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(54) **AEROGEL TRIPLE INSULATED GLAZING UNIT**

(57) The present invention relates to a triple insulated glazing unit comprising a first glass pane, an intermediate second glass pane and a third glass pane arranged in parallel, wherein the first glass pane comprises a first major glass surface and a second major glass surface, wherein the first major glass surface is facing an outside environment of the triple insulated glazing unit and the second major glass surface is facing a first gap of the triple insulated glass unit, wherein the intermediate second glass pane comprises a third major glass surface and a fourth major glass surface, wherein the third major glass surface is facing the first gap while the fourth major glass surface is facing a second gap of the triple insulated glass unit, wherein the third glass pane comprises a fifth major glass surface and a sixth major glass surface, wherein the fifth major glass surface is facing the second gap and the sixth major glass surface is facing the outside environment of the triple insulated glazing unit, wherein the first gap and second gap are enclosed by one or more edge seals, and wherein the triple insulated glazing unit comprises a first aerogel layer and a first low-emissivity coating, wherein each of the first low-emissivity coating and the first aerogel layer is arranged on a major glass surface of one of the glass panes.

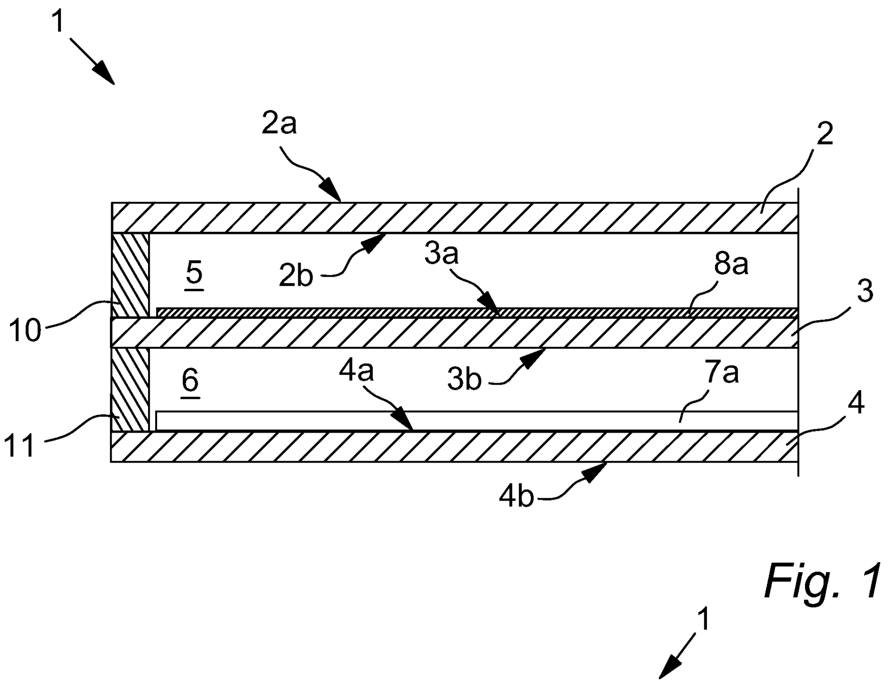

Fig. 1

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Description

[0001] The invention relates to a triple insulated glazing unit for a building aperture cover and to a building aperture cover comprising such triple insulated glazing unit.

BACKGROUND

[0002] The manufacturing of building aperture covers with glazing units has been the subject of development over many years, where one of the major development goals has been to increase the insulation properties of the cover. This has among others been achieved by developing glazing units with improved heat insulation properties e.g. by providing glazing units comprising two glass sheets spaced apart by an insulating gap, such as a gap filled with an inert gas. Other solutions comprise providing a vacuum insulated glass unit with an evacuated gap between glass sheets of the unit. Additionally, the cover frame, e.g. window frame, has been subject to development in order to increase the insulation properties of the frame e.g. by developing the structure, design as well as the materials used in providing the frame structure.

