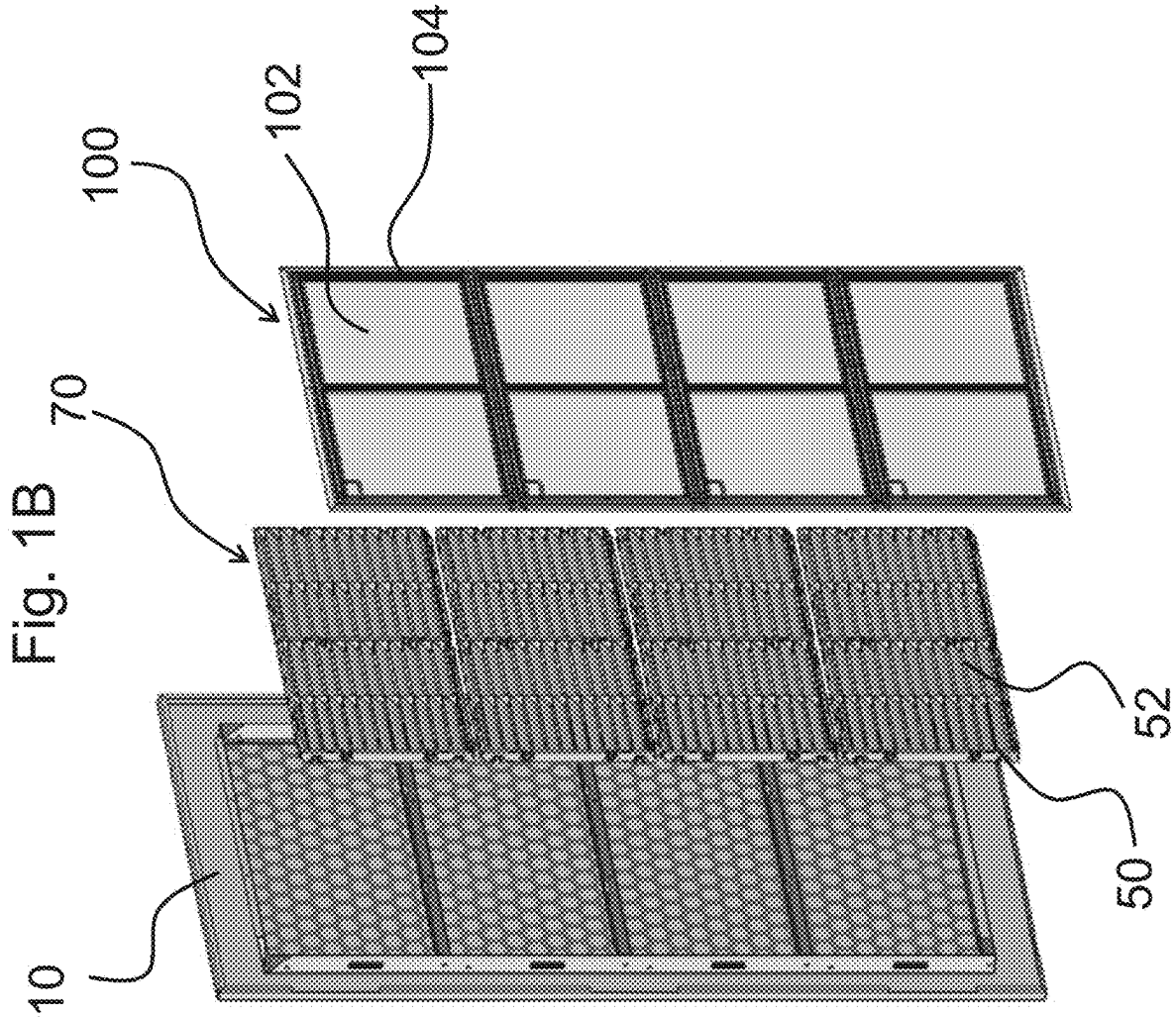


Fig. 1B

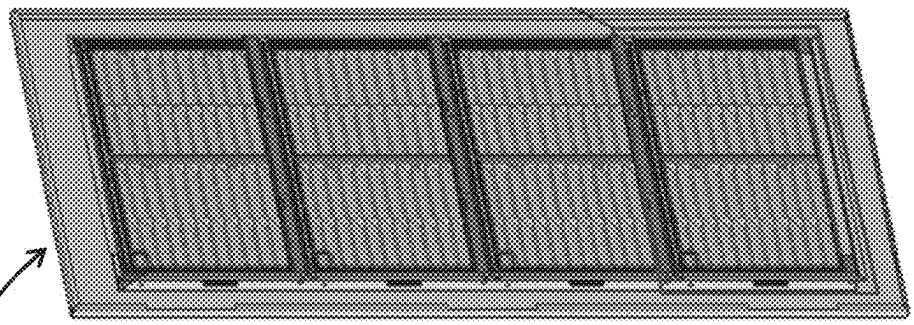


Fig. 1A

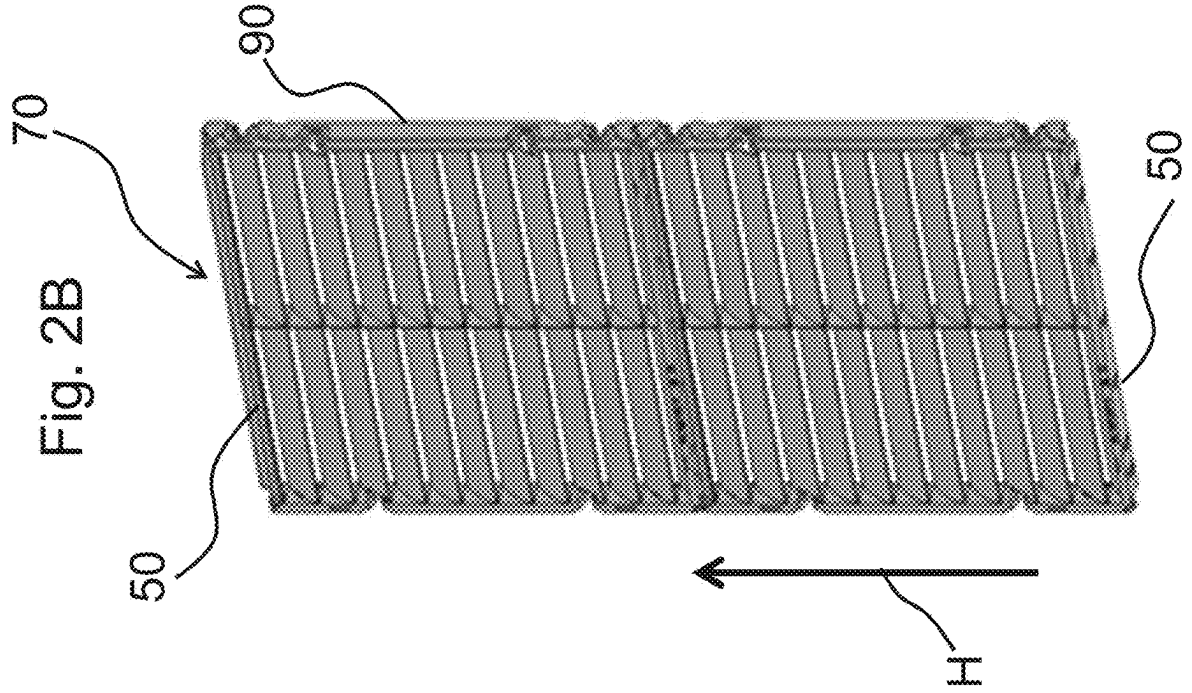


Fig. 2B

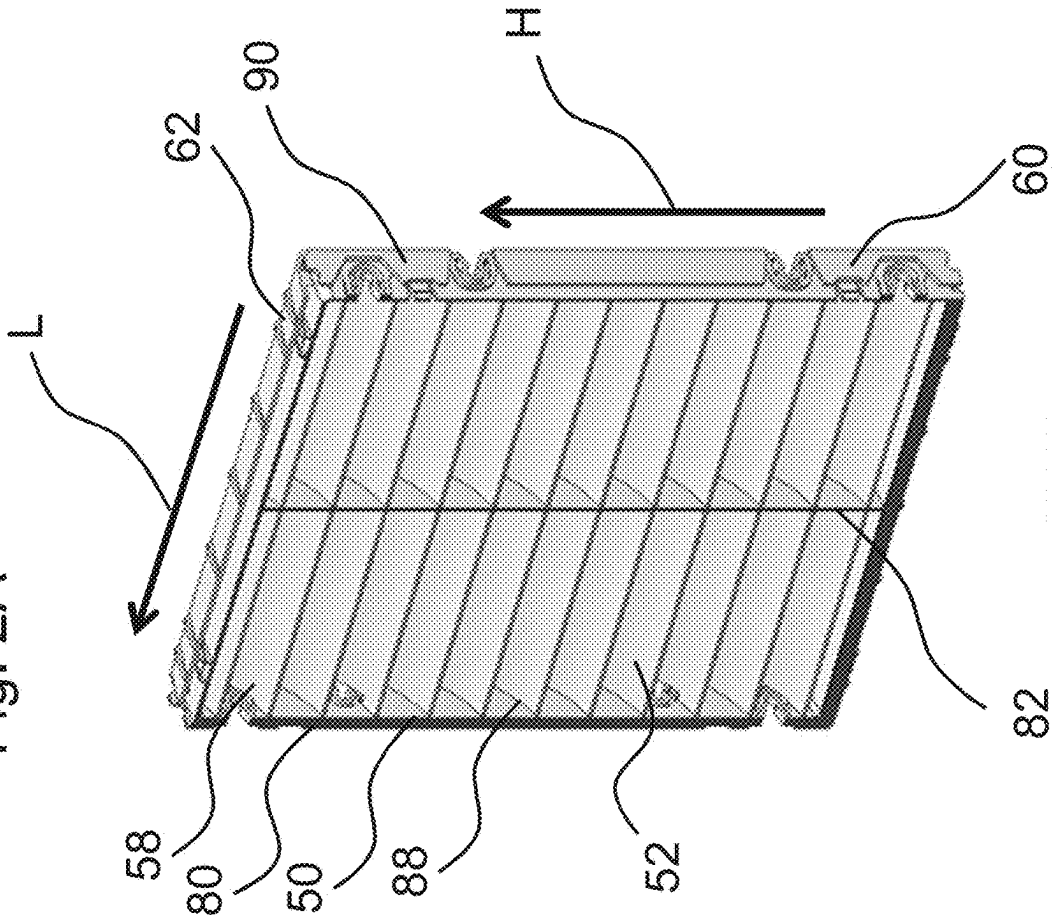


Fig. 2A

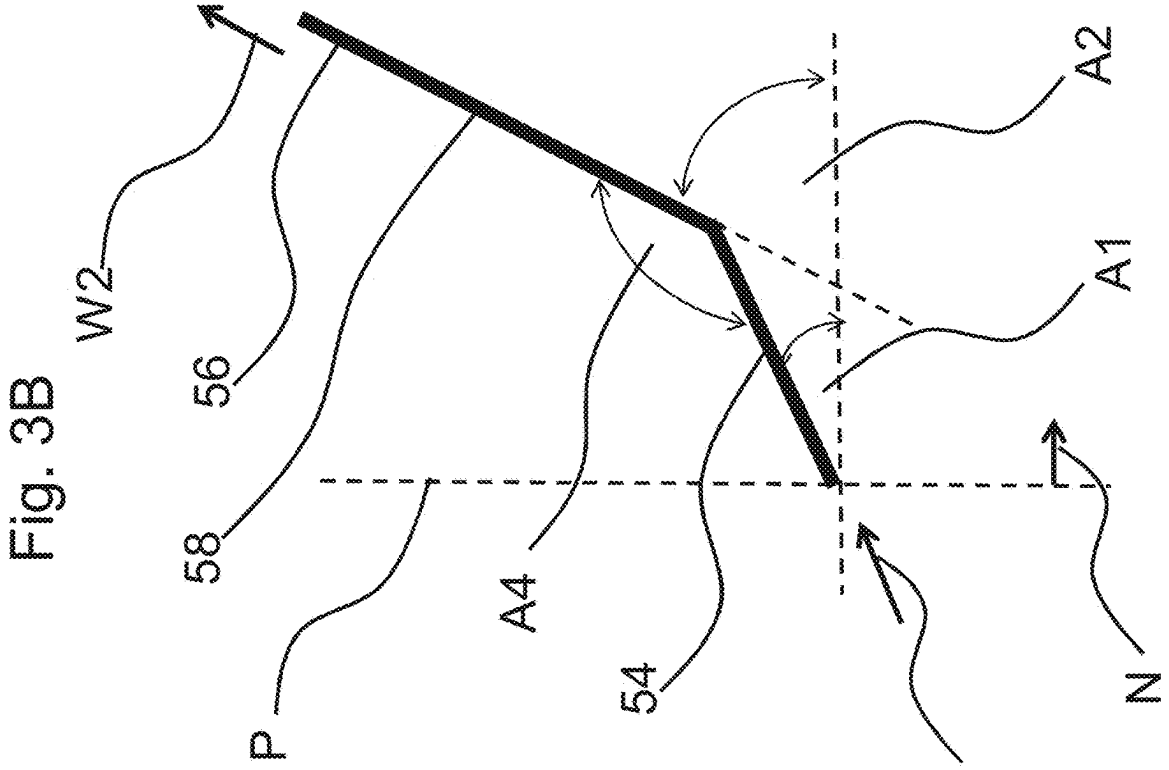


Fig. 3B

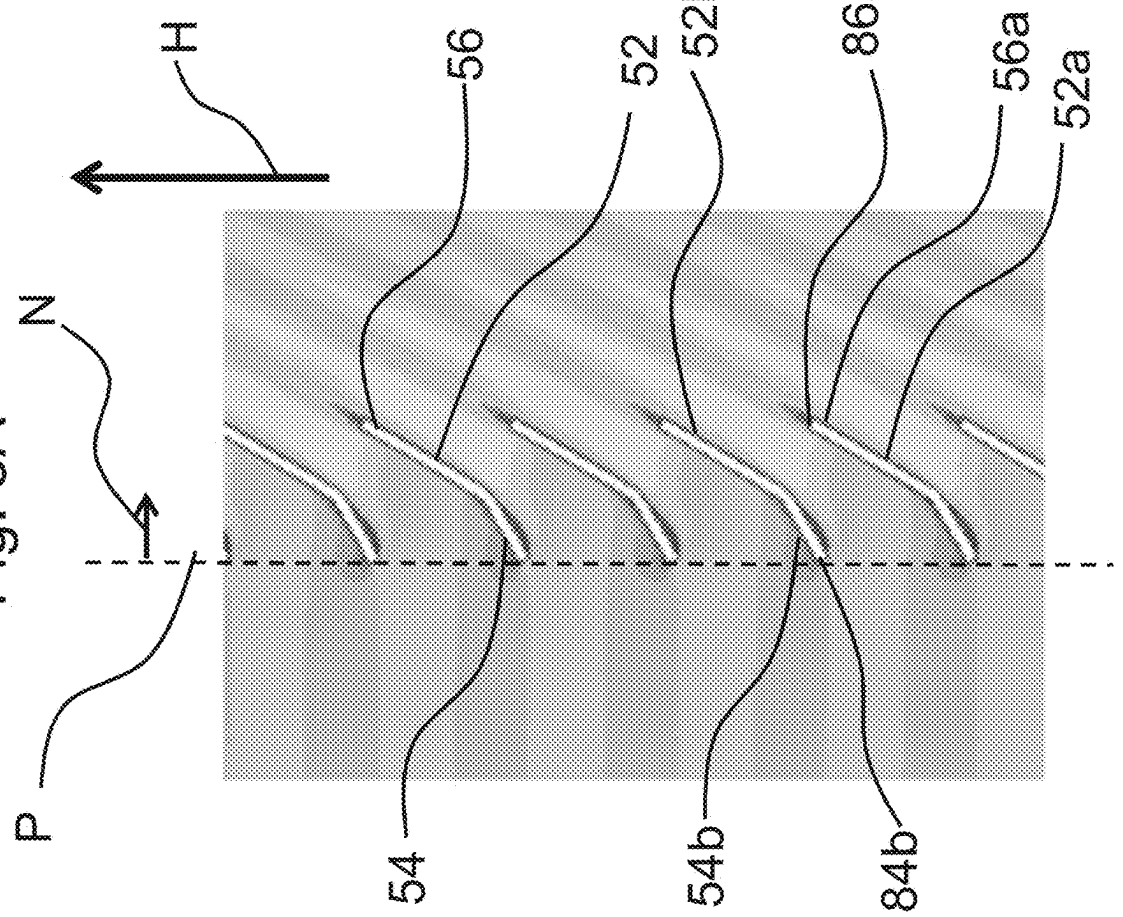


Fig. 3A

Fig. 4

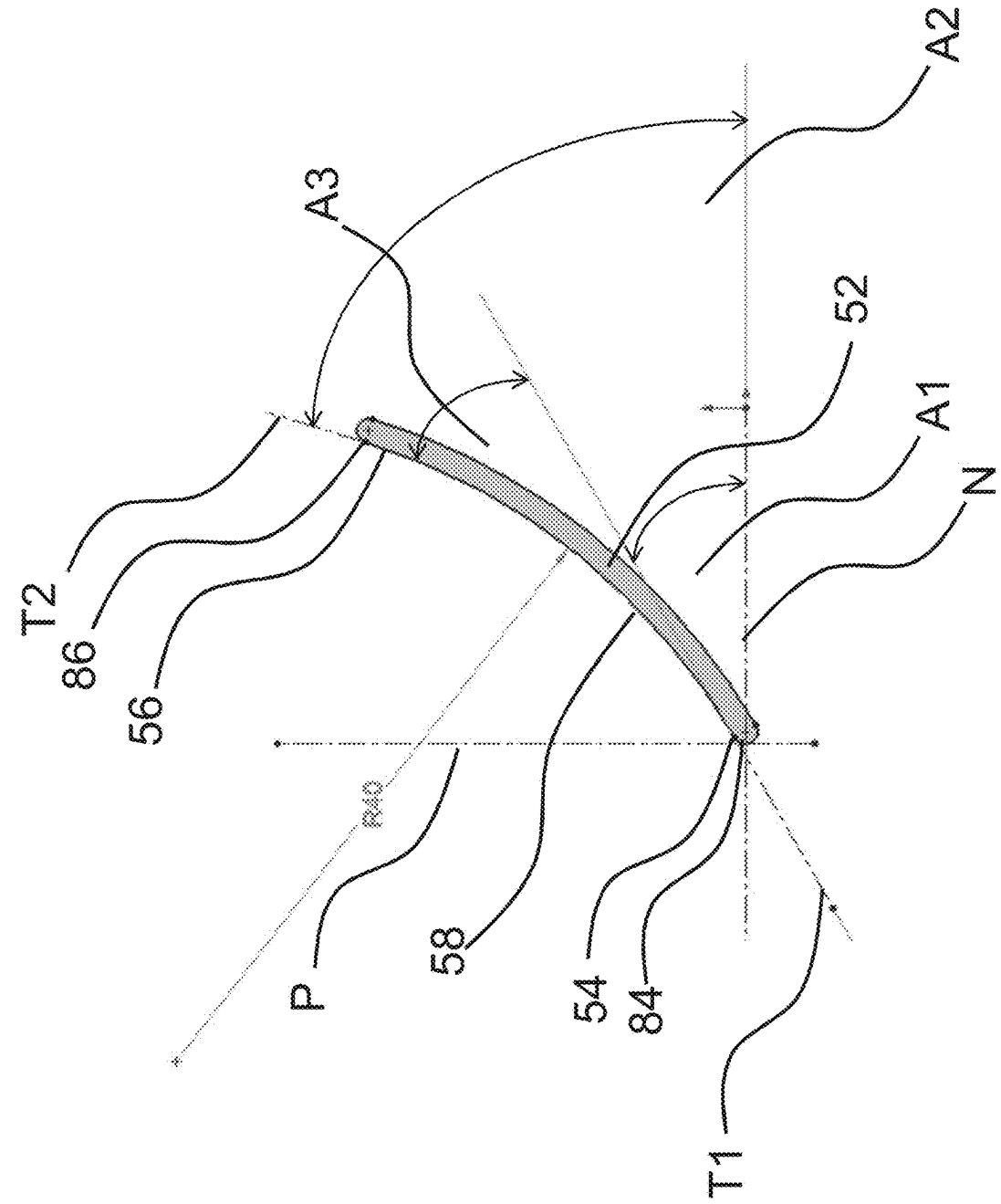
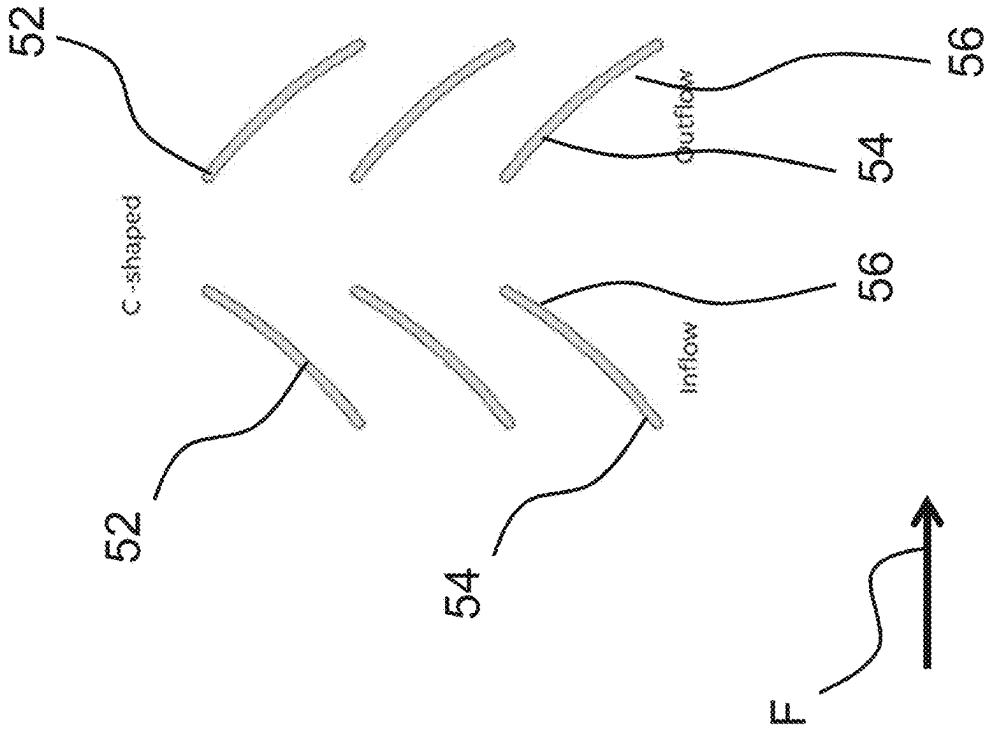


Fig. 5A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C -shaped
Inflow
Outflow
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56
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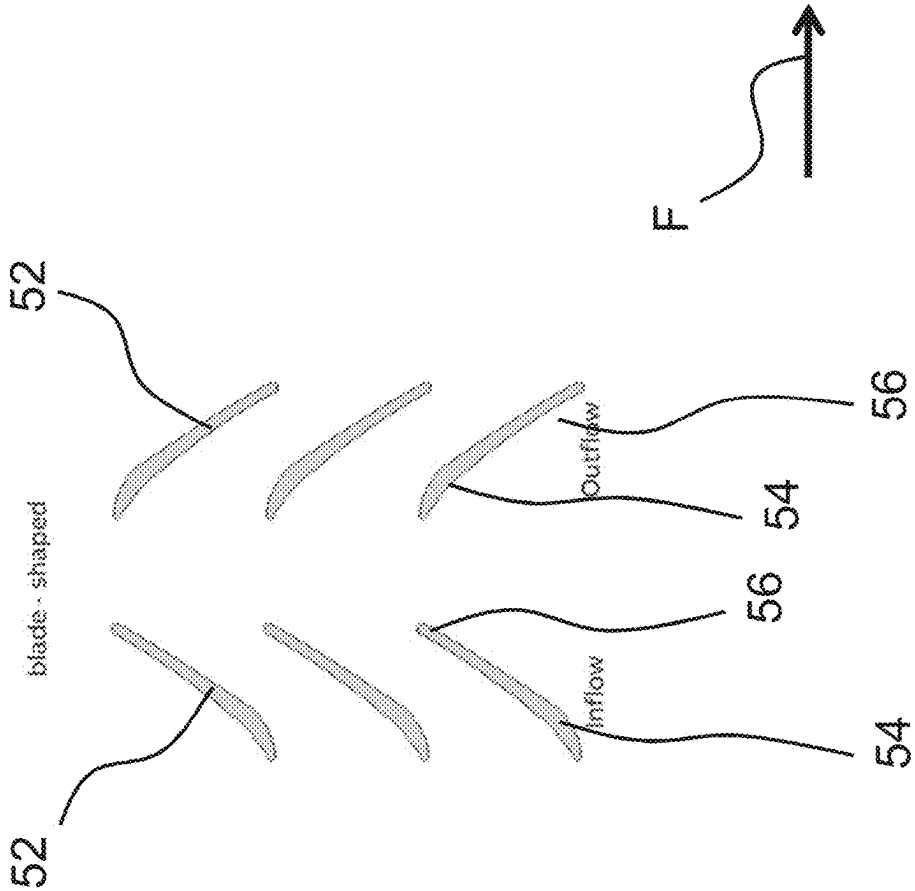
Fig. 5B


52
52
blade - shaped
