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(54) Benævnelse: **VENTILATIONSSYSTEM OG FREMGANGSMÅDE**

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DESCRIPTION

TECHNICAL FIELD

[0001] The present application generally relates to soundproof spaces. In particular, but not exclusively, the present application relates to ventilation of soundproof spaces.

BACKGROUND

[0002] This section illustrates useful background information without admission of any technique described herein being representative of the state of the art.

[0003] Soundproof spaces, such as phone booths or conference rooms, are typically sealed structures requiring an air circulation, or ventilation, system in order to ascertain adequate ventilation and to prevent the temperature from rising unpleasantly high. If the soundproof space is movable, it might not be always be possible to connect it to the ventilation system of the surrounding space, such as an office building.

[0004] It is desirable to avoid bulky structures, such as thick walls, in movable soundproof spaces, which makes it difficult to arrange the structures required for a ventilation system. A further challenge is presented by the soundproofing, i.e. the ventilation system should not affect the soundproofing. Furthermore, the ventilation system itself should not produce noise inside the soundproof space or outside of it, which can be challenging, especially in smaller spaces.

[0005] The present invention aims to provide a ventilation system and method for movable soundproof spaces that overcomes or at least mitigates the above-mentioned challenges.

SUMMARY

[0006] Various aspects of the invention are set out in the claims.

[0007] According to a first aspect of the present invention as defined in claim 1, there is provided a sandwich-type wall, roof or floor structure of a space to be ventilated comprising a ventilation system, the ventilation system comprising

at least one fan positioned at at least one air inlet aperture or at at least one air outlet aperture for sucking air therethrough and providing an air flow;

at least one ventilation aperture for guiding air into the space to be ventilated;

at least a first and a second air channel;

wherein the first and the second air channel are formed respectively into a single layer of a sandwich-type wall, roof or floor structure of the space to be ventilated; and wherein

the first and the second air channel are joined at one end thereof to form an indirect air path having curves and bends from the air inlet aperture to the ventilation aperture.

[0008] The ventilation system may further comprise at least a third and a fourth air channel formed respectively into a single layer of a sandwich-type wall, roof or floor structure of the space to be ventilated and joined at one end thereof to form an indirect air path from the space to be ventilated to the air outlet aperture.

[0009] The first and the second air channel and/or the third and the fourth air channel, respectively may not overlap in the direction perpendicular to the roof, floor or wall, except at the end thereof where they are joined.

[0010] The ventilation system may further comprise at least one further air channel formed respectively into a single layer of the sandwich-type wall, roof or floor structure and joined with the first and the second air channel and/or with the third and the fourth air channel, respectively to form the indirect air path having curves and bends.

[0011] The at least one of said air channels may comprise curves or bends in the plane of a layer in which it is formed.

[0012] The width of said air channels may be larger than their height.

[0013] According to a preferred aspect of the present invention, there is provided a soundproof space, comprising

a sandwich-type roof, wall and/or floor structure according to the first aspect of the invention and comprising at least two sound

dampening layers and at least one sound stopping layer; and

a ventilation system according to the first example aspect of the present invention.

[0014] The at least one air inlet aperture and/or the at least one air outlet aperture may be positioned at the roof, the floor or at the lower corners of the soundproof space.

[0015] The material of the layers in which the first, the second, the third and/or the fourth air channel are formed may be chosen in such a way that the surface properties thereof do not

substantially hinder the air flow in the air channel.

[0016] According to a second aspect of the present invention as defined in claim 10, there is provided a method of ventilating a soundproof-space having a sandwich type wall, roof or floor structure, comprising

forming an indirect air path through the wall, roof or floor structure from at least one inlet aperture by forming a first and a second air channel joined at one end thereof and formed respectively into a single layer of the sandwich-type wall, roof or floor structure of the space to be ventilated;

providing an air flow into the indirect air path with at least one fan positioned at the at least one air inlet aperture or at at least one air outlet aperture by sucking air therethrough; and

adjusting the air flow so that the amount thereof is large enough and the noise caused by the ventilation does not exceed a desired threshold.