Inflow
Outflow
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56
F

Fig. 6B

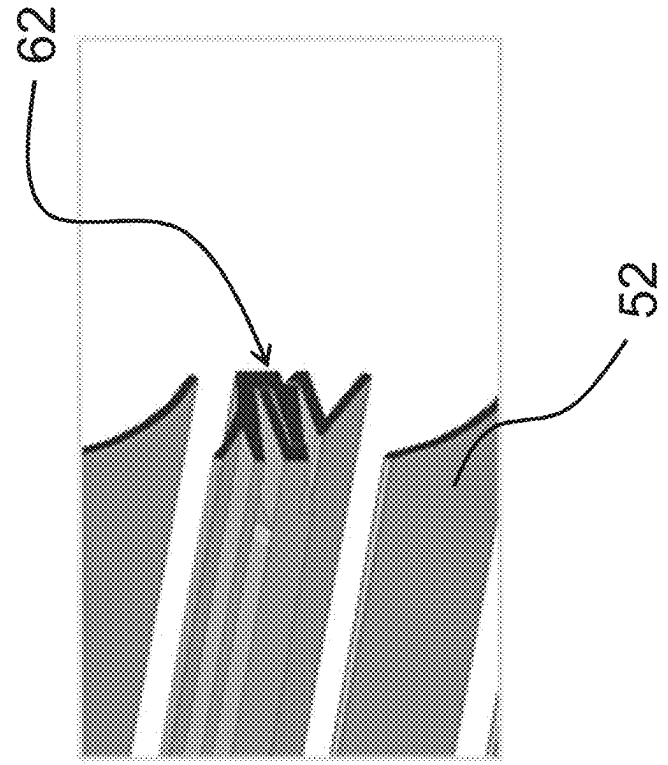
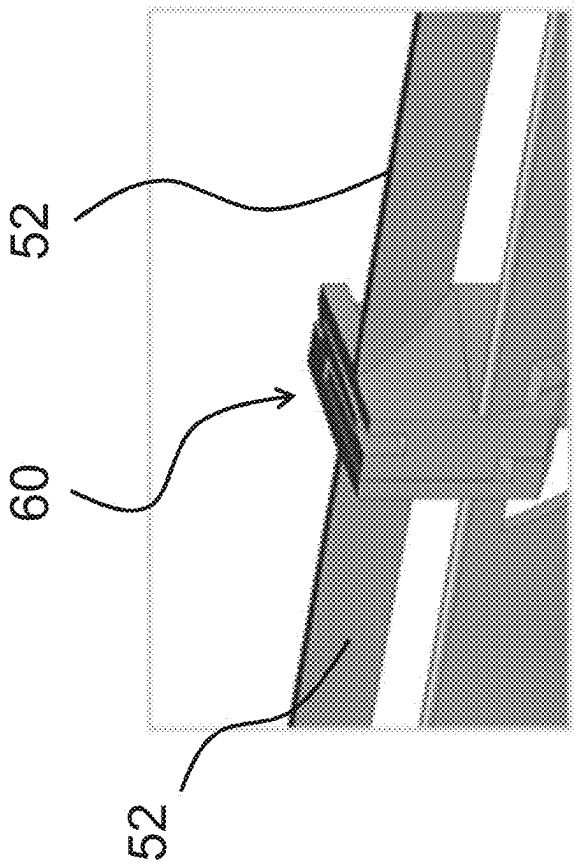


Fig. 6A



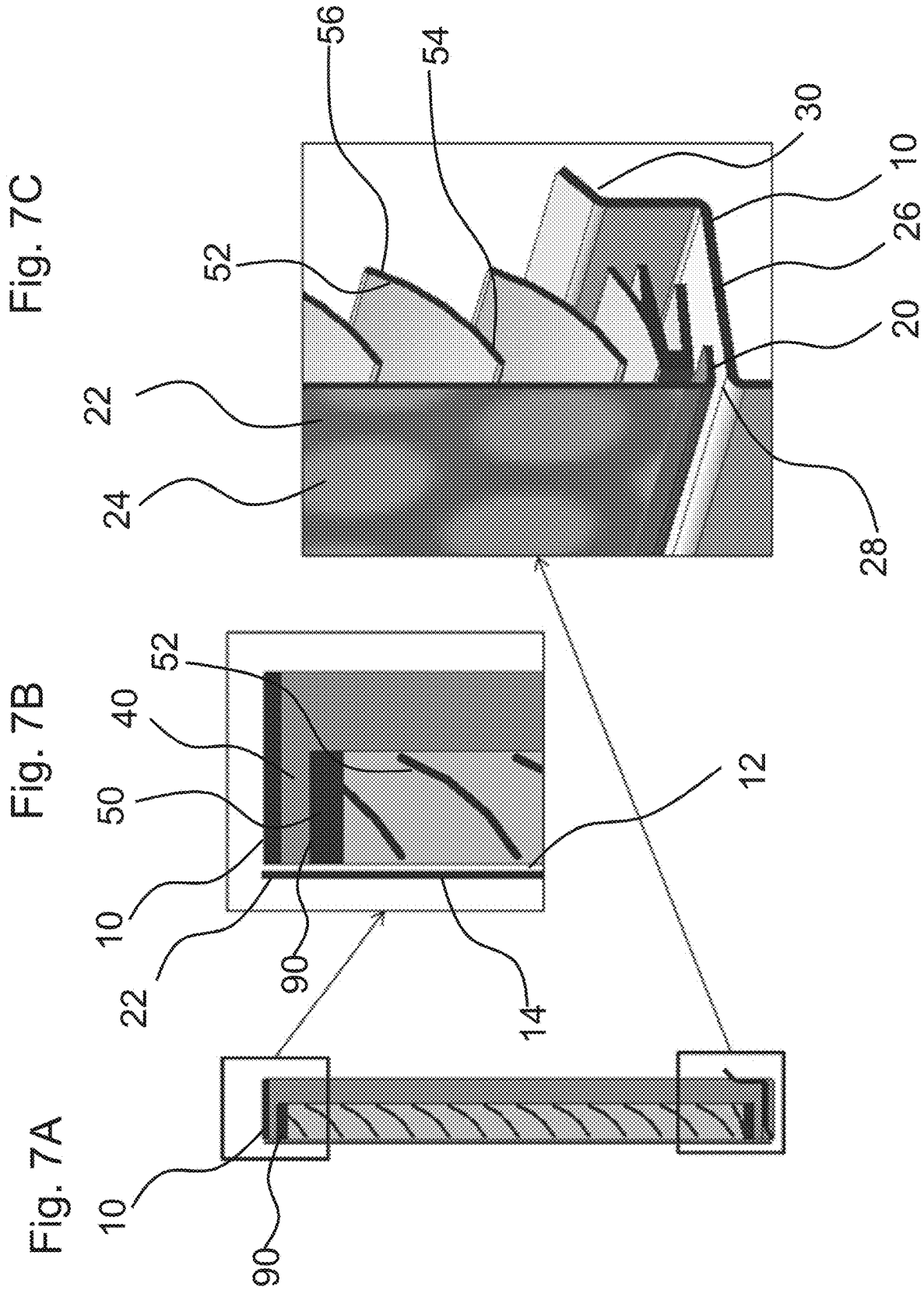


Fig. 7C
56
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Fig. 7B
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12
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22
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14
Fig. 7A
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90

Fig. 8C

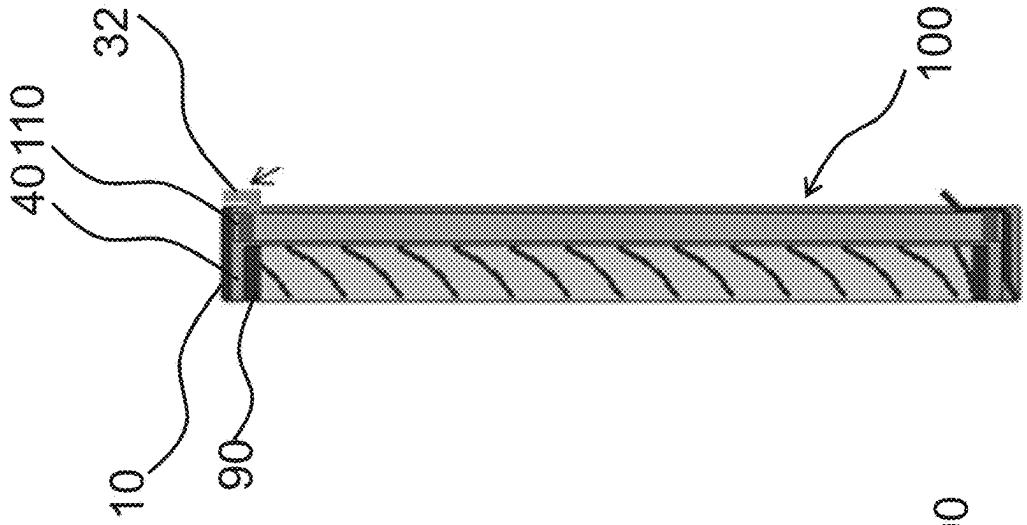


Fig. 8B

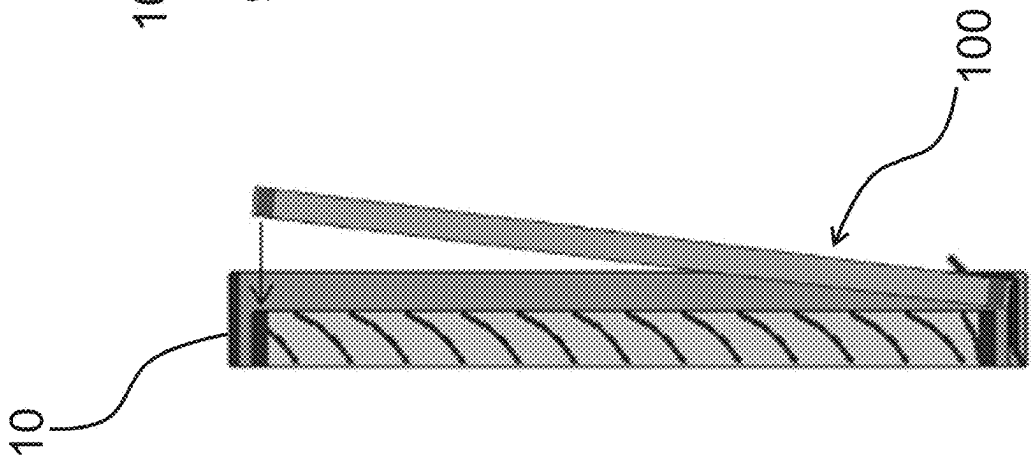
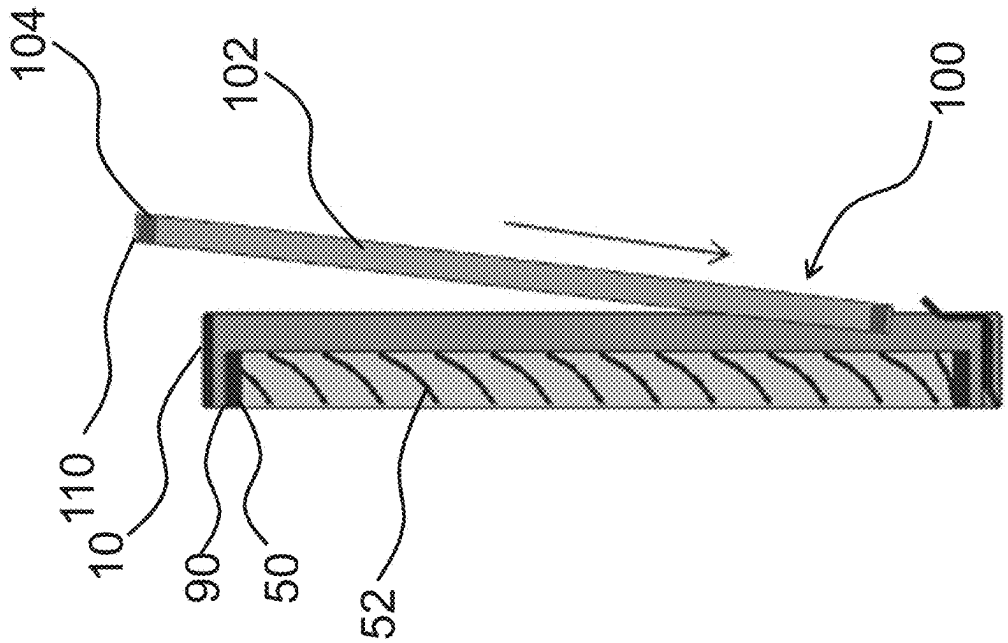