[0017] Different non-binding example aspects and embodiments of the present invention have been illustrated in the foregoing. The embodiments in the foregoing are used merely to explain selected aspects or steps that may be utilized in implementations of the present invention. Some embodiments may be presented only with reference to certain example aspects of the invention. It should be appreciated that corresponding embodiments may apply to other example aspects as well.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] For a more complete understanding of example embodiments of the present invention, reference is now made to the following descriptions taken in connection with the accompanying drawings in which:

Fig. 1 shows a principle view of a soundproof space, a conference booth, for example in which an embodiment of the invention is used;

Fig. 2 shows a schematic view of a ventilation system according to an embodiment of the invention;

Fig. 3 shows a schematic view of air apertures of a ventilation system according to an embodiment of the invention; and

Fig. 4 shows a flow chart of a ventilation method according to an embodiment of the invention.

DETAILED DESCRIPTON OF THE DRAWINGS

[0019] The present invention and its potential advantages are understood by referring to Figs. 1 through 4 of the drawings. In this document, like reference signs denote like parts or steps.

[0020] Fig. 1 shows a principle view of a soundproof space, in this example a movable conference booth, for example in which an embodiment of the invention is used. The phone booth 100 comprises walls 120 and a door 140. The ventilation system 200 (Fig. 2) and the ventilation method according to an embodiment of the invention is for example used in the conference booth 100. The wall structure of the conference booth 100 is not thick and accordingly, the ventilation system 200 is not bulky. The ventilation system and method according to an embodiment of the invention is further used for example in vehicles, in engine rooms, in temporary housing and other buildings or casings requiring ventilation with low noise levels. Fig. 1 further shows at least one fan of the ventilation system 200 and an air outlet aperture 90e which will be described hereinafter with reference to Figs. 2 and 3.

[0021] Fig. 2 shows a schematic view of a ventilation system 200 according to an embodiment of the invention. Fig. 2 shows the wall, or roof, structure in which the ventilation system is arranged. The wall structure is a sandwich-type structure comprising a first layer 10 of sound stopping material 10, for example a layer of metal, a second layer 20 and a third layer 30 of sound dampening material, for example porous or open cell material, a fourth layer 40 of sound stopping material, for example metal, plywood, hardboard, plastic or composite metal, and a fifth layer 50 of sound dampening or acoustic material, for example porous or open cell material. In an embodiment, the fourth layer 40 comprises a steel plate having apertures at the sides thereof.

[0022] The ventilation system 200 is arranged into roof structure of the soundproof space. In a further embodiment, the ventilation system is arranged in a wall or floor of the soundproof space, or into a roof of a soundproof space that is not horizontal. In an embodiment, the ventilation system comprises at least one fan 70 for sucking air from outside of the soundproof space through an air inlet aperture and providing an air flow. Although two fans are shown in Fig.2, the number of fans 70 is not limited thereto. The number of fans, and the type of fans, is chosen in accordance with the situation, i.e. the required amount of air and the required air flow speed and static pressure. Furthermore, the noise produced by the fans must not rise beyond a certain predetermined level. In an embodiment, the ventilation system 200 comprises a control arrangement for adjusting the power of the fans in order to achieve a suitable balance between air flow and noise produced. In a further embodiment, the at least one fan 70 is instead or in addition to being positioned at at least one air inlet aperture for sucking air from the outside of the space, positioned at at least one air outlet aperture for sucking air from inside the soundproof space and providing the airflow.

[0023] The ventilation system further comprises at least a first air channel 60a and a second air channel 60b. The first 60a and the second 60b air channel are both formed in a single layer of the sandwich-type structure respectively in order to maintain the soundproofing quality of the

structure, since the soundproofing material is removed only from a single layer at each position. The first 60a and the second 60b air channel are joined at one end thereof, for example through an aperture in a sound stopping layer 40, to form an indirect air path through the sandwich-type roof structure. Furthermore, it is to be noted, that the structure of the air channels leading to air outlet apertures, for example near the floor of the soundproof space, is similar to that of the air channels from the inlet apertures as described hereinbefore and hereinafter.