Fig. 8A



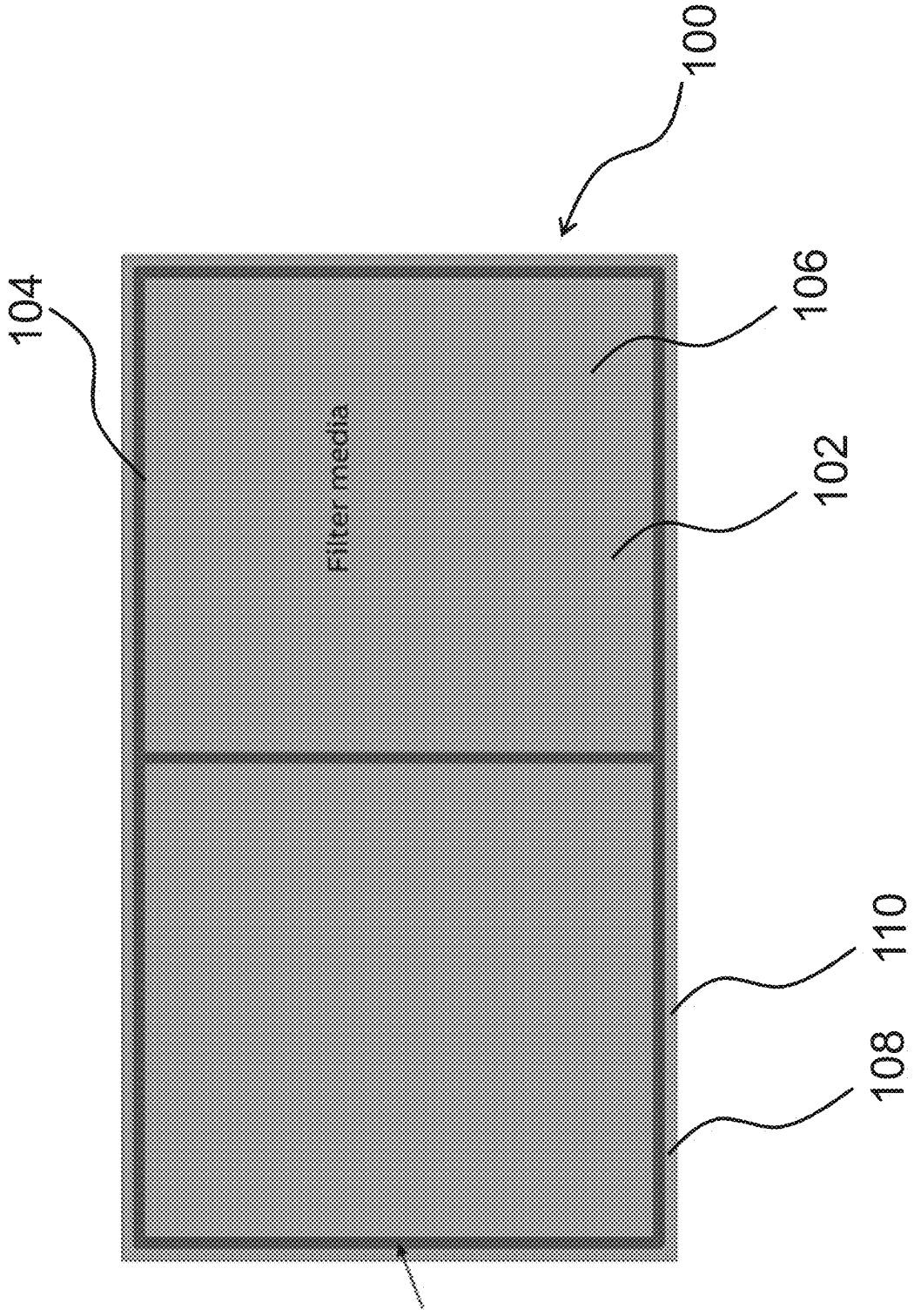


Fig. 8D

Fig. 9A

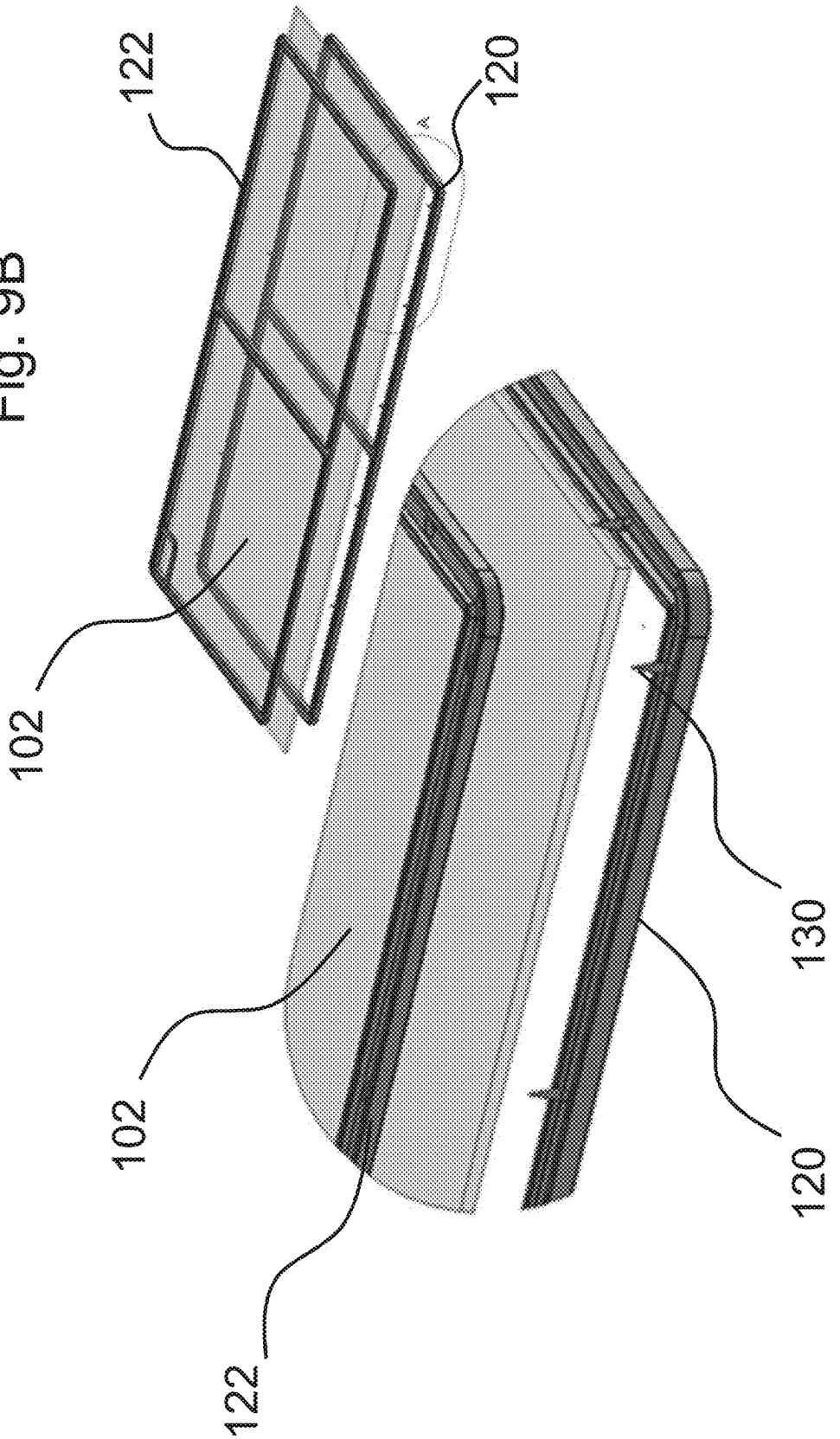


Fig. 9B

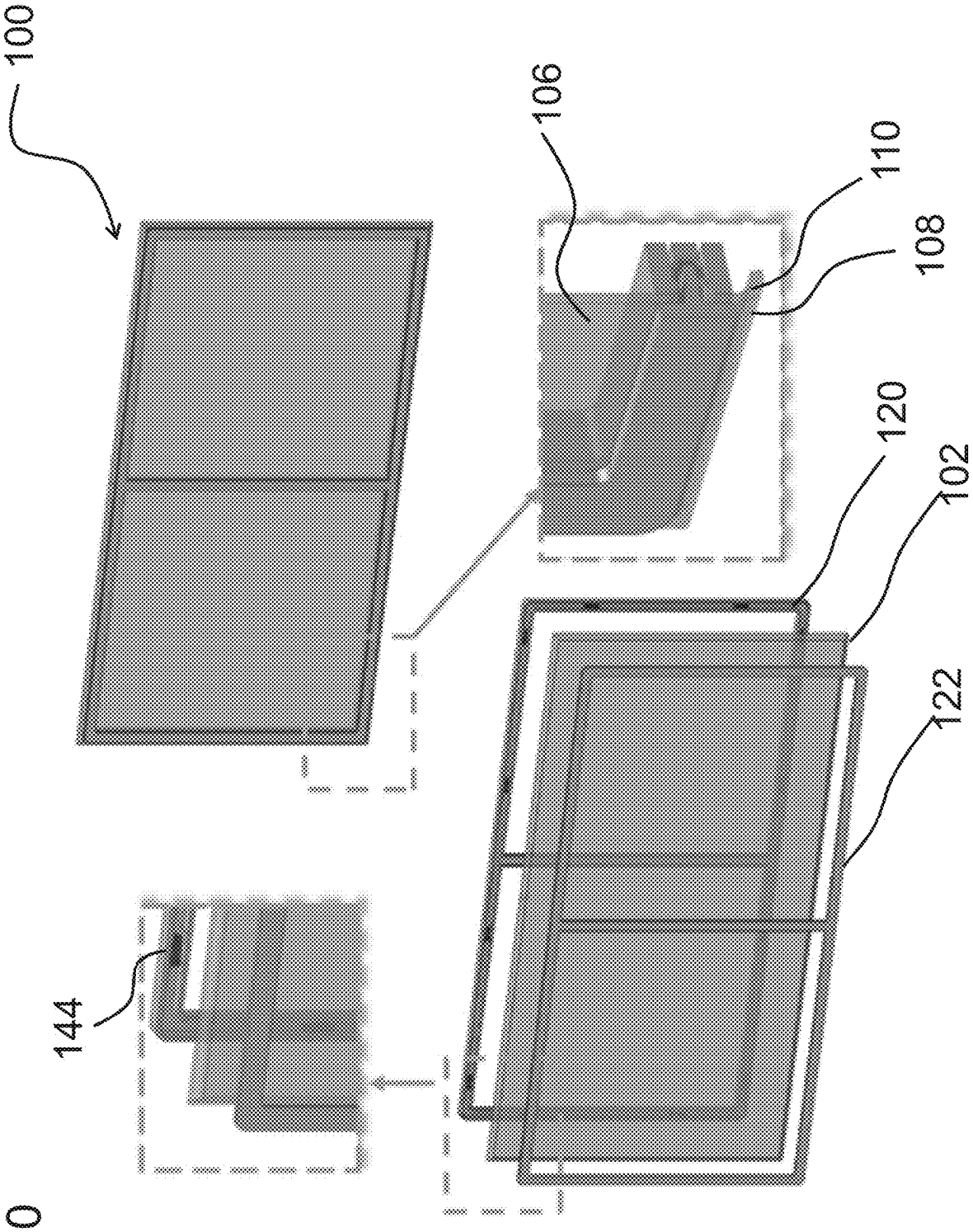


Fig. 10

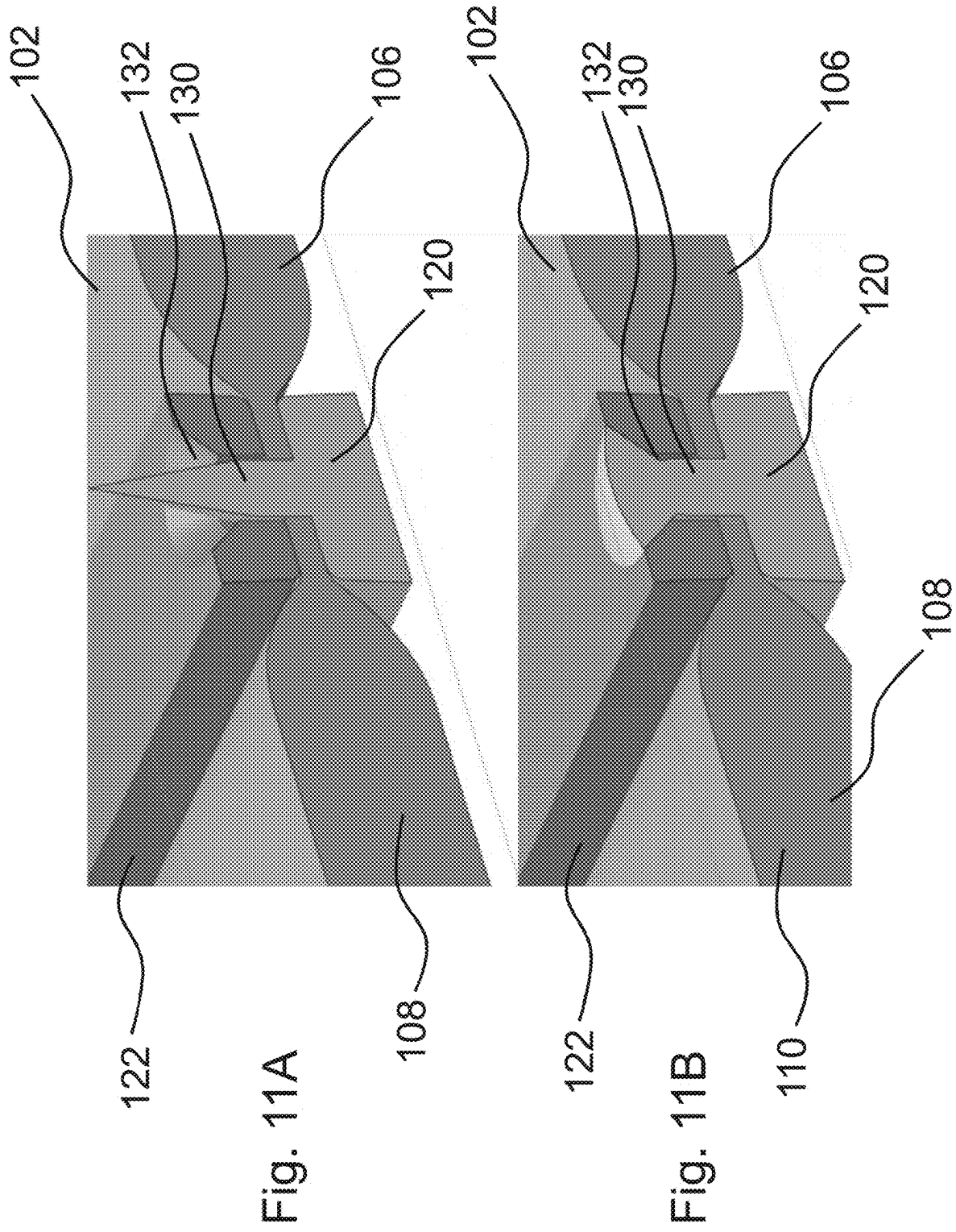


Fig. 11A

Fig. 11B

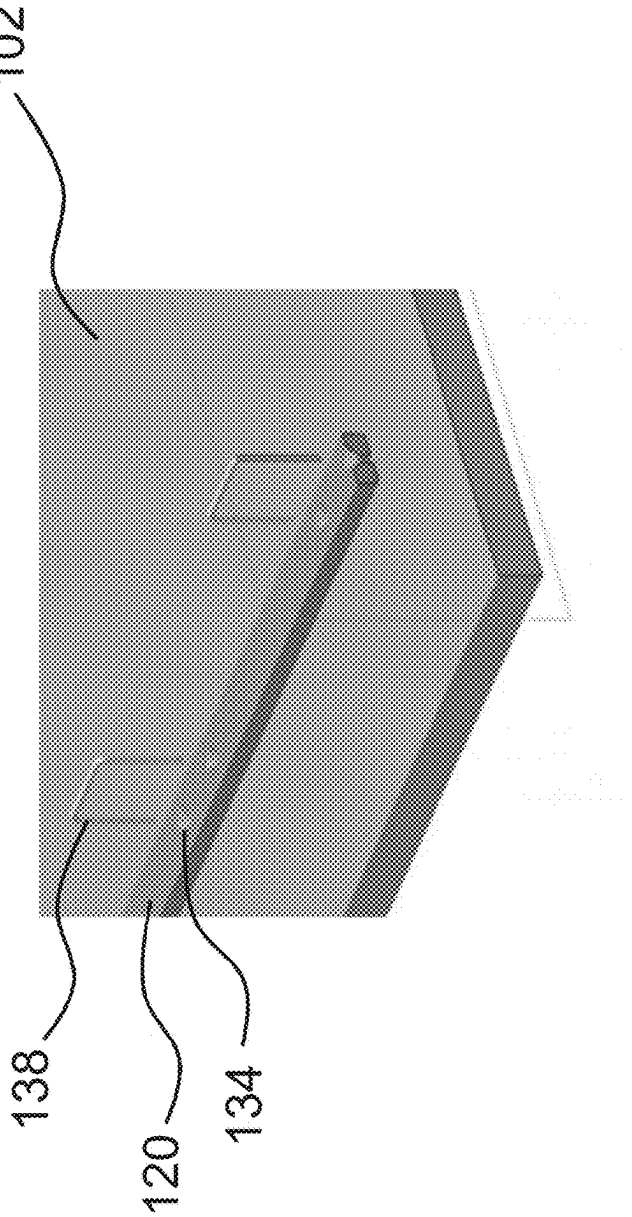


Fig. 12A

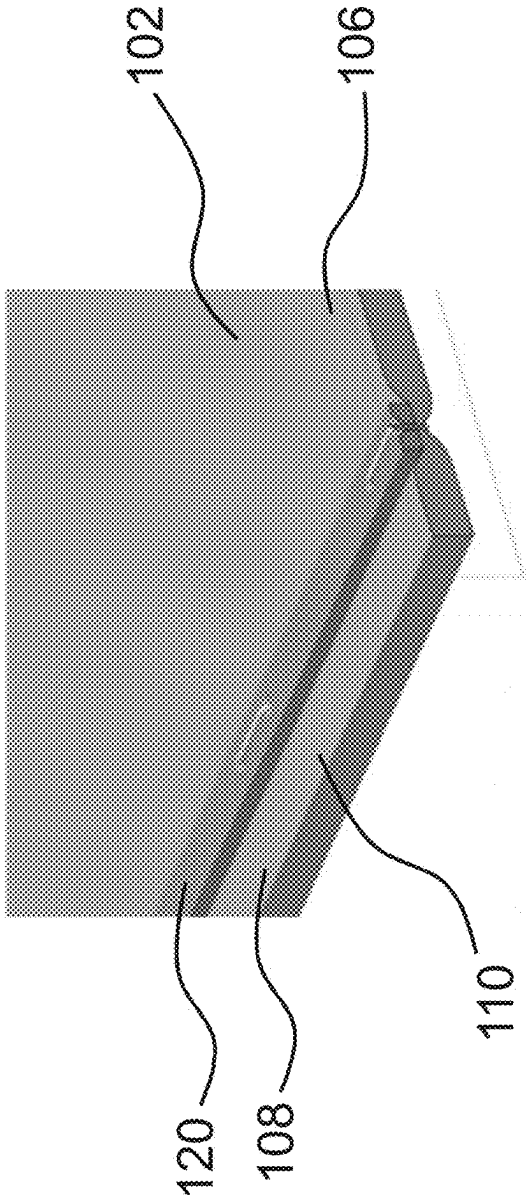


Fig. 12B

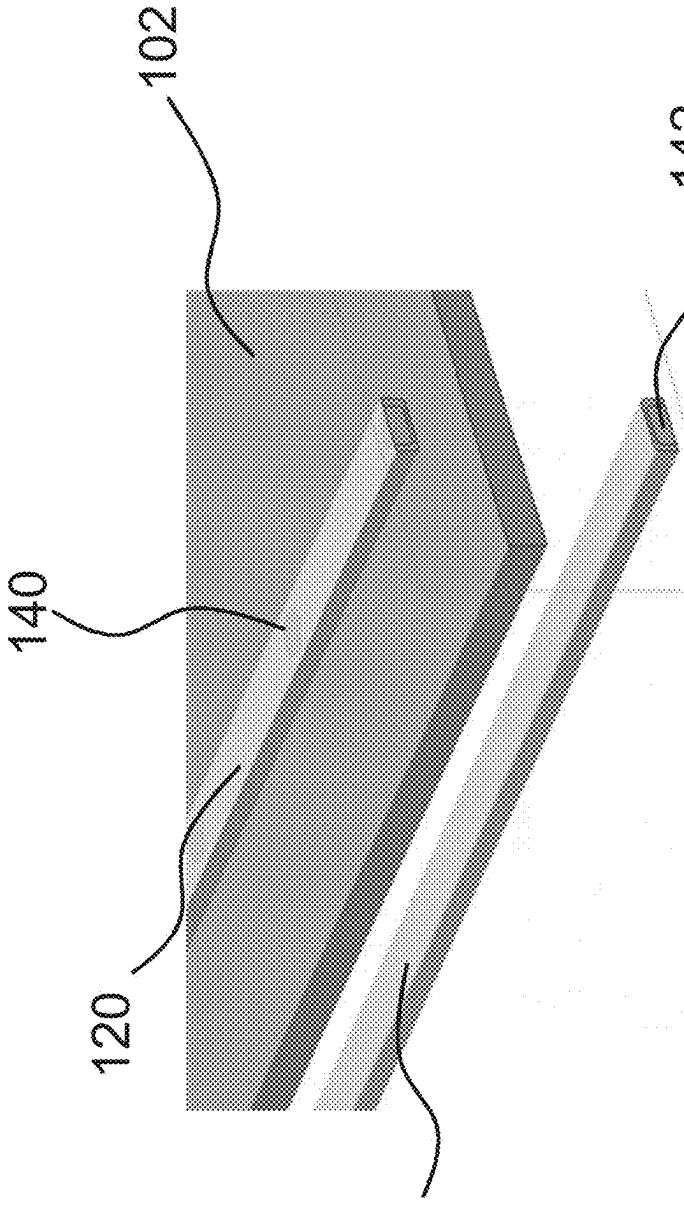


Fig. 13A

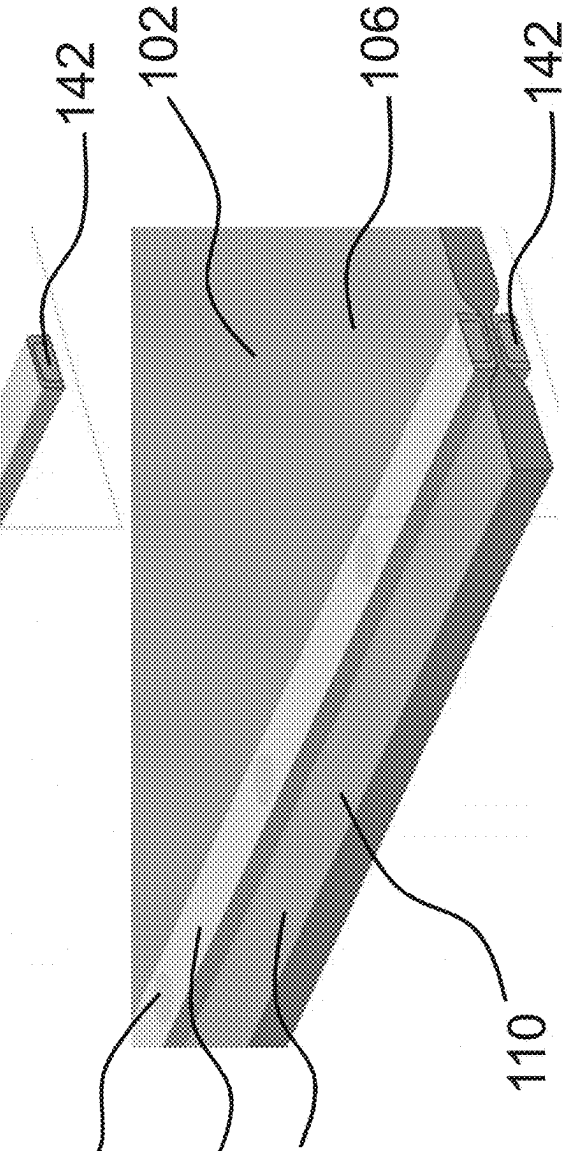


Fig. 13B

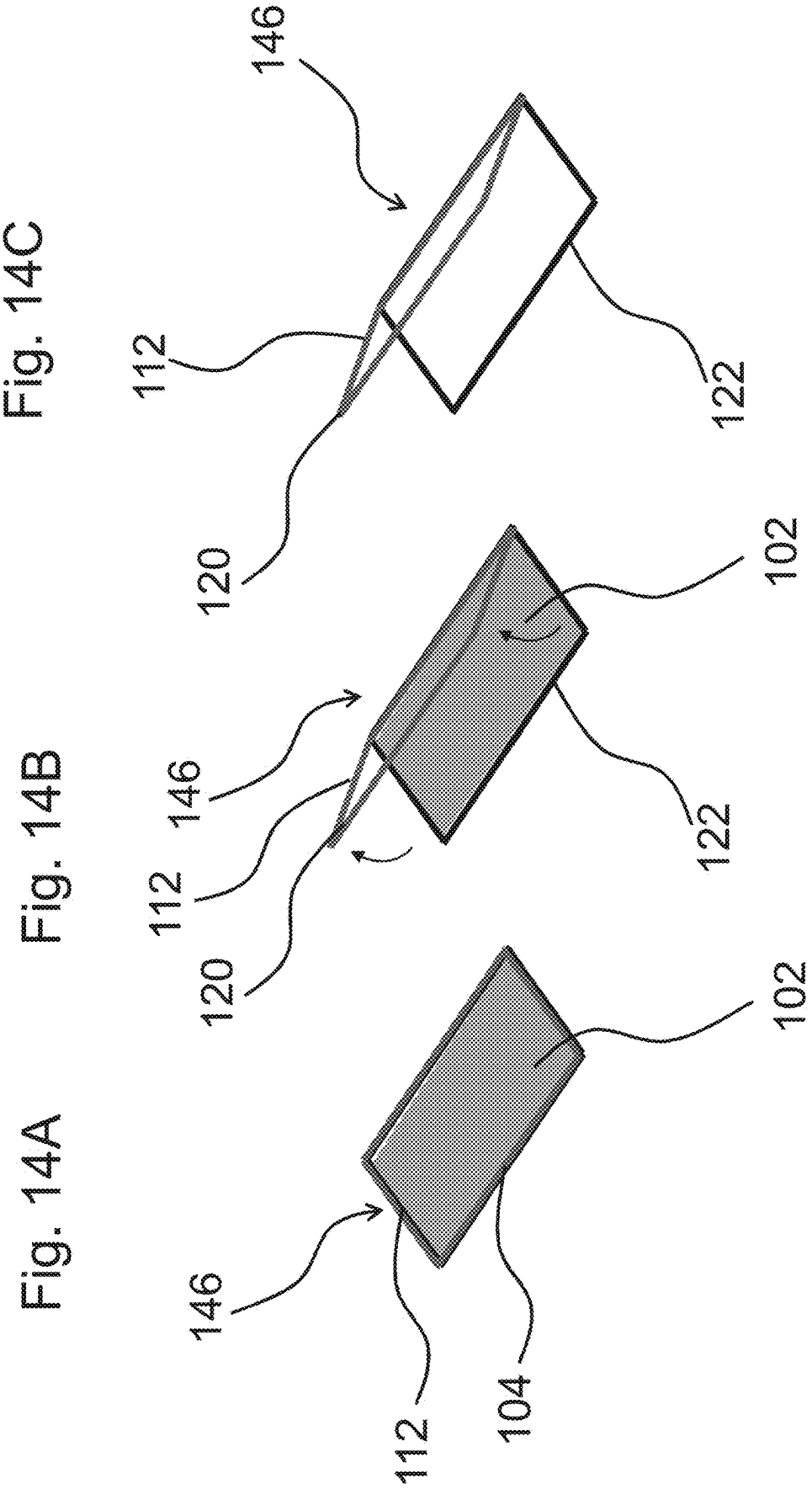


Fig. 14C

Fig. 14B

Fig. 14A

Fig. 15B

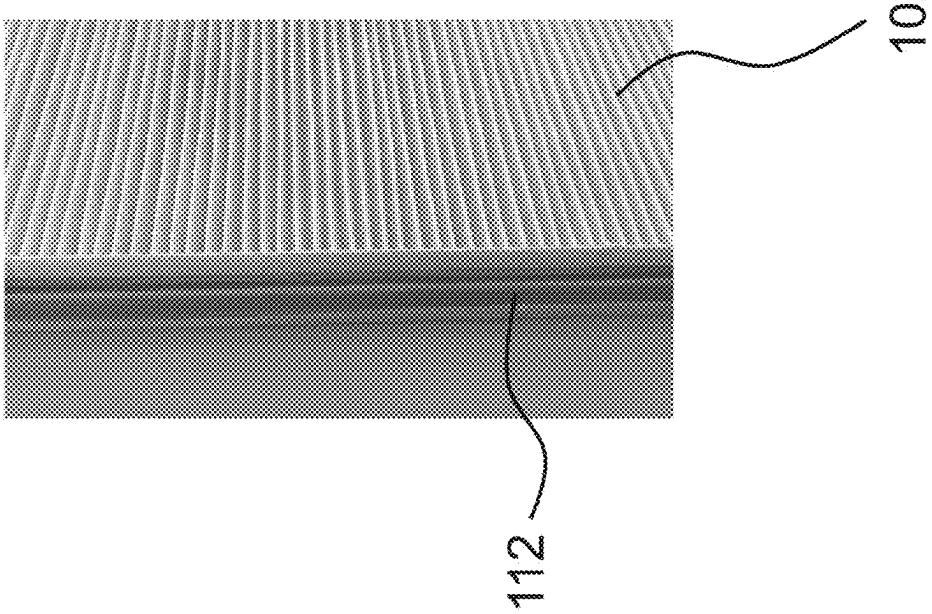


Fig. 15A

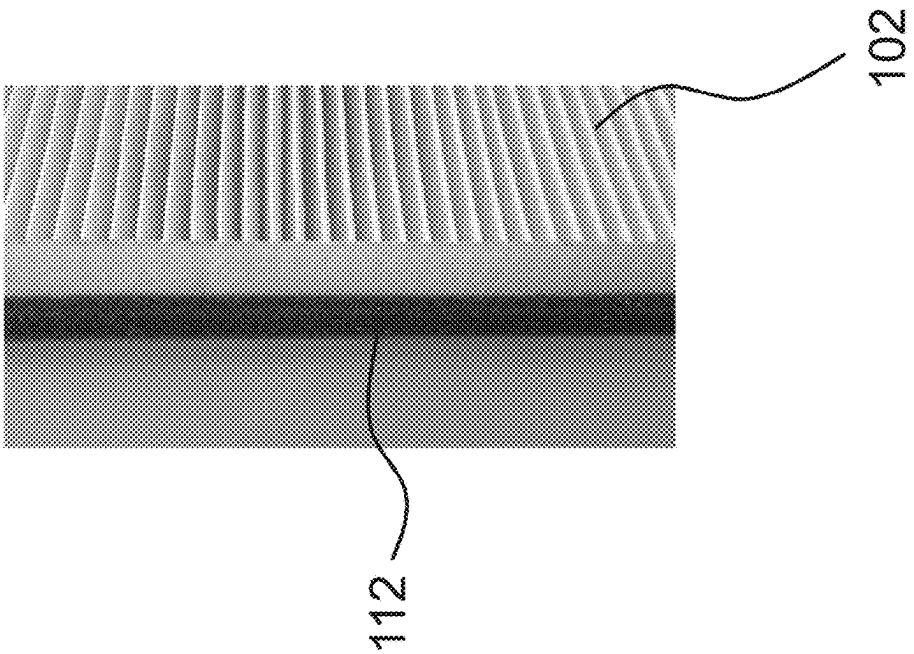


Fig. 16B

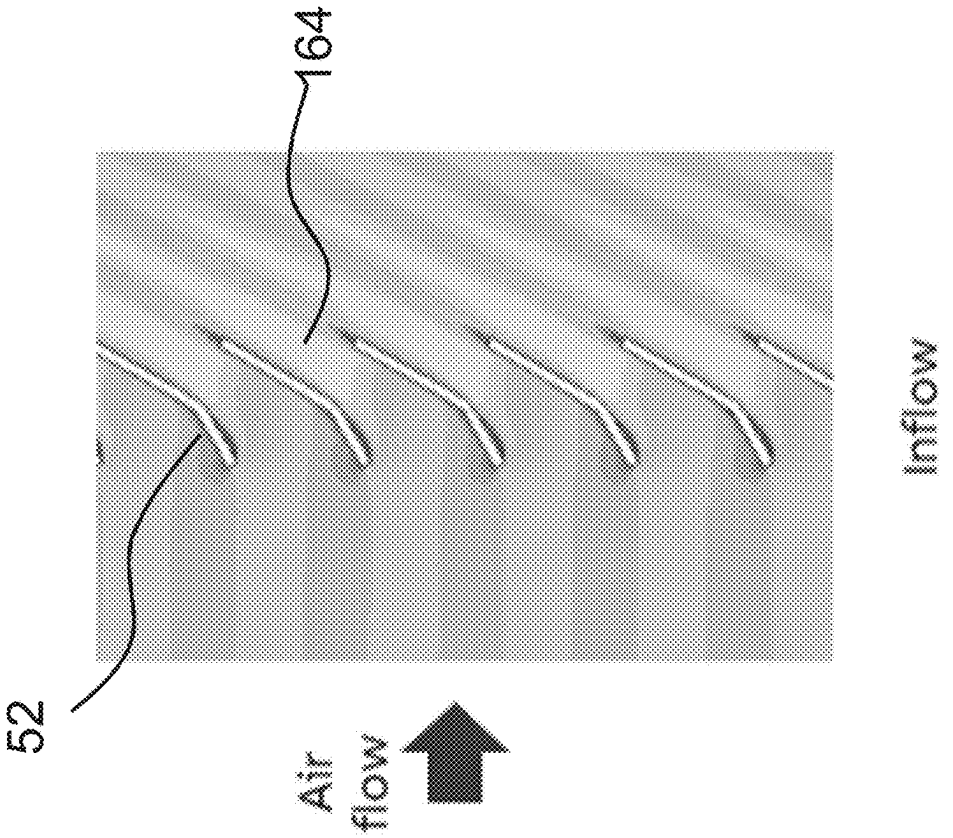


Fig. 16A

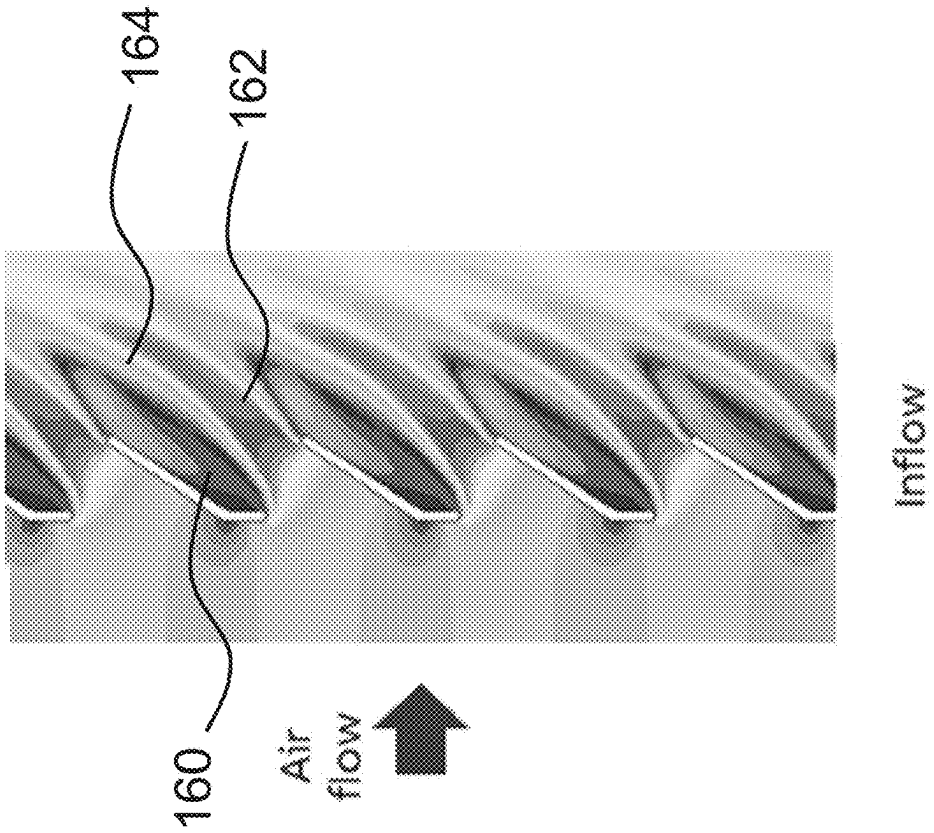
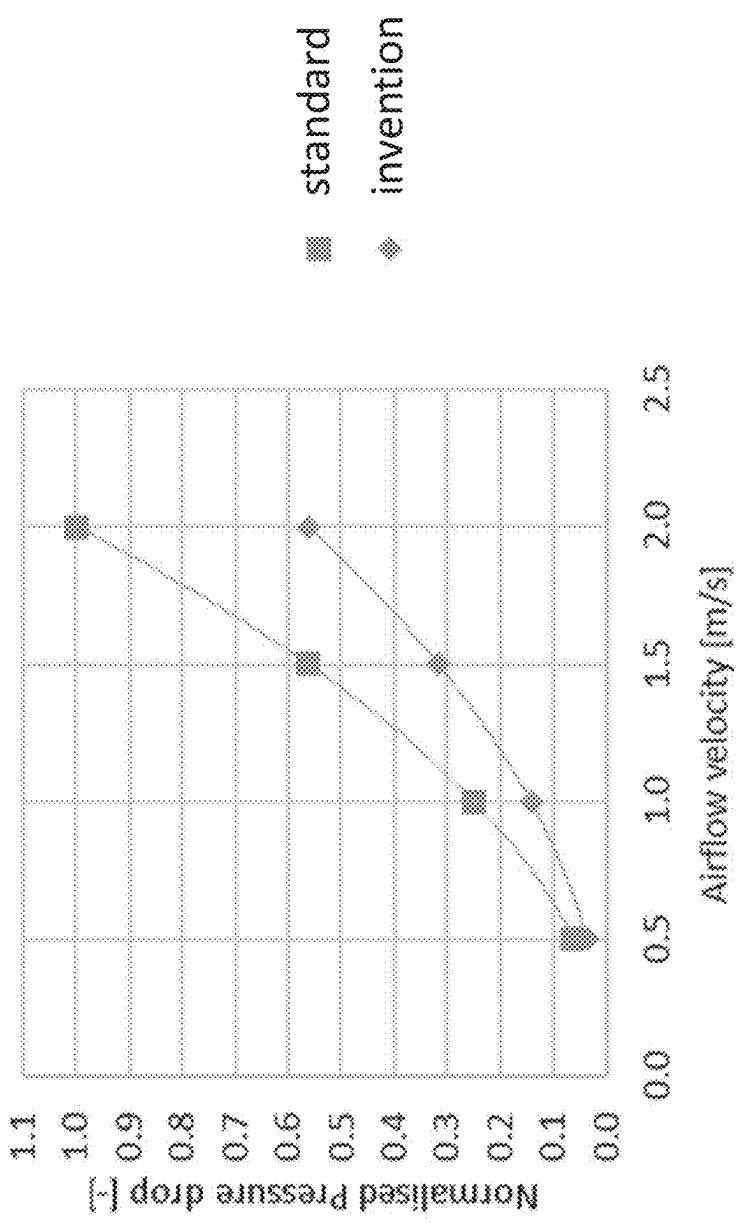


Fig. 17


standard
invention
Normalised Pressure drop [-]
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.5
1.0
1.5
2.0
2.5
Airflow velocity [m/s]

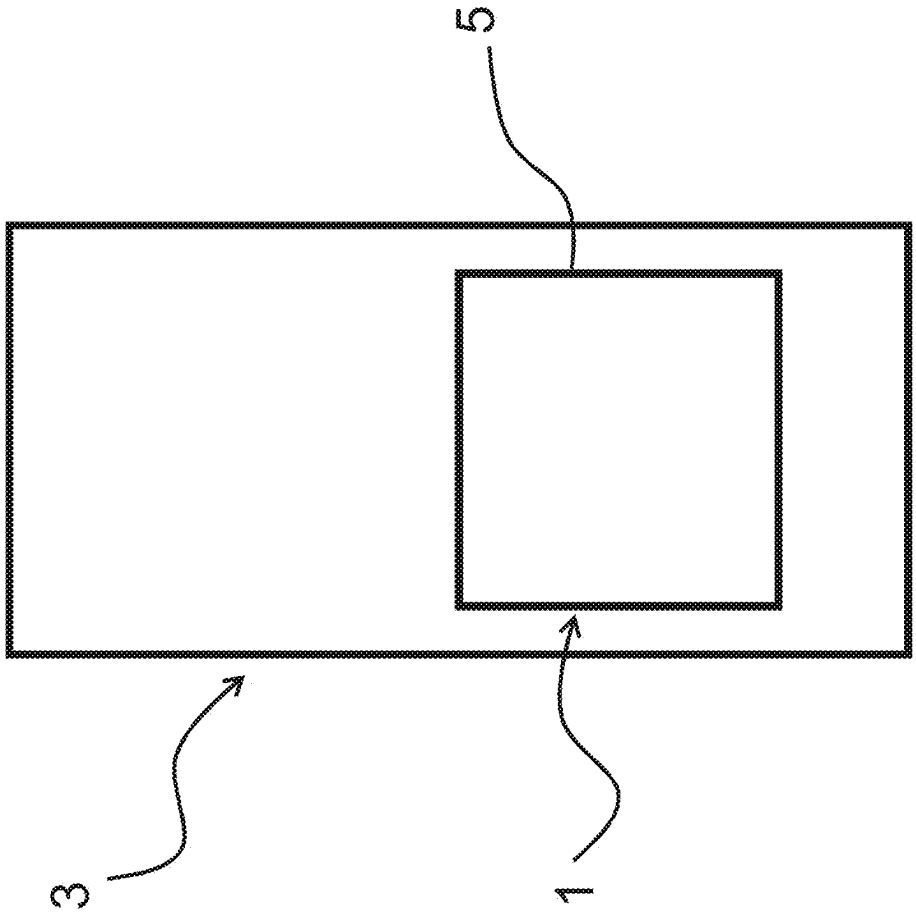


Fig. 18

VENTILATION PANEL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority to European Patent Application No. 24156577.9 filed on Feb. 8, 2024, and titled "VENTILATION PANEL", which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure relates to a ventilation panel.

BACKGROUND

[0003] The continuous growth in the power density of electric vehicle (EV) charging station is making anything than negligible the charger power losses, therefore the resulting heat must be dissipated through a devoted cooling system. The air cooling is the standard solution selected by the different charging station producers, mainly because it is cheaper compared with liquid or two-phase cooling solutions. Unfortunately, the increase of power density requires an increase of air volume flow rate to guarantee the same thermal performance; that means increase the fans numbers or increasing the fans speed, leading, in any case, to higher acoustic noise, that is in contrast with the current market demand, asking for silent solutions.

[0004] Air cooling solutions require that the charger has at least an inlet for the fresh air and an outlet for the exhaust air, namely have ventilations panels that must fulfil several requirements, including: guarantee a proper IP (ingress protection) rating (e.g. IP 54 rating, or IP 55 rating), guarantee a proper IK (impact protection) rating (e.g. guarantee at least IK8 mechanical protection degree), allow sufficient air flow rate for power electronic cooling, guarantee proper EMI shielding (if the class of the power electronic device is non-sufficient for the standard), withstand weather and direct exposure to sun radiation, meet the flammability requirement (UL 94), at least the part of the ventilation panel closer to the heat sources, and must be cheap enough to make the solution applicable in the final product.

[0005] Solution for air ventilation panels employed in EV chargers exist that consist of a steel louver coupled with a filter media. The louver can offer protection against rain, wind, insects, as well as some electromagnetic interference (EMI) shielding; the dust capturing is demanded to the filter media, which moreover must catch the water (jets or droplets) passed by the louver. The IP rating of the ventilation panel is dependent on those parts, and how they are joined. Such a solution is cheap and suitable when airflow velocity through the louver is low, but as soon as the airflow increase, the resulting pressure losses impact significantly the thermal performance of the power electronics.

[0006] There is a need to provide a ventilation panel with improved properties such as improved usage of the filter.

BRIEF DESCRIPTION

[0007] The problem is solved by the ventilation panel according to claim **1** and the charging station comprising a ventilation panel according to the present disclosure. Further embodiments of these aspects of the present disclosure are stated in the corresponding sub claims and/or are described below.