[0024] The height of the first 60a and the second 60b is accordingly limited by the respective layer in which they are formed and their width is chosen in accordance with the required air flow. In an embodiment, the width of the first 60a and second 60b air channel is substantially larger that the height thereof in order to ascertain an adequate cross-sectional area. In an embodiment, the thickness of the roof is about 100mm and the thickness of the single layers and therethrough the maximum height of the air channels is 20-40 mm. The material of the layers in which the first 60a and the second 60b air channel are formed is in an embodiment chosen in such a way that the surface properties thereof do not substantially hinder the air flow in the air channel.

[0025] The amount of ventilation is not merely affected by the number and/or power of the fans, as mentioned hereinbefore, but also by the cross-sectional area of the air channels, the length and geometry of the air channels and the position of air inlet and outlet apertures. Furthermore, structures such as grilles or grids or meshes covering the air inlet and outlet apertures affect the amount of ventilation, or air flow.

[0026] The ventilation system 200 comprises at least one ventilation aperture 80 for guiding the air into the space to be ventilated, for example into the soundproof space from the first 60a and second 60b air channel. It is to be noted that the ventilation system 200 shown in Fig. 2 comprises a first 60a and a second 60b air channel forming an indirect path from the fan to the inside of the soundproof space on both sides of the roof. In an embodiment, the ventilations system comprises just one indirect path formed by the first 60a and second 60b air channel. In a further embodiment, the ventilation system comprises several indirect paths formed by the first 60a and second 60b air channel, i.e. the number of indirect air paths is not limited to one or two.

[0027] The ventilation system 200 comprises the first 60a and second 60b air channel forming an indirect air path in order not to compromise the soundproofing of the space. Should the air path be direct through the roof or wall structure sound would travel therethrough relatively easily as well. Since the air path is indirect, i.e. has curves and bends, the sound must travel a longer and indirect way therethrough. Although Fig. 2 shows the indirect air path formed by the first 60a and the second 60b air channel, in a further embodiment the ventilation system comprises an air path formed by three or more air channels, if the sandwich-type structure has sufficient space for further air channels. Furthermore, the first 60a and second 60b air channel comprise, in an embodiment, curves or bends also in the plane of the respective layer in which they are formed, i.e. they do not run straight in the plane of the layer. Furthermore, the first

60a and second 60b air channel are in an embodiment formed in different positions in the plane of the roof, i.e. they do not overlap in the direction perpendicular to the roof, floor or wall, except of course at the position in which they are joined together.

[0028] The length of the first 60a and second 60b air channel is chosen in accordance with the situation so that they are long enough in order not to compromise the soundproofing and short enough so as to be able to provide an adequate ventilation. The amount of ventilation required for a space is, in an embodiment, at least 8 l/s per person. Accordingly, for example in a soundproof space having a volume of 4,8 m^3 and having space for four people, the amount of ventilation needed is 32 l/s.

[0029] Fig. 3 shows a schematic view of air apertures of a ventilation system 200 according to an embodiment of the invention. The air inlet and outlet apertures are in an embodiment positioned in such a way that they are as far as possible from people in the environment of the soundproof space, for example people working in an office in which the movable soundproof space is in use in order to prevent sound from outside being conveyed in to the soundproof space via the air inlet and outlet apertures and in order for the possible noise of the at least one fan 70 at the air inlet apertures not to disturb the people in the environment of the soundproof space. Appropriate positions for the inlet and outlet apertures are for example the roof, the floor and lower corners of the soundproof space. Fig.3 shows air inlet apertures 90a,90b and air outlet apertures 90c,90d,90e. The number of inlet and outlet apertures is not limited to the example shown, but rather the number thereof is chosen in accordance with the situation, starting from one inlet and outlet aperture each. In an embodiment, an indirect air path as hereinbefore described formed by a first channel 60a and a second channel 60b leads from inlet apertures to a ventilation aperture 80 and an indirect air path as hereinbefore described with reference to at least the first 60a and second 60b air channels, formed at least by a third and a fourth air channel (not shown) leads from the space to be ventilated to the outlet apertures. In an embodiment, several indirect air paths formed by a first channel 60a and a second channel 60b lead into the soundproof space from each air inlet aperture 90a,90b or from one or more of the air inlet apertures 90a,90b. In an embodiment, several indirect air paths formed by a third channel and a fourth channel lead into each air outlet aperture 90c,90d,90e or to one or more of the air outlet apertures 90e,90d,90e from inside the soundproof space.

[0030] Fig. 4 shows a flow chart of a ventilation method according to an embodiment of the invention. At step 410 at least a first 60a and a second 60b air channel is formed into a single layer of a roof, wall or floor structure of a soundproof space as hereinbefore described with reference to Figs. 1-3 in order to provide an indirect air path through the roof, floor or wall structure. At step 420, an air flow is provided to the indirect air path by sucking air through an inlet aperture 90a,90b with a fan 70 or by sucking from the inside of the soundproof space through an outlet aperture 90c,90d,90e with a fan 70. At step 430, the air flow is adjusted so that the amount thereof is large enough and the noise caused by the ventilation does not exceed a desired threshold, i.e. the noise does not rise to an uncomfortable level.

[0031] Without in any way limiting the scope, interpretation, or application of the claims appearing below, a technical effect of one or more of the embodiments disclosed herein is providing a stand alone sandwich-type wall, roof or floor structure of a space to be ventilated comprising a ventilation system for a movable soundproof space. Another technical effect of one or more of the embodiments disclosed herein is providing a sandwich-type wall, roof or floor structure of a space to be ventilated comprising a ventilation system without increasing the bulk of the wall or roof structures of a soundproof space. A still further technical effect of one or more of the embodiments disclosed herein is providing a sandwich-type wall, roof or floor structure of a space to be ventilated comprising a ventilation system for a soundproof space without compromising the soundproofing or causing noise.

[0032] It is also noted herein that while the foregoing describes example embodiments of the invention, these descriptions should not be viewed in a limiting sense. Rather, there are several variations and modifications which may be made without departing from the scope of the present invention as defined in the appended claims.

VENTILATIONSSYSTEM OG FREMGANGSMÅDE

PATENTKRAV

1. Sandwichstruktur til væg, tag eller gulv i et rum, der skal ventileres, som omfatter et ventilationssystem (200), der omfatter

mindst én ventilator (70), der er placeret ved mindst én luftindløbsåbning (90a, 90b) eller mindst én luftudløbsåbning (90c, 90d, 90e), til at suge luft derigennem og tilvejebringe en luftstrøm,

mindst én ventilationsåbning (80) til at lede luft ind i rummet, der skal ventileres,

mindst en første (60a) og en anden (60b) luftkanal,

kendetegnet ved, at den første (60a) og den anden (60b) luftkanal er dannet til henholdsvis et enkelt lag af sandwichstrukturen til væg, tag eller gulv i det rum, der skal ventileres, hvor den første og den anden luftkanal er dannet i planet af det respektive lag, hvori de er dannet, og ved, at

den første (60a) og den anden (60b) luftkanal er forbundet i den ene ende deraf for at danne en indirekte luftvej med kurver og bøjninger fra luftindløbsåbningen til ventilationsåbningen (80).

2. Sandwichstruktur til væg, tag eller gulv ifølge krav 1, hvor ventilationssystemet yderligere omfatter mindst en tredje og en fjerde luftkanal, der er konfigureret til at blive formet henholdsvis til et enkelt lag af en sandwichstruktur til væg, tag eller gulv i rummet, der skal ventileres, og forbindes i den ene ende deraf for at danne en indirekte luftvej med kurver og bøjninger fra det rum, der skal ventileres, til luftudløbsåbningen.