[0008] A first aspect of the present disclosure relates to a ventilation panel for a charging station, particularly an electric vehicle charging station. The ventilation panel comprises a louver support, and a plurality of louver blades supported by the louver support. The louver blades have a sheet-like shape with a downstream trailing edge portion and an upstream leading edge portion. The louver blades have a bent shape in a cross-sectional side view. The louver blades are supported by the louver support such that the louver blades define a louver plane and a normal direction being orthogonal to the louver plane, and that in the cross-sectional side view, the upstream leading edge portion defines a smaller angle with respect to the normal direction than the downstream trailing edge portion.

[0009] In an embodiment, the louver blades of the plurality of louver blades are arranged to span the louver plane. In an embodiment, the louver plane is spanned by a longitudinal extension direction of the louver blades and a distance between the louver blades perpendicular to the longitudinal direction. In an embodiment, the louver plane is spanned by the longitudinal extension direction of the louver blades and a height direction. The louver blades can be offset from each other in the height direction.

[0010] In an embodiment, all louver blades of the plurality of louver blades of the louver support have the same shape. In an embodiment, all louver blades of the plurality of louver blades of the louver support have the same size. In an embodiment, all louver blades of the plurality of louver blades of the louver support have the same size and the same shape.

[0011] The louver blades can be arranged parallel to each other. In an embodiment the louver blades are arranged such at the louver support that the longitudinal extension directions of the louver blades extend in parallel.

[0012] The leading edge portion can comprise a leading edge. The trailing edge portion can comprise a trailing edge. The leading edge can extend in the longitudinal extension direction of the respective louver blade. The trailing edge can extend in the longitudinal extension direction of the respective louver blade. In an embodiment, the leading edge and the trailing edge can extend in the longitudinal extension direction of the respective louver blade. In an embodiment, the leading edge and the trailing edge can extend in parallel.

[0013] In an embodiment, the louver blades have a curved shape in a cross-sectional side view. In an embodiment, the louver blades have an angled (buckled) shape in a cross-sectional side view. In an embodiment, the louver blades comprise a first section with a curved shape in a cross-sectional side view and a second section with an angled (buckled) shape in a cross-sectional side view.

[0014] In an embodiment, in the side view, the louver blade can have a partially curved shape. In an embodiment, in the side view, the louver blade can have a C-shape. In an embodiment, in the side view, the louver blade can have an arc-shape. In an embodiment, in the side view, the louver blade can have a fin-shape. In an embodiment, the louver blade can comprise a concavely curved section.

[0015] In an embodiment, in the side view, the leading edge portion is smaller than the trailing edge portion.

[0016] The leading edge portion can enclose an acute angle with respect to the normal direction of the louver plane. The leading edge portion can enclose an angle

between 0° and 75°, particularly between 0° and 60°, particularly between 0° and 45°, with respect to the normal direction of the louver plane.

[0017] The trailing edge portion can enclose an acute angle with respect to the normal direction of the louver plane. The trailing edge portion can enclose an angle between 10° and 90°, particularly between 20° and 85°, particularly between 40° and 80°, with respect to the normal direction of the louver plane.

[0018] In an embodiment, the leading edge portion can enclose an angle between 0° and 75° with respect to the normal direction of the louver plane, and the trailing edge portion can enclose an angle between 10° and 90° with respect to the normal direction of the louver plane. In an embodiment, the leading edge portion can enclose an angle between 0° and 60° with respect to the normal direction of the louver plane, and the trailing edge portion can enclose an angle between 20° and 85° with respect to the normal direction of the louver plane. In an embodiment, the leading edge portion can enclose an angle between 0° and 45° with respect to the normal direction of the louver plane, and the trailing edge portion can enclose an angle between 40° and 80° with respect to the normal direction of the louver plane. In an embodiment, the leading edge portion can enclose an angle of 30° with respect to the normal direction of the louver plane, and the trailing edge portion can enclose an angle of 73° with respect to the normal direction of the louver plane. The difference angle between the angles defined by the leading edge portion and the trailing edge portion can be 43°. In an embodiment, the leading edge portion and the trailing edge portion enclose an obtuse angle.

[0019] In an embodiment of louver blades with a curved shape in a cross-sectional side view, the respective angles can be considered with regard to the respective tangents and the normal direction of the louver plane.

[0020] The aerodynamic properties of the louver blades can advantageously be improved. An advantage can be that the separation of the air flow can be reduced. An advantage can be that the airflow can pass the louver blades more even. Advantageously, regions of low airflow velocity can be reduced.

[0021] In an embodiment, the louver blades are arranged along a height direction perpendicular to the normal direction, wherein a first louver blade and a neighboring second louver blade are arranged and configured such that neighboring pairs of louver blades overlap with each other in height direction.

[0022] In an embodiment, with respect to the height direction, the trailing edge of the first louver blade protrudes over the leading edge of the second louver blade.

[0023] In an embodiment, the louver blades comprise a first side edge connecting the leading edge and trailing edge, wherein the louver blades are mounted at the louver support by the first side edge.

[0024] In an embodiment, the louver blades comprise the first side edge and an opposing second side edge connecting the leading edge and trailing edge, wherein the louver blades are mounted at the louver support by the first side edge and the second side edge.

[0025] In an embodiment, the louver blades comprise the first side edge and the opposing second side edge connecting the leading edge and trailing edge, wherein the louver blades are mounted at the louver support only by the first side edge and the second side edge.

[0026] In an embodiment, the leading edge is unconnected to the louver support. In an embodiment, the trailing edge is unconnected to the louver support. In an embodiment, the connection between the louver blade and the louver support is provided, particularly only provided, by the first side edge and/or the second side edge.

[0027] An advantage can be that the aerodynamic properties of the louver support with attached louver blades can advantageously be improved. An advantage can be that the separation of the air flow can be reduced. An advantage can be that the airflow can pass the louver blades more even.

[0028] In an embodiment, the louver blades are rotatably mounted at the louver support. In an embodiment, the louver blades are rotatable (hingeable, tiltable). In an embodiment, the louver blades are repeatedly, reversibly rotatable between a working position and a closed position, wherein in the closed position the louver blades are set at a steeper angle than in the working position. In an embodiment, the louver blades are repeatedly, reversibly rotatable between a working position and a closed position such that in the closed position an air flow through the louver support is reduced.