3. Sandwichstruktur til væg, tag eller gulv ifølge krav 1 eller 2, hvor henholdsvis den første (60a) og den anden (60b) luftkanal og/eller den tredje og den fjerde luftkanal ikke overlapper hinanden vinkelret på tag, gulv eller væg, undtagen i enden af den, hvor de er sammenføjet.

4. Sandwichstruktur til væg, tag eller gulv ifølge et hvilket som helst af de foregående krav, hvor ventilationssystemet yderligere omfatter mindst en yderligere luftkanal, der er konfigureret til at blive dannet henholdsvis til et enkelt lag af

sandwichstrukturen til væg, tag eller gulv og forbundet med den første (60a) og den anden (60b) luftkanal og/eller med henholdsvis den tredje og den fjerde luftkanal for at danne den indirekte luftvej med kurver og bøjninger.

5. Sandwichstruktur til væg, tag eller gulv ifølge et hvilket som helst af de foregående krav, hvor mindst én af luftkanalerne omfatter kurver eller bøjninger i planet af et lag, hvori den er dannet.

6. Sandwichstruktur til væg, tag eller gulv ifølge et hvilket som helst af de foregående krav, hvor bredden af luftkanalerne er større end højden.

7. Lydisoleret rum, bestående af

en sandwichstruktur til væg, tag eller gulv ifølge et hvilket som helst af de foregående krav, idet sandwichstrukturen til væg, tag eller gulv omfatter mindst to lyddæmpende lag (20, 30, 50) og mindst ét lydisolerende lag (10, 40).

8. Lydisoleret rum ifølge krav 7, hvor den mindst ene luftindløbsåbning (90a, 90b) og/eller den mindst ene luftudløbsåbning er placeret ved taget, gulvet eller ved de nedre hjørner af det lydisolerede rum.

9. Lydisoleret rum ifølge krav 7 eller 8, hvor materialet af lagene, hvori den første (60a), den anden (60b), den tredje og/eller den fjerde luftkanal er udformet, er valgt på en sådan måde, at overfladeegenskaberne af dette ikke væsentligt hindrer luftstrømmen i luftkanalen.

10. Fremgangsmåde til at ventilere et lydisoleret rum med en sandwichstruktur til væg, tag eller gulv, der omfatter

dannelse af en indirekte luftvej med kurver og bøjninger gennem sandwichstrukturen til væg, tag eller gulv fra mindst én indløbsåbning (90a, 90b) ved at danne en første (60a) og en anden (60b) luftkanal, der er forbundet i den ene ende deraf og dannet henholdsvis i et enkelt lag af sandwichstrukturen til væg, tag eller gulv i rummet, der skal ventileres, hvor den første og den anden luftkanal er dannet i planet af det respektive lag, hvori de er dannet,

tilvejebringelse af en luftstrøm i den indirekte luftvej med kurver og bøjninger med mindst én ventilator (70), der er placeret ved den mindst ene luftindløbsåbning

(90a, 90b), eller mindst én luftudløbsåbning (90c, 90d, 90e) ved at suge luft derigennem, og

justering af luftstrømmen, så mængden heraf er stor nok, og støjen forårsaget af ventilationen ikke overstiger en ønsket grænseværdi.