[0029] In an embodiment, in the closed position, the trailing edge of a louver blade can touch the leading edge portion of the neighboring louver blade. In an embodiment, in the closed position, the trailing edge of a louver blade can be adjacent to the leading edge portion of the neighboring louver blade. In an embodiment, in the closed position, the trailing edge of a louver blade can be closer to the leading edge portion of the neighboring louver blade than in the working position.

[0030] In an embodiment, the louver blades are rotatable around an axis extending parallel to the longitudinal extension direction of the louver blades.

[0031] In an embodiment, a working-angle of the louver blades can be adjusted by rotating the louver blades.

[0032] In an embodiment, the louver blades can be rotated in the closed position when the charging station is not in charging state. An advantage can be a reduction of the dust ingress. An advantage can be that the replacement time for the filter can be increased. Advantageously, when ambient temperature is cold, a higher temperature of the charger can be maintained. Advantageously, the power module reliability can be increased.

[0033] In an embodiment, the ventilation panel comprises a rotation actuation system. In an embodiment, the ventilation panel comprises a locking mechanism. In an embodiment, the locking mechanism can be configured to lock the louver blades in the working position. In an embodiment, the locking mechanism can be configured to repeatedly, reversible lock the louver blades in the working position. In an embodiment, the locking mechanism is configured to lock the louver blades in the closed position. In an embodiment, the locking mechanism is configured to repeatedly, reversible lock the louver blades in the closed position. In an embodiment, the locking mechanism is configured to repeatedly, reversible lock the louver blades in the closed position and configured to repeatedly, reversible lock the louver blades in the working position.

[0034] In an embodiment, the louver support comprises an interlocking structure, wherein the interlocking structure is configured such that a plurality of louver supports are attachable to each other thereby forming a one-dimensional or a two-dimensional array of interlocked louver supports.

[0035] In an embodiment, the interlocking structure is arranged and configured such that a first louver support is repeatedly, reversible assemblable to a further louver support via the interlocking structure of the louver support and a corresponding interlocking structure of the further louver support to generate the array of louver supports.

[0036] The louver supports each with the interlocking structure can allow a plurality of louver supports to be attached to each other thereby forming a one-or two-dimensional array of interlocked louver supports.

[0037] The interlocking structures of the louver supports can be configured to provide a horizontal assembly of two louver supports. The interlocking structures of the louver supports can be configured to provide a vertical assembly of two louver supports.

[0038] The interlocking structures of the louver supports can be configured such that the louver planes of the louver supports of the array of interlocked louver supports are arranged in a common louver plane.

[0039] An advantage can be that different sizes and/or shapes of arrays can be formed by a plurality of equal louver supports. The louver supports can be modules of a modular system which can easily be adapted (e.g. change of the size). The production process can advantageously be simplified. Production costs can advantageously be reduced.

[0040] An advantage can be that single louver supports of an allay of louver supports can be replaced. This can advantageously reduce the costs (e.g. reduce repair costs). Advantageously, resources can be saved.

[0041] According to an embodiment, the louver support can be used in the context of the inflow airflow. In an embodiment, the louver support can be used in the context of the outflow airflow. In an embodiment, in comparison to the inflow configuration, the louver support is rotated by 180° about the vertical axis.

[0042] An inflow of air (inflow airflow) can be that air from an external space, e.g. from the environment, flows into an interior space, e.g. an interior compartment of the charging station, particularly through the ventilation panel. The ventilation panel can be configured and arranged for use in an inflow configuration allowing (supporting) an inflow of air. Particularly, the ventilation panel can be configured and arranged such that air can flow from the external space via the ventilation panel into the interior space.

[0043] An out of air (outflow airflow) can be that air from an interior space, e.g. from the interior compartment of the charging station, flows into the external space, e.g. the environment, particularly through the ventilation panel. The ventilation panel can be configured and arranged for use in an outflow configuration allowing (supporting) an outflow of air. Particularly, the ventilation panel can be configured and arranged such that air can flow from the interior space via the ventilation panel into the external space.

[0044] Advantageously, louver supports can be used for inflow as well as outflow configuration. The production process can advantageously be simplified. Production costs can advantageously be reduced.

[0045] In an embodiment, the louver support comprises a plastic material. In an embodiment, the louver support consists of a plastic material. In an embodiment, the louver blades comprise a plastic material. In an embodiment, the louver blades consist of a plastic material. In an embodiment, the louver support and the louver blades comprise a plastic material. In an embodiment, the louver support and the louver blades consist of a plastic material. In an embodiment, the plastic material can be a moldable plastic material. Advantageously, the production costs can be reduced. Advantageously, a plastic material may easily be formed in the particular sheet-like shape of the louver blades.

[0046] In an embodiment, the ventilation panel further comprises a filter arrangement. The filter arrangement can comprise a filter supported by a filter support. The filter can comprise a filter surface. The filter arrangement can be configured such that the filter surface is arrangeable essentially in parallel to the louver plane.

[0047] In an embodiment, the filter arrangement and the louver support are configured and arrangeable such that in an inflow configuration the trailing edge is closer to the filter, particularly the filter surface, than the leading edge.

[0048] In an embodiment, the filter arrangement and the louver support are configured and arrangeable such that in an outflow configuration the leading edge is closer to the filter than the trailing edge.

[0049] In an embodiment, the filter arrangement is configured and arrangeable such that the filter surface is arrangeable essentially in parallel to the louver plane, such that in the inflow configuration the filter surface is affected by air flowing through the louver support.

[0050] In an embodiment, the filter arrangement is configured and arrangeable such that the filter surface is arrangeable essentially in parallel to the louver plane such that in an outflow configuration the louver support is reachable by air leaving the filter surface.

[0051] In an embodiment, the louver blade comprises an airflow-facing surface. In an embodiment, in the inflow configuration the airflow-facing surface faces away from the filter. In an embodiment, in the outflow configuration the airflow-facing surface faces towards the filter. In an embodiment, in the inflow configuration, the louver blade is arranged such that it is bent upwards (particularly from the leading edge towards the trailing edge). In an embodiment, in the outflow configuration, the louver blade is arranged such that it is bent downwards (particularly from the leading edge towards the trailing edge).

[0052] In an embodiment, in comparison to the inflow configuration, in the outflow configuration the louver support is rotated by 180° about a vertical axis of the louver support.

[0053] In an embodiment, depending on the orientation, the louver support can be used for the inflow configuration as well as for the outflow configuration. Advantageously, no installation of different louver supports for the different configurations (inflow/outflow) is necessary. Advantageously, the production can be simplified. Advantageously, the maintenance can be simplified.

[0054] In an embodiment, the filter can be a pleated filter.

[0055] In an embodiment, the distance between louver blades, particularly the trailing edge, and the filter (or filter surface) is between 0 mm and 5 mm, particularly between 0.5 mm and 3 mm. In an embodiment, the distance between louver blades and filter (or filter surface) is between 1 mm and 3 mm, particularly 2 mm. In an embodiment, the filter (or filter surface) is pushed against the louver blades.

[0056] In an embodiment, distance between louver blades, particularly the trailing edge, and the filter (or filter surface) is between 2 cm and 25 cm, particularly between 5 cm and 20 cm. In an embodiment, the distance between louver

blades and filter (or filter surface) is between 7 cm and 15 cm, particularly between 9 cm and 12 cm, particularly 10 cm.

[0057] The filter support can comprise a filter frame. In an embodiment, the filter frame comprises plastic. In an embodiment, the filter frame consists of plastic. In an embodiment, the filter frame comprises metal. In an embodiment, the filter frame consists of metal.

[0058] In an embodiment, the filter arrangement can comprise the filter (the filtering media) and the frame.

[0059] In an embodiment, particularly with regard to the inflow (of air), the filter surface is arrangeable such that the filter surface is affected by air flowing through the louver support.

[0060] In an embodiment, particularly with regard to the inflow (of air), the filter can be arranged downstream of the louver blades.

[0061] In an embodiment, particularly with regard to the outflow (of air), the filter surface is arrangeable such that air leaving the filter surface can flow through the louver support.

[0062] An advantage can be that the aerodynamic properties of the louver blades can advantageously be improved, such that a larger portion of the filter (filter surface) can be affected by the airflow (particularly the inflow). The filter properties can advantageously be improved. Advantageously, a larger area of the filter can be used. The efficiency can be improved.

[0063] In an embodiment, the filter arrangement comprises an outer perimeter, wherein the outer perimeter of the filter arrangement comprises a portion of the filter, wherein the outer perimeter of the filter arrangement is configured for sealing.

[0064] In an embodiment, the filter arrangement comprises an outer perimeter, wherein the outer perimeter of the filter arrangement comprises a portion of the filter support, wherein the outer perimeter of the filter arrangement is configured for sealing.

[0065] In an embodiment, the filter arrangement comprises an outer perimeter, wherein the outer perimeter of the filter arrangement comprises a portion of the filter and a portion of the filter support, wherein the outer perimeter of the filter arrangement is configured for sealing.

[0066] In an embodiment, the outer perimeter of the filter arrangement is configured for perimetric sealing.

[0067] In an embodiment, the sealing between the filter and the structural frame where it is installed is realized in the outer perimeter of the filter frame.

[0068] In an embodiment, the filter comprises a portion configured for sealing, particularly perimetric sealing. In an embodiment, the filter comprises a first portion (perimetric portion) configured for sealing, and a second portion (central portion) configured for filtering.

[0069] In an embodiment, the filter support comprises a portion configured for sealing, particularly perimetric sealing. In an embodiment, the filter support comprises a first portion configured for sealing, and a second portion configured for supporting the filter.

[0070] In an embodiment, the filter and/or the filter support has to guaranteed a perimetric sealing between the structural frame and the filter itself. In an embodiment of a filter solution where the filter protrudes outwards beyond the filter support, the filter can be this part to fulfil the sealing task. In an embodiment of a filter in which the perimetric part consist of the filter frame, then, a sealing means, e.g., a gasket, has to be installed on the perimeter to guarantee the sealing. In an embodiment, the filter frame comprises the sealing means.

[0071] In an embodiment, the filter support comprises a first filter frame and a corresponding second filter frame, wherein the first filter frame and the second filter frame are configured such that the first filter frame is assembleable to the second filter frame.

[0072] In an embodiment the first filter frame and the second filter frame are configured such that the filter is mechanically locked between the first filter frame and the second filter frame, when the first filter frame is assembled to the second filter frame.

[0073] In an embodiment, the first filter frame is repeatedly, reversible assembleable to the second filter frame.

[0074] In an embodiment, the filter support is configured such that it is easily disassembled. In an embodiment, the filter frames are easily disassembleable, to allow the recycling of all the part of which it is made. An advantage can be that environmental friendliness can be increased.

[0075] In an embodiment, the filter support is openable to allow the replacement of the filtering media only, that can be recycled.

[0076] Advantageously, the filter support, the filter frame and/or parts of filter support (or filter frame) can be re-used. Advantageously, resources can be saved. An advantage can be that environmental friendliness can be increased. In an embodiment, the filter can be recycled.

[0077] In an embodiment, the filter frame, particularly the plastic frame, comprises two parts (particularly the first filter frame and the second filter frame), where the filter media is installed between. In an embodiment, the two filter frames are compressed together and mechanically locked. In an embodiment, an easy disassemble can be enabled, advantageously enabling easy recycling. In an embodiment, the filter frame can be re-used.

[0078] The mechanical assembling of the filter can be done in several ways.

[0079] In an embodiment, the first filter frame and/or the second filter frame comprises a handle to casing the filter dismounting.

[0080] In an embodiment, the filter support comprises an attachment device, wherein the attachment device is arranged and configured to attach the filter to the filter support, wherein the attachment device is configured for single use.

[0081] In an embodiment, the attachment device comprises a meltable spike.

[0082] In an embodiment, the filter support comprises an attachment device, wherein the attachment device is arranged and configured to attach the filter to the filter support, wherein the attachment device is configured for repeated, reversible attachment.

[0083] In an embodiment, the attachment device comprises a magnet, particularly a plurality of magnets. The magnets can be arranged and configured such that the magnetic forces can keep the filter together. In an embodiment, the attachment device comprises a clip, particularly a plurality of clips. In an embodiment, the attachment device comprises a metal clip, particularly a plurality of metal clips. In an embodiment, the attachment device comprises a hinge. In an embodiment, the attachment device comprises a plurality of hinges. In an embodiment the hinged filter frame

can be a permanent filter frame that can be opened and can accept filter replacement. Such a filter frame can be re-used. In an embodiment, the attachment device comprises a wire, particularly a plurality of wires. In an embodiment, the attachment device comprises a tongue, particularly a plurality of tongues. In an embodiment, the attachment device comprises a groove, particularly a plurality of grooves. In an embodiment, the attachment device comprises a plug, particularly a plurality of plugs. In an embodiment, the attachment device comprises a socket, particularly a plurality of sockets.

[0084] In an embodiment, the filter arrangement comprises an outer perimeter, wherein the filter protrudes outwards beyond the filter support when the filter is mechanically locked between the first filter frame and the second filter frame, such that the outer perimeter of the of the filter arrangement comprises the filter protruding outwards beyond the filter support.

[0085] In an embodiment, the filter protrudes radially outwards beyond the filter support when the filter is mechanically locked between the first filter frame and the second filter frame, such that the outer perimeter of the of the filter arrangement comprises the filter protruding outwards beyond the filter support.

[0086] In an embodiment, the filter support comprises a sealing means, particularly wherein the sealing means is arranged at the outer perimeter of the filter support, such that the outer perimeter of the of the filter arrangement comprises the filter support comprising the sealing means.

[0087] In an embodiment, the filter arrangement and the louver support are configured and arranged for the reduction of an intrusion of dust and/or liquids. In an embodiment, the filter arrangement and the louver support are configured and arranged such that an ingress protection is provided. In an embodiment, the filter arrangement and the louver support are configured and arranged such that an IP rating of IP54 is provided. In an embodiment, the filter arrangement and the louver support are configured and arranged such that an IP rating of IP55 is provided.

[0088] In an embodiment, the ventilation panel for a charging station further comprises a structural frame, wherein the structural frame comprises an outer surface and an inner surface, wherein the structural frame and the louver support are configured such that the louver support is arrangeable at the inner surface of the structural frame, particularly such that the louver plane is arrangeable parallel to the inner surface of the structural frame.

[0089] In an embodiment, the structural frame is removably installable in a ventilation opening of the charging station.

[0090] In an embodiment, the louver support is repeatedly, reversible arrangeable at the inner surface of the structural frame.

[0091] In an embodiment, the structural frame can comprise a metal frame.

[0092] In an embodiment, the structural frame comprises an interlocking structure and the louver support comprises a corresponding interlocking structure, wherein the interlocking structures are configured such that the louver support is repeatedly, reversibly assemblable to the structural frame.

[0093] In an embodiment, the structural frame comprises an interlocking structure and the louver support comprises a corresponding interlocking structure, wherein the interlocking structure of the structural frame and the interlocking structure of the louver support are configured such that the louver support is repeatedly, reversibly assemblable to the structural frame, via these interlocking structures.

[0094] In an embodiment, the interlocking structure of the structural frame and the interlocking structure of the louver support provide a clamping interlocking system.

[0095] In an embodiment, the installation of the louver support, particularly the plastic louver support, in the structural frame, particularly the metal structural frame, can be achieved by a clamping locking system. Advantageously, a fastening-device-free installation can be provided. In an embodiment, advantageously, no screws are needed. An advantage can be that no additional tools are needed for installation. The installation process can be simplified. Advantageously, maintenance can be simplified and/or accelerated.

[0096] In an embodiment, the structural frame comprises a metal front face, wherein the metal front face comprises a plurality of through-openings.

[0097] In an embodiment, the structural frame comprises a liquid collection container, wherein the liquid collection container is in fluid communication with an outlet.

[0098] In an embodiment, the structural frame is made of metal. In an embodiment, the metal front face is holed to allow the air passage. The diameter of the holes can affect the EMI shielding properties of the ventilation panel. In an embodiment, the connection between the structural frame and the plastic louver is not watertight. In an embodiment, the bottom part of the structural frame comprises a water catch tank (liquid collection container).

[0099] In an embodiment, the structural frame comprises a filter installation system. In an embodiment, the filter installation system is configured to receive the filter arrangement, particularly to receive the filter support with the supported filter. In an embodiment, the filter installation system is arranged and configured such that when the louver support is assembled to the structural frame and the filter arrangement is received by the filter installation system, the outer perimeter of the filter arrangement provides a sealing, particularly a perimetric sealing, between the structural frame and the filter. In an embodiment, the filter can fill the gap between the filter frame and the structural frame.

[0100] In an embodiment, the filter installation system is arranged and configured such that when the louver support is assembled to the structural frame, the filter is pressed against the louver support and/or against the louver blades, when the filter support with the supported filter is received by the filter installation system.

[0101] In an embodiment, when the filter arrangement is installed at the structural frame, the filter arrangement can be kept in position by a fastening system. In an embodiment, the fastening system can be located on the top region of the ventilation panel. In an embodiment, the fastening system can push the filter against the louver blades.

[0102] In an embodiment, the ventilation panel can comprise a plurality of aerodynamic louvers, particularly supported by a louver support. In an embodiment, the ventilation panel can comprise a filter, particularly a filter of a filter arrangement. In an embodiment, the ventilation panel can comprise a structural frame. The structural frame can be configured to receive the louver support. The structural frame can be configured to receive the filter arrangement. In an embodiment, the structural frame can be configured to receive the louver support and the filter arrangement.

[0103] In an embodiment, the louver blades (aerodynamic louvers) can be configured to reduce (particularly minimize) the pressure loss (pressure drop) due to the louver (see, e.g., FIG. **17**). In an embodiment, the louver blades can be configured to minimize the separation regions to allow the airflow to use the whole filter media surface (see, e.g., FIG. **16**B). The louver blades can be configured such that the flow separation is prevented and the airflow velocity is reduced.

[0104] A louver blade can be used in inflow configuration. A louver blade can be used in outflow configuration. In an embodiment, the louver blade can reduce the pressure loss in inflow configuration. In an embodiment, the louver blade can reduce the pressure loss in outflow configuration.

[0105] In an embodiment, wherein the ventilation panel can comprise a louver support, and a plurality of louver blades supported by the louver support, wherein a louver blade of the plurality of louver blades, particularly each louver blade of the plurality of louver blades, has a sheet-like shape, wherein the louver blade comprises a downstream trailing edge portion of the louver blade and an upstream leading edge portion of the louver blade, wherein the louver blade has a bent shape in a cross-sectional side view, wherein the louver blade is configured and arranged and/or arrangeable such that the upstream leading edge portion of the louver blade is at a smaller angle to the normal direction than the downstream trailing edge portion.

[0106] In an embodiment, the louver support can comprise a front side of the louver support, wherein the front side of the louver support can define a virtual front plane, wherein the louver blades are configured and arranged and/or arrangeable such that the upstream leading edge portion of the louver blade and the virtual front plane enclose a larger angle than the downstream trailing edge portion of the louver blade and the virtual front plane. In an embodiment, the trailing edge portion can be steeper than the leading edge portion.

[0107] In an embodiment, the structural frame is configured and arranged for impact protection. In an embodiment, the structural frame is configured and arranged to provide a protection against external mechanical impacts. In an embodiment, the structural frame is configured and arranged to provide at least an IK8 mechanical protection degree.

[0108] In an embodiment, the structural frame, the filter arrangement and the louver support are configured and arranged for the reduction of an intrusion of dust and/or liquids. In an embodiment, the structural frame, the filter arrangement and the louver support are configured and arranged such that an ingress protection is provided. In an embodiment, the structural frame, the filter arrangement and the louver support are configured and arranged such that an IP rating of IP54 is provided. In an embodiment, the structural frame, the filter arrangement and the louver support are configured and arranged such that an IP rating of IP55 is provided.

[0109] In an embodiment, the ventilation panel can be configured and arranged for use in an inflow configuration allowing (supporting) an inflow of air. Particularly, the ventilation panel can be configured and arranged such that air can flow from the external space via the metal front face, via the louver support and via the filter arrangement into the interior space.

[0110] In an embodiment, the ventilation panel can be configured and arranged for use in an outflow configuration allowing (supporting) an outflow of air. Particularly, the ventilation panel can be configured and arranged such that air can flow from the interior space via the filter arrangement, via the louver support and via the metal front face into the external space.

[0111] A further aspect relates to a charging station comprising the ventilation panel according to the present disclosure. The charging station can be a charging station for an electric vehicle.

[0112] In an embodiment, the ventilation panel is removably installable in a ventilation opening of the charging station. In an embodiment, the ventilation panel is repeatedly, reversibly removably installable in a ventilation opening of the charging station.

[0113] In an embodiment, the ventilation panel is arranged in the ventilation opening in the inflow configuration. In the inflow configuration, the filter can be arranged downstream of the louver support.

[0114] In an embodiment, the ventilation panel can be arranged at the charging station in the outflow configuration. In the outflow configuration, the filter can be arranged upstream of the louver support. In an embodiment, the charging station comprises a plurality of ventilation panels. In an embodiment, the charging station comprises a plurality of ventilation panels wherein a first ventilation panel of the plurality of ventilation panels is in inflow configuration and a second ventilation panel of the plurality of ventilation panels is in outflow configuration.

[0115] In an embodiment, in the inflow configuration, the louver blades are downstream of the metal front face of the structural frame and the filter is downstream of the louver blades. In an embodiment, in the outflow configuration, the louver blades are downstream of the filter and the metal front face of the structural frame is downstream of the louver blades.

[0116] In an embodiment, in comparison to the inflow configuration, in the outflow configuration, the louver support is rotated by 180° about the vertical axis.

[0117] A ventilation panel can be arranged in a side wall of the charging station.

[0118] The ventilation panel, particularly the plurality of ventilation panels, can be arranged such that air-cooling of the charging station is provided.

[0119] An advantage can be that the charging station can easily be maintained. Advantageously, this can save time and/or resources. Further, the filter properties can advantageously be improved. Advantageously, the structural frame, the louver support and the filter arrangement can provide proper impact and/or ingress protection. Advantageously, a proper protection of the internal components (e.g. electrical or electronic components) of the charging station against mechanical impacts and/or liquids and/or dust can be provided while also providing a proper air cooling. The functioning of the charging station can advantageously be improved.

BRIEF DESCRIPTION OF DRAWINGS

[0120] Further features and embodiments of the present disclosure are described in the following with reference to the Figures.

[0121] FIG. **1**A shows a schematic view of an embodiment of a ventilation panel in a fully assembled state.

[0122] FIG. **1**B shows a schematic view of an embodiment of a ventilation panel in a disassembled state.

[0123] FIG. **2**A shows a schematic perspective view of an embodiment of a louver support with supported louver blades.

[0124] FIG. **2**B shows a schematic view of an embodiment of an array of louver supports.

[0125] FIG. **3**A shows a schematic side view of an embodiment of a plurality of angled louver blades.

[0126] FIG. **3**B shows a schematic side view of an embodiment of an angled louver blade.

[0127] FIG. **4** shows a schematic side view of an embodiment of a curved louver blade.

[0128] FIG. **5**A shows a schematic side view of an embodiment of a plurality of C-shaped louver blades.

[0129] FIG. **5**B shows a schematic side view of an embodiment of a plurality of blade-shaped louver blades.

[0130] FIG. **6**A shows an embodiment of an interlocking structure.

[0131] FIG. **6**B shows an embodiment of an interlocking structure.

[0132] FIG. **7**A shows a schematic side view of an embodiment of a structural frame and an embodiment of an associated louver support.

[0133] FIG. **7**B shows a detail of FIG. **7**A (upper part).

[0134] FIG. **7**C shows a detail of FIG. **7**A (lower part).

[0135] FIG. **8**A shows a schematic side view of the arrange of the filter arrangement at the structural frame.

[0136] FIG. **8**B shows a schematic side view of the arrange of the filter arrangement at the structural frame.

[0137] FIG. **8**C shows a schematic side view of the arrange of the filter arrangement at the structural frame.

[0138] FIG. **8**D shows a schematic view of an embodiment of a filter arrangement.

[0139] FIGS. **9**A, **9**B show a filter arrangement in the disassembled state.

[0140] FIG. **10** shows a filter arrangement with a clip mechanism.

[0141] FIGS. **11**A, **11**B show a filter arrangement with a spike-and-hole-mechanism.

[0142] FIGS. **12**A, **12**B show a filter arrangement with a wire-mechanism.

[0143] FIGS. **13**A, **13**B show a filter arrangement with a magnet-mechanism.

[0144] FIGS. **14**A-C show a filter arrangement with a hinged filter frame.

[0145] FIGS. **15**A, **15**B show a filter arrangement with a sealing at the filter support.

[0146] FIG. **16**A shows a contour plot of air velocity through a standard louver, compute by CFD simulations.

[0147] FIG. **16**B shows a contour plot of air velocity through a louver support according to the present disclosure, compute by CFD simulations.

[0148] FIG. **17** shows the normalized pressure drop across as a function of airflow velocity.

[0149] FIG. **18** shows a scheme of an embodiment of a charging station.

DETAILED DESCRIPTION

[0150] In FIG. **1**A, an embodiment of a ventilation panel **1** for a charging station **3** is illustrated in a fully assembled state. The ventilation panel **1** can be arranged in the ventilation opening **5** of the charging station **3** (see FIG. **18**). In FIG. **1**B, the embodiment of FIG. **1**A is shown in a disassembled state. The illustrated ventilation panel **1** comprises a structural frame **10**. The illustrated ventilation panel **1** comprises a louver support **50**, particularly a plurality of louver supports **50**, and a plurality of louver blades **52**. A louver blade **52** of the plurality of louver blades can be supported by the louver support **50**. In the illustrated example, an array **70** of eight louver supports **50** is shown (comprising four rows and two columns of louver supports **50**). The illustrated ventilation panel **1** comprises a filter arrangement **100**. The illustrated filter arrangement **100** comprises a filter **102** and a filter support **104**. The filter support **104** can support the filter **102**. The filter **102** can extend in a filter extension plane. In the fully assembled state (FIG. **1**A) that louver support **50** and the filter arrangement **100** are attached to the structural frame **10**.

[0151] In FIG. **2**A, a louver support **50** is illustrated. The louver support **50** can comprise a louver support frame **80**. The louver support **50** can comprise a plurality of louver blades **52**. The plurality of louver blades **52** can be arranged in a louver blade area **53**. The louver blade area **53** can be surrounded by the louver support frame **80**.

[0152] The louver support **50** can support a plurality of louver blades **52**, particularly a plurality of louver blades **52** of the same shape and/or size. In an embodiment, the louver support **50** can support a plurality of identical louver blades **52**.

[0153] The louver support **50** can comprise an outer louver support frame **80**. The louver support **50** can comprise a central louver support strut **82**. The central louver support strut **82** can extend in a height direction H of the louver support **50**. The louver support frame **80** of a louver support **50** can form an outer perimeter **90** (external border) of the louver support **50**. The louver support frame **80** of a louver support **50** can extend in a circumferential direction of the louver support **50**.

[0154] A louver blade **52** of the plurality of louver blades **52** can be arranged between the central louver support strut **82** and the outer louver support frame **80**. In the illustrated embodiment, each louver blade **52** of the plurality of louver blades **52** can be arranged between the central louver support strut **82** and the outer louver support frame **80**. The louver blades can comprise a first side edge **88**. The louver blades **52** can be attached to the louver support **50** via the first side edge **88**. The louver blades **52** can be arranged perpendicular to the height direction H. In the illustrated embodiment, the plurality of louver blades **52** is stacked at a distance from each other along the height direction H. The louver blades **52** can span a louver plane P (also see FIGS. **3**A, **3**B, **4**).

[0155] A louver blade **52** of the plurality of louver blades **52** can extend in the longitudinal extension direction L of the louver blade **52**. The louver blades **52** of the louver support **50** can be arranged aligned with each other (also see FIGS. **3**A, **5**A, **5**B). The louver blades **52** of a louver support **50** can be arranged parallel to each other (also see FIGS. **3**A, **5**A, **5**B). The louver blades **52** can be arranged such that the longitudinal extension directions L of the louver blades **52** run perpendicular to the height direction H. The louver blades **52** can be arranged such that the longitudinal extension directions L of the louver blades **52** run horizontally. In the illustrated embodiment, the louver blades **52** are arranged evenly distributed along the height direction H (equally spaced apart along the height direction H) (also see FIGS. **3**A, **5**A, **5**B).

[0156] A louver blade **52** can comprise a leading edge **84** (foot edge **84**). The leading edge **84** of the louver blade **52**

can extend in the longitudinal extension direction L of the respective louver blade **52**. The leading edges **84** of the louver blades **52** can be arranged aligned. In an embodiment, the leading edges **84** of the louver blades **52** are arranged in the louver plane P. The leading edges **84** of the louver blades **52** can span the louver plane P (also see FIGS. **3**A, **3**B, **4**).

[0157] One louver blade **52**, particularly each louver blade **52**, can comprises an air-flow-facing surface **58**. The louver blades **52** can be arranged or arrangeable such that the air-flow-facing surface **58** faces the airflow when the panel **1** is used as intended. The air-flow-facing surface **58** can be concavely curved (particularly from the leading edge towards the trailing edge).

[0158] The louver support **50** can comprise an interlocking structure **60**, **62** (also see FIGS. **6**A, **6**B). In an embodiment, the louver support **50** comprises a plurality of interlocking structures **60**, **62**. An interlocking structure **60**, **62** can be arranged and configured to attach neighboring louver supports **50**. The interlocking structure **60** can be arranged and configured for horizontal attachment, such that the attached louver supports **50** are arranged side by side (row of an array **70** of louver supports **50**) (also see FIG. **6**A). The interlocking structure **62** can be arranged and configured for vertical attachment, such that the attached louver supports **50** are arranged one above the other (column of an array **70** of louver supports **50**) (also see FIG. **6**B). In an embodiment, the interlocking structure **60**, **62** can comprise a click-mechanism. In an embodiment, the interlocking structure **60**, **62** can comprise a slide-in mechanism. In an embodiment, the interlocking structure **60**, **62** can be configured for repeatedly, reversible assembly. In an embodiment, the interlocking structure **60**, **62** can be configured for repeatedly, reversible disassembly.

[0159] In an embodiment, the louver support **50** comprises a further interlocking structure **64**. The further interlocking structure can be configured for attachment of the louver support **50** to the structural frame **20**. In an embodiment, the interlocking structure **60**, **62** can be configured for attachment of the louver support **50** to the structural frame **20**.

[0160] Attached (interconnected) louver supports **50** can form the array **70** of louver supports **50**, particularly the array **70** of louver supports **50** each supporting a plurality of louver blades **52**. In an embodiment, outer portions (particularly non-interconnected portions) of the attached louver supports **70** can form the outer perimeter **90** of the array **70**.

[0161] An array **70** of louver supports **50** can comprise a plurality of equal louver supports **50**. In an array **70** of louver supports **52**, the louver blades **52** of all louver supports **50** of the array **70** can be arranged parallel to each other (see particularly FIGS. **1**B, **2**B). In an array **70** of louver support **52**, each louver blade **52** can be equally aligned. In an embodiment, in an array **70** of louver support **52**, all louver blades **52** can have the same size. In an embodiment, in an array **70** of louver support **52**, all louver blades **52** can have the same shape. In an embodiment, in an array **70** of louver support **52**, all louver blades **52** can face in the same direction.

[0162] The louver blades **52** can comprise a section with a curved shape in a cross-sectional side view. The louver blades **52** can comprise a plurality of section with a curved shape in a cross-sectional side view. The louver blades **52** can comprise a section with a straight shape in a cross-sectional side view. The louver blades **52** can comprise a plurality of sections with a straight shape in a cross-sectional side view. The louver blades **52** can comprise a section with a curved shape in a cross-sectional side view and a section with a straight shape in a cross-sectional side view.

[0163] The louver blades **52** can have a curved shape in a cross-sectional side view (see, e.g., FIGS. **2**A, **4**, **5**A). The louver blades **52** can have a C-shape in a cross-sectional side view (see, e.g., FIGS. **2**A, **5**A). The louver blades **52** can have a buckled (angled) shape in a cross-sectional side view (see, e.g., FIGS. **3**A, **3**B). The louver blades **52** can have a blade-shape in a cross-sectional side view (see, e.g., FIG. **5**B).

[0164] The louver blade **52** can comprise a leading edge portion **54**. The louver blade **52** can comprise a trailing edge portion **56** (see FIGS. **3**A, **3**B, **4**, **5**A, **5**B). The leading edge portion **54** can adjoin the trailing edge portion **56**. The leading edge portion **54** can extend from the leading edge **84** of the respective louver blade **52**.

[0165] In an embodiment, e.g. as illustrated in FIG. **3**B, in the cross-sectional side-view, the leading edge portion **54** is shorter than the trailing edge portion **56**. In its width extension direction W**1**, the leading edge portion **54** can be shorter than the trailing edge portion **56** in its width extension direction W**2**.

[0166] The leading edge portion **54** can enclose a first angle A**1** with respect to the normal direction of the louver plane P. The trailing edge portion **56** can enclose a second angle A**2** with respect to the normal direction N of the louver plane P. The first angle A**1** can be smaller than the second angle A**2**. A difference between the second angle A**2** and the first angle A**1** can be a difference angle A**3**.

[0167] In case of louver blades **52** with a curved shape in a cross-sectional side view, the angles (e.g. angles A**1**, A**2**) can be considered with regard to the respective tangents (e.g. tangents T**1**, T**2**) and the normal direction N of the louver plane P. In an embodiment, the first angle Al can be considered with regard to a tangent T**1** at the leading edge **84** (and the normal direction N of the louver plane P). In an embodiment, the second angle A**2** can be considered with regard to the tangent T**2** at the trailing edge **86** (head edge **86**) (and the normal direction N of the louver plane P). The trailing edge **86** can be arranged opposite to the leading edge **84** of the louver blade **52** (particularly see FIG. **4**). The trailing edge portion **56** can comprise the trailing edge **86**.

[0168] Along an extension direction from the leading edge **84** towards to trailing edge **86**, the curvature of the louver blade **52** can change.

[0169] The louver blades **52** can be arranged and configured such that in the side view, the trailing edge portion **56**, **56***a* of a first louver blade **52**, **52***a* extends beyond the leading edge **84***b* of a second louver blade **52**, **52***b*, with regard perpendicular to the normal direction N. In height direction H, the first louver blade **52**, **52***a* and the second louver blade **52**, **52***b* can overlap (see, e.g. FIG. **3**A).

[0170] In FIG. **3**B an embodiment with an angled cross-sectional side view is illustrated. The leading edge portion **54** and the trailing edge portion **56** can enclose an obtuse angle A**4**. Particularly, the air-flow-facing surface of the leading edge portion **54** and the air-flow-facing surface of the trailing edge portion **56** can enclose the obtuse angle A**4**.

[0171] The louver blades **52** can be arranged and configured such that the leading edge portions **54** of the plurality of louver blades **52** are arranged in parallel. The louver blades **52** can be arranged and configured such that the

trailing edge portions **56** of the plurality of louver blades **52** are arranged in parallel (see FIG. **3**A, also see FIGS. **5**A, **5**B).

[0172] In FIGS. **5**A and **5**B, embodiments of louver blades **52** are illustrated. In FIG. **5**A, a plurality of C-shaped louver blades **52** is illustrated. In FIG. **5**B, a plurality of blade-shaped louver blades **52** is illustrated. On the left sides of FIGS. **5**A and **5**B, an exemplary orientation of the louver blades **52** for inflow of air for the air flow direction F is illustrated. On the right sides of FIGS. **5**A and **5**B, an exemplary orientation of the louver blades **52** for outflow of air for the air flow direction F is illustrated. In the inflow configuration (left) as well as in the outflow configuration (right), the air flow (along the air flow direction F) first reaches the leading edge portions **54**.