DRAWINGS

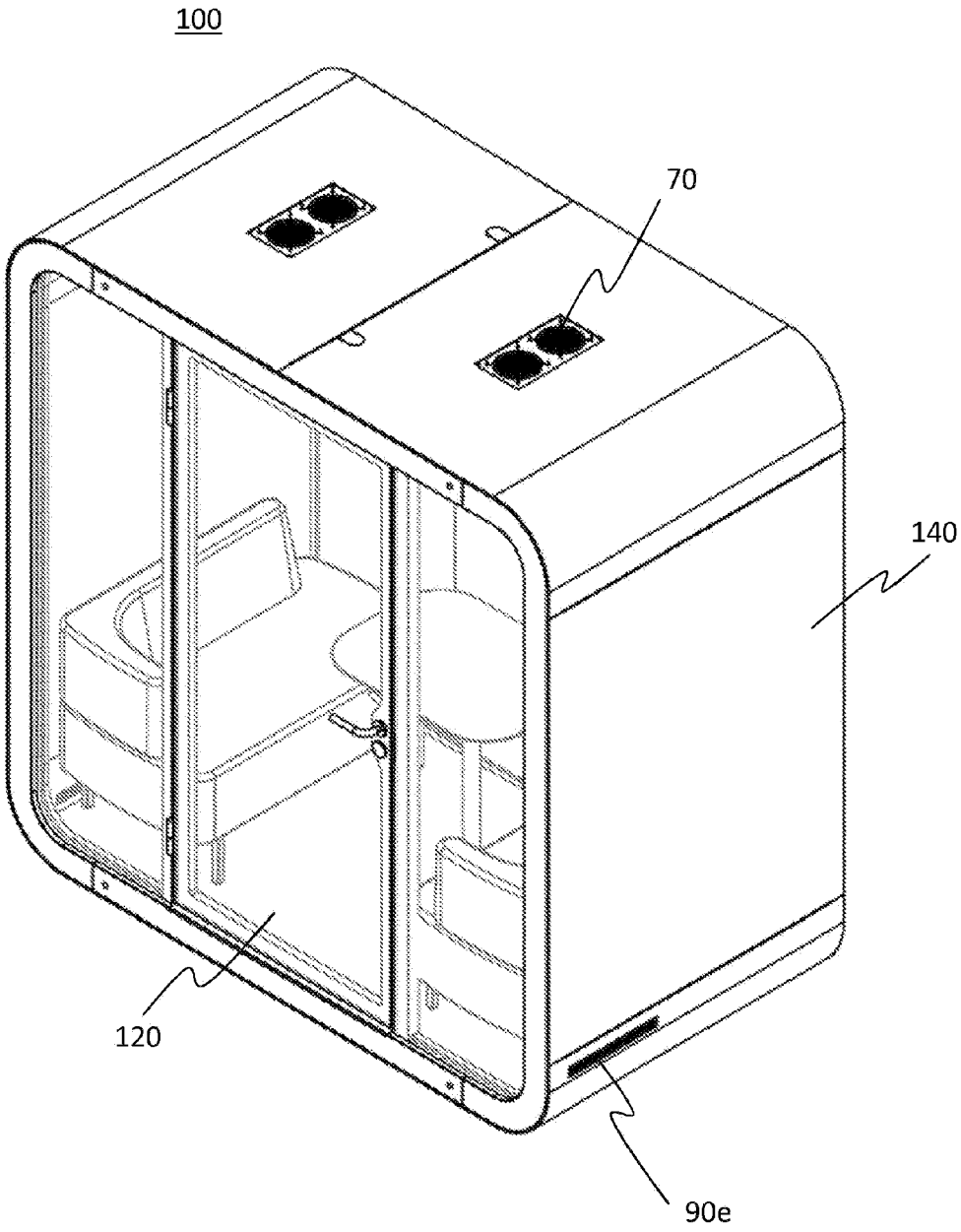

Fig. 1