[0173] In contrast to the inflow configuration, in the outflow configuration (orientation) the louver blades **52** are rotated. This can easily be established by rotating the entire louver support **50**. Hence, a louver support may be used for the inflow configuration as well as for the outflow configuration. The production of louver supports **50** can be simplified.

[0174] In FIGS. **7**A to **7**C, an embodiment of a structural frame **10** with an attached louver support **50** supporting louver blades **52** is illustrated. In FIG. **7**A a schematic overview of the embodiment is given. FIG. **7**B gives a more detailed view of the upper part of FIG. **7**A. FIG. **7**B gives a more detailed view of the lower part of FIG. **7**A.

[0175] The structural frame **10** can comprise a metal front face **22**. The metal front face **22** comprises an inner surface **12** and an outer surface **14**. In an embodiment, a through-opening **24** (particularly a plurality of through-openings **24**) can span the metal front face **22**, particularly from the inner surface **12** to the outer surface **14**. in an embodiment, the metal front face **22** can be holed (perforated). The metal front face **22** can extend in a plane.

[0176] In the illustrated embodiment, the structural frame **10** comprises an interlocking structure **20** of the structural frame **10** (FIG. **7**C). In the embodiment, the interlocking structure **20** of the structural frame **10** is configured for attachment of the louver support **50**, particularly via the interlocking structure of the louver support **50**.

[0177] In an embodiment, the interlocking structure **20** of the structural frame **10** is arranged corresponding to the outer perimeter **90** of the louver support **50**. In an embodiment, the interlocking structure **20** of the structural frame **10** is arranged corresponding to the outer perimeter **90** of the array **70** of louver supports **50**.

[0178] The louver support **50** can be arranged such at the structural frame **10** that the louver plane P extends parallel to the metal front face (extension plane of the metal front plane). In the illustrated embodiment, the louver support **50** can be arranged such at the structural frame **10** that the leading edge portion **54** is arranged adjacent to the metal front face **22**. In the illustrated embodiment, the louver support **50** can be arranged such at the structural frame **10** that the trailing edge portion **56** is arranged distant to the metal front face **22**.

[0179] In the illustrated embodiment, the louver support **50** is arranged such at the structural frame **10** that a gap **40** between the louver support **50** and the structural frame **10**. In particular, the gap **40** can be present between the louver support frame **80** and the structural frame **10**. The gap **40** can be present between the outer perimeter **90** of the louver support **50** and the structural frame **10** (see FIG. **7**B).

[0180] The illustrated exemplary structural frame **10** can comprise a liquid collection container **26**. The liquid collection container **26** can be in fluid communication with an outlet **28**. In an embodiment, via the outlet **28**, liquid collected in the liquid collection container **26** can be guided out of the ventilation panel **1**.

[0181] The structural frame **10** can comprise a filter installation system **30**. The filter installation system **30** can be configured to receive the filter arrangement **100** (also see FIGS. **8**A, **8**B, **8**C).

[0182] The filter arrangement **100** and the filter installation system **30** can be configured such that the filter arrangement **100** is insertable in the filter installation system **30**. The filter arrangement **100** and the filter installation system **30** can be configured such that when the filter arrangement **100** is received by the filter installation system **30**, the filter **102** of the filter arrangement **100** is arranged downstream of the louver support **50**. The filter arrangement **100** and the filter installation system **30** can be configured such that when the filter arrangement **100** is received by the filter installation system **30**, the filter **102** of the filter arrangement **100** is arranged downstream of the louver support **50** and the metal front face **22** of the structural frame **10**. In an embodiment, when the filter arrangement **100** is received by the filter installation system **30**, louver support **50** is arranged between the metal front face **22** of the structural frame **10** and the filter arrangement **100** (particularly the filter **102** of the filter arrangement **100**).

[0183] In an embodiment, the filter arrangement **100** can be inserted in the filter installation system **30** (FIG. **8**A) and then pushed towards the louver support **50** (FIG. **8**B). The filter arrangement **100** can be fixed to the structural frame **10** (FIG. **8**C).

[0184] In an embodiment, in the fully assembled state (louver support **50** and filter arrangement **100** attached to the structural frame), the louver plane P, the filter extension plane and the plane in that the metal front face extends extend in parallel. In an embodiment, in the fully assembled state, the filter extension plane and the plane in that the metal front face extend, extend perpendicular to the normal direction of the louver plane P.

[0185] In an embodiment, the filter **102** can be configured such that in the fully assembled state, the filter **102** aligns with the louver blade area **53**. In an embodiment, the filter **102** can be configured such that in the fully assembled state, the filter **102** is arranged downstream of the plurality of louver blades **52**. In an embodiment, the filter support **104** can be configured such that in the fully assembled state, the filter support **104** is arranged aligned with the louver support frame **80**.

[0186] In an embodiment, the filter arrangement **100** can be fixed to the structural frame **10** and/or the louver support **50** by means of a fastening device **32**.

[0187] The filter arrangement **100** can comprise an outer perimeter **110** (also see FIG. **8**D). The filter arrangement **100**, the louver support **50** and the structural frame **10** can be configured such that in the fully assembled state, the outer perimeter **110** of the filter arrangement **100** extends outward beyond the outer perimeter **90** of the louver support **50**. In an embodiment, in the fully assembled state, the outer perimeter **110** of the filter arrangement **100** can extend

towards the structural frame **10**. In an embodiment, the outer perimeter **110** of the filter arrangement **100** can cover the gap **40**.

[0188] In an embodiment, the filter **102** can extend outwards beyond the filter support **104** (see FIGS. **8**A, **8**B, **8**C, **8**D, **10**, **11**, **12**B, **13**B). In an embodiment, the filter **102** can protrude outwards from the filter support **104**. In an embodiment, the filter **102** can extend radially outwards beyond the filter support **104**. In an embodiment, the filter **102** can extend radially outwards beyond the first filter frame **120** and/or the second filter frame **122**.

[0189] The filter can comprise a central portion **106** and a perimetric portion **108**. In an embodiment, the perimetric portion **108** can extend outwards beyond the filter support **104**. In an embodiment, the central portion **106** can extend inwards beyond the filter support **104**. In an embodiment, the outer perimeter **110** of the filter arrangement **100** can comprise the perimetric portion of the filter **102**. In an embodiment, the outer perimeter **110** of the filter arrangement **100** consists of the perimetric portion of the filter **102**. In an embodiment, the perimetric portion **108** and the central portion **106** extend in a common plane.

[0190] In an embodiment, the filter **102** can end in or at the filter support **104**. In an embodiment, the outer perimeter **110** of the filter arrangement **100** can comprise a portion of the filter support **104** (see FIGS. **14**C, **15**A, **15**B). In an embodiment, the outer perimeter **110** of the filter arrangement **100** can comprise a portion of the filter support **104**. In an embodiment, the sealing means **112** can be arranged at the filter support **104** such that the outer perimeter **110** of the filter arrangement **100** comprises the sealing means **112**. The sealing means **112** can be a gasket. The scaling means **112** can be a sealing band (FIG. **15**A). The sealing means **112** can be a sealing foam arranged at the filter support **104** (FIG. **15**B).

[0191] In an embodiment, the filter support **104** comprises a first filter frame **120** and a second filter frame **122** (see, FIGS. **9**-**14**). The filter **102** can be fixed between the first filter frame **120** and the second filter frame **122**, when the first filter frame **120** is assembled to the second filter frame **122**.

[0192] In an embodiment, the first filter frame **120** and the second filter frame **122** can be assembled (particularly with the filter **102** between) by means of a spike-and-hole mechanism (FIGS. **9**A, **9**B, **11**A, **11**B). The first filter frame **120** can comprise a spike **130** protruding from the first filter frame **120**. The second filter frame **122** can comprise a corresponding hole **132**, particularly a through-hole. The spike **130** and the hole **132** can be arranged such that they align with each other, when the first filter frame **120** and the second filter frame **122** align. The spike **130** can pierce through (penetrate) the filter **102**. The spike **130** can extend through the hole **132** (FIG. **11**A). In an embodiment, for fixation, the spike **130** can be melt, particularly such that the spike **130** is fastened in the hole **132** (FIG. **11**B). In an embodiment, the first filter frame **120** can comprise a plurality of spikes **130** and the second filter frame **122** can comprise a corresponding plurality of corresponding holes **132**.

[0193] In an embodiment, the first filter frame **120** and the second filter frame **122** can be assembled (particularly with the filter **102** between) by means of a wire-mechanism (FIGS. **12**A, **12**B). The first filter frame **120** can comprise a pair of holes **134**. The second filter frame **122** can comprise a further pair of holes **136**. The pair of holes **134** can align with the further pair of holes **136** when the first filter frame **120** and the second filter frame **122** align. a wire **138** can be passed through the pair of holes **134**. The wire **138** can be folded at the first filter frame **120** and/or the second filter frame **122**. In an embodiment, the first filter frame **120** can comprise a plurality of pairs of holes **134** and the second filter frame **122** can comprise a corresponding plurality of corresponding further pairs of holes **136**.

[0194] In an embodiment, the first filter frame **120** and the second filter frame **122** can be assembled (particularly with the filter **102** between) by means of a magnet-mechanism (FIGS. **13**A, **13**B). The first filter frame **120** can comprise a magnet **140**, particularly an overmolded magnet. The second filter frame **122** can comprise a further magnet **142**, particularly an overmolded magnet. The magnet **140** can align with the further magnet **142** when the first filter frame **120** and the second filter frame **122** align. In an embodiment, the first filter frame **120** can comprise a plurality of magnets **140** and the second filter frame **122** can comprise a corresponding plurality of corresponding further magnets **142**.

[0195] In an embodiment, the first filter frame **120** and the second filter frame **122** can be assembled (particularly with the filter **102** between) by means of a clip-mechanism (FIG. **10**). The first filter frame **120** can comprise a clip **144**, particularly a metal clip. The clip **144** is arranged and configured to block together the first filter frame **120** and the second filter frame **122**, and particularly, the filter **102** between. The first filter frame **120** can comprise a plurality of clips **144**.

[0196] In an embodiment, the first filter frame **120** and the second filter frame **122** form a hinged filter frame **146** (FIG. **14**A, **14**B, **14**C).

[0197] The contour plot shown in FIG. **16**A relates to a standard louver support. The contour plot shown in FIG. **16**B relates to a louver support **50** according to an embodiment of the present disclosure. For the illustrated inflow condition, the plot shows a flow separation. A low velocity region **160**, a high velocity region **162** and an intermediate velocity region **164** are present. A low velocity downstream the louver blade can significantly reduce the air passage, and consequently lead to an airflow acceleration.

[0198] When a filter is coupled to the standard louver, only some regions of the filters are used by the airflow, namely those one aligned with the high-velocity regions **162** (high-speed trails) coming from the louver. Hence, only some regions of the filter are used by the airflow to get out. Therefore using a standard louver is not an efficient solution, since that accelerates the airflow and leads to a restricted usage of the filter surface.

[0199] A significant aerodynamic improvement can be achieved by the louver blades **52** according to an embodiment of the present disclosure (see FIG. **16**B). The lover blades **52** (aerodynamic fins) prevent the flow separation and reduce the airflow velocity.

[0200] In FIG. **17**, the normalized pressure drop across the standard and louvers according to an embodiment of the present disclosure are shown as a function of airflow velocity. The pressure loss can be reduced for the louver blades according to the present disclosure (compared to standard louver blades). In particular, the drop of pressure can be reduced for higher airflow velocities.

[0201] The disclosed systems and methods are not limited to the specific embodiments described herein. Rather, com-

ponents of the systems or steps of the methods may be utilized independently and separately from other described components or steps.

[0202] This written description uses examples to disclose various embodiments, which include the best mode, to enable any person skilled in the art to practice those embodiments, including making and using any devices or systems and performing any incorporated methods. The patentable scope is defined by the claims and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences form the literal language of the claims.

1. A ventilation panel for an electric vehicle charging station, wherein the ventilation panel comprises:

a louver support; and

a plurality of louver blades supported by the louver support,

wherein the louver blades have a sheet-like shape with a downstream trailing edge portion and an upstream leading edge portion,

wherein the louver blades have a bent shape in a cross-sectional side view, and

wherein the louver blades are supported by the louver support such that the louver blades define a louver plane and a normal direction that is orthogonal to the louver plane, and in the cross-sectional side view, the upstream leading edge portion defines a smaller angle with respect to the normal direction than the downstream trailing edge portion.

2. The ventilation panel for the electric vehicle charging station according to claim **1**, wherein the louver blades have a curved shape in a cross-sectional side view and/or wherein the louver blades have an angled shape in a cross-sectional side view.

3. The ventilation panel for the electric vehicle charging station according to claim **1**, wherein the louver blades are arranged along a height direction perpendicular to the normal direction, wherein a first louver blade and a neighbouring second louver blade are arranged and configured such that neighbouring pairs of louver blades overlap with each other in the height direction.

4. The ventilation panel for the electric vehicle charging station according to claim **1**, wherein:

the louver blades comprise a first side edge connecting a leading edge and a trailing edge, wherein the louver blades are mounted at the louver support by the first side edge,

the louver blades comprise the first side edge and an opposing second side edge connecting the leading edge and trailing edge, wherein the louver blades are mounted at the louver support by the first side edge and the second side edge, and/or

the louver blades are rotatably mounted at the louver support.

5. The ventilation panel for the electric vehicle charging station according to claim **1**, wherein the louver support comprises an interlocking structure, wherein the interlocking structure is configured such that a plurality of louver supports are attachable to each other thereby forming a one-dimensional or a two-dimensional array of interlocked louver supports.

6. The ventilation panel for the electric vehicle charging station according to claim **1**, wherein the ventilation panel further comprises a filter arrangement comprising a filter supported by a filter support, wherein the filter comprises a filter surface, and wherein the filter arrangement is configured such that the filter surface is arrangeable essentially in parallel to the louver plane.

7. The ventilation panel for the electric vehicle charging station according to claim **6**, wherein:

the filter arrangement comprises an outer perimeter,

the outer perimeter of the filter arrangement comprises a portion of the filter, and/or a portion of the filter support, and

the outer perimeter of the filter arrangement is configured to be sealable.

8. The ventilation panel for the electric vehicle charging station according to claim **6**, wherein the filter support comprises a first filter frame and a corresponding second filter frame, wherein the first filter frame and the second filter frame are configured such that the first filter frame is assemblable to the second filter frame,

wherein the first filter frame and the second filter frame are configured such that the filter is mechanically locked between the first filter frame and the second filter frame, when the first filter frame is assembled to the second filter frame.

9. The ventilation panel for the electric vehicle charging station according to claim **6**, wherein the filter support comprises an attachment device, wherein the attachment device is arranged and configured to attach the filter to the filter support, wherein:

the attachment device is configured to be single use, or

the attachment device is configured to be repeatedly, reversibly attachable, or

the attachment device comprises a magnet, a clip, a hinge, a wire, a tongue, a groove, a plug and/or a socket.

10. The ventilation panel for the electric vehicle charging station according to claim **7**, wherein:

the filter protrudes outwards beyond the filter support when the filter is mechanically locked between the first filter frame and the second filter frame, such that the outer perimeter of the of the filter arrangement comprises the filter protruding outwards beyond the filter support, and/or

the filter support comprises a sealing mechanism, wherein the sealing mechanism is arranged at an outer perimeter of the filter support, such that the outer perimeter of the of the filter arrangement comprises the filter support comprising the sealing mechanism.

11. The ventilation panel for the electric vehicle charging station according to claim **1**, wherein:

the ventilation panel for the electric vehicle charging station further comprises a structural frame,

the structural frame comprises an outer surface and an inner surface, and

the structural frame and the louver support are configured such that the louver support is arrangeable at the inner surface of the structural frame, such that the louver plane is arrangeable parallel to the inner surface of the structural frame.

12. The ventilation panel for the electric vehicle charging station according to claim **11**, wherein:

the structural frame comprises an interlocking structure,

the louver support comprises a corresponding interlocking structure,

the interlocking structures are configured such that the louver support is repeatedly, reversibly assemblable to the structural frame, and

the interlocking structure of the structural frame and the interlocking structure of the louver support provide a clamping interlocking system.

13. The ventilation panel for the electric vehicle charging station according to claim **11**, wherein:

the structural frame comprises a metal front face, wherein the metal front face comprises a plurality of through-openings, and/or

the structural frame comprises a liquid collection container, wherein the liquid collection container is in fluid communication with an outlet.

14. The ventilation panel for the electric vehicle charging station according to one of the claims **11**, wherein;

the structural frame comprises a filter installation system,

the filter installation system is configured to receive the filter arrangement, and

the filter installation system is arranged and configured such that when the louver support is assembled to the structural frame and the filter arrangement is received by the filter installation system, the outer perimeter of the filter arrangement provides a sealing between the structural frame and the filter.

15. A charging station comprising a ventilation panel, the ventilation panel comprising:

a louver support; and

a plurality of louver blades supported by the louver support,

wherein the louver blades have a sheet-like shape with a downstream trailing edge portion and an upstream leading edge portion,

wherein the louver blades have a bent shape in a cross-sectional side view,

wherein the louver blades are supported by the louver support such that the louver blades define a louver plane and a normal direction which is orthogonal to the louver plane, and that in the cross-sectional side view, the upstream leading edge portion defines a smaller angle with respect to the normal direction than the downstream trailing edge portion, and

wherein the ventilation panel is removably installable in a ventilation opening of the charging station.

16. The ventilation panel for the electric vehicle charging station according to claim **4**, wherein the louver blades are repeatedly, reversibly rotatable between a working position and a closed position, wherein in the closed position the louver blades are set at a steeper angle than in the working position such that in the closed position an air flow through the louver support is reduced.

17. The ventilation panel for the electric vehicle charging station according to claim **6**, wherein the filter arrangement and the louver support are configured and arrangeable such that in an inflow configuration the trailing edge is closer to the filter than the leading edge.

18. The ventilation panel for the electric vehicle charging station according to claim **6**, wherein the filter arrangement and the louver support are configured and arrangeable such that in an outflow configuration the leading edge is closer to the filter than the trailing edge.

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