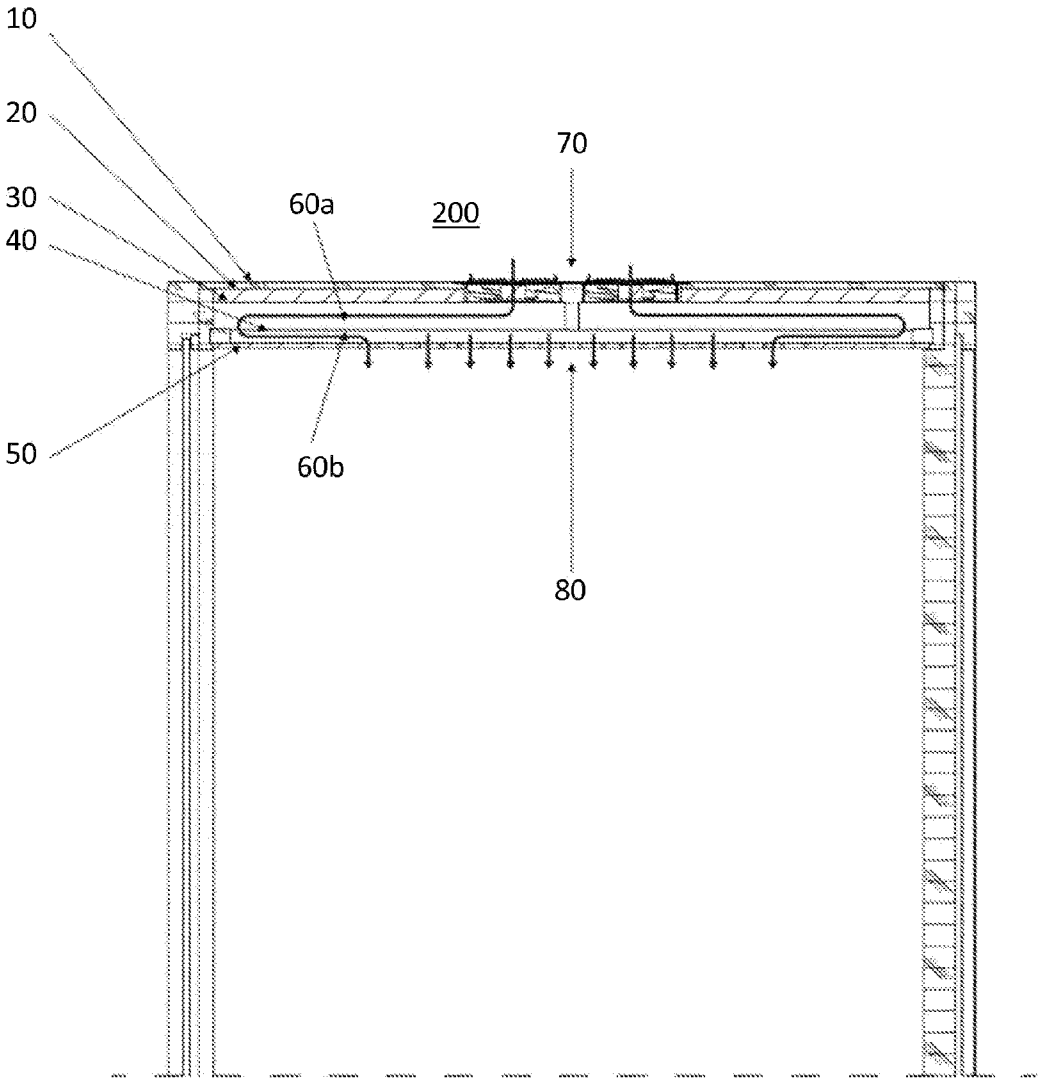

Fig. 2

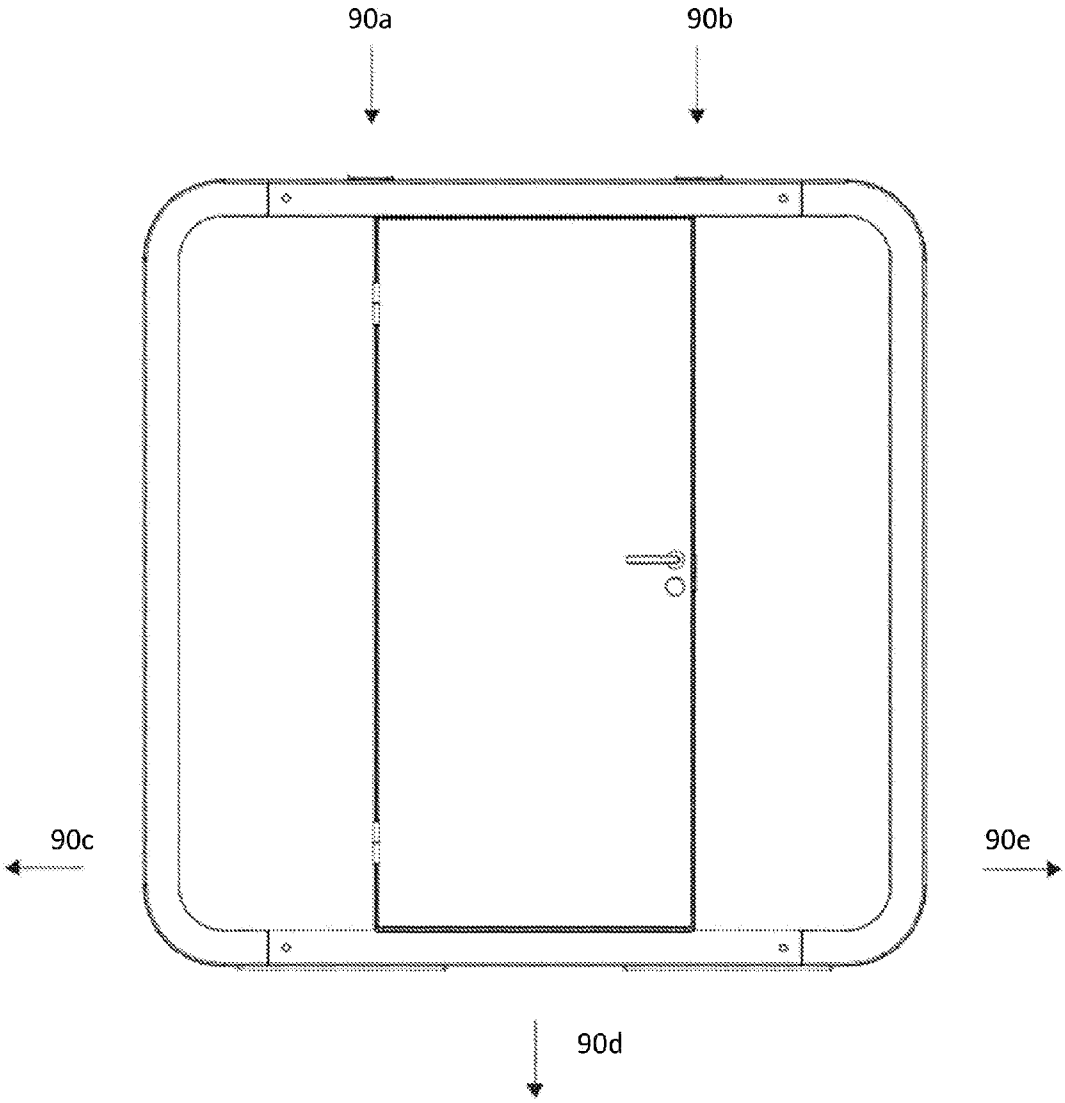

Fig. 3

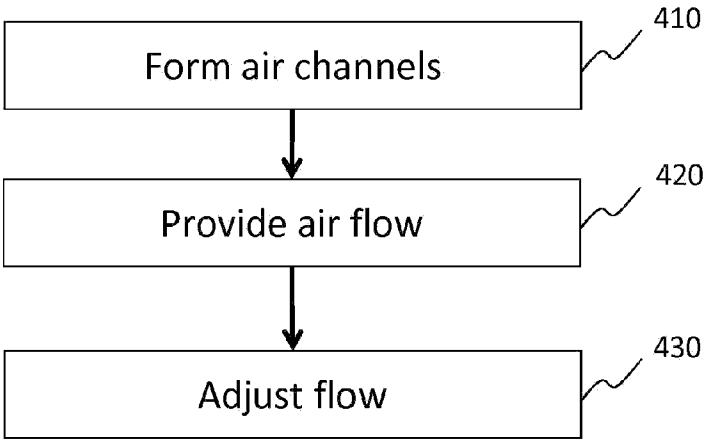

Fig. 4