[0003] In pursuit to improve the insulating properties of the building aperture cover, it is a further object to provide a window, which is applicable to a wide range of different climates and consequently a larger market.

BRIEF DESCRIPTION OF THE INVENTION

[0004] The first aspect of the present invention relates to a triple insulated glazing unit comprising a first glass pane, an intermediate second glass pane and a third glass pane arranged in parallel,

wherein the first glass pane comprises a first major glass surface and a second major glass surface, wherein the first major glass surface is facing an outside environment of the triple insulated glazing unit and the second major glass surface is facing a first gap of the triple insulated glass unit,
wherein the intermediate second glass pane comprises a third major glass surface and a fourth major glass surface, wherein the third major glass surface is facing the first gap while the fourth major glass surface is facing a second gap of the triple insulated glass unit,
wherein the third glass pane comprises a fifth major glass surface and a sixth major glass surface, wherein the fifth major glass surface is facing the second gap and the sixth major glass surface is facing the outside environment of the triple insulated glazing unit,
wherein the first gap and second gap are enclosed by one or more edge seals, and
wherein the triple insulated glazing unit comprises a first aerogel layer and a first low-emissivity coating, wherein each of the first low-emissivity coating and the first aerogel layer is arranged on a major glass surface of one of the glass panes.

[0005] By the first aspect of the present invention, an improved triple insulating glazing unit is provided. This is in particular due to the combined insulating capabilities of the insulating gaps, the low-emissivity coating and the aerogel layer. Compared to a double insulating glazing unit, the extra glass pane and gap increases the insulation capabilities of the glazing unit. The triple insulated glazing unit further provides an increased number of major glass surfaces on which the low emissivity and aerogel layer can be located, thereby increasing the positions and combinations available within the triple insulated glazing unit for the low-emissivity coating and the aerogel layer. Potentially this larger freedom of design makes the triple insulated glazing unit applicable to different climates and a larger market.

[0006] Heat transfer by convection within insulated glazing units are a commonly known problem. However, surprisingly the combined features of the present invention, and in particular the introduction of the aerogel layer, have been found to decrease such heat transfer by convection within the insulated glazing.

[0007] In one or more embodiments, the aerogel is derived from a gel in which the liquid from the gel is removed and replaced with a gas or vacuum, leaving behind a gel material network providing the aerogel structure. The gel may be obtained by a sol-gel process. The liquid may be removed by a drying method or supercritical drying method. The resulting aerogel has very low density and very low thermal conductivity. Advantageously, the aerogel layer has also shown to contribute to noise reduction through the glazing unit.

[0008] In one or more embodiments, the first aerogel layer has a density below 0.5 g/cm^3, such as below 0.4 g/cm^3, such as below 0.3 g/cm^3 or such as below 0.2 g/cm^3. The density may be between 0.1-0.5 g/cm^3, such as between 0.15-0.35 g/cm^3 or such as between 0.2-0.3 g/cm^3. The density is measured at atmospheric pressure and 20 degrees Celsius.

[0009] In one or more embodiments, the aerogel of the aerogel layer is open-porous providing open hollow cavities. Since the volume of the aerogel is mostly composed of hollow cavities, which may be filled with insulating gas, aerogel act as very good heat insulator against conduction heat transfer. Some aerogel materials are more favourable than other in regards to minimizing heat transfer by conductions, e.g. silica is more insulating than carbon.

[0010] Generally, the aerogel comprise a microstructure originating from the gel structure established during manufacturing. The microstructure may effectively decrease or prevent net gas movement as the microstructure provides obstructions for gas circulation.

[0011] In one or more embodiments, the thermal conductivity of the first aerogel layer at atmospheric pressure is below 15 mW/mK, such as below 10 mW/mK or such as below 7 mW/mK. In one or more embodiments the thermal conductivity of the first aerogel layer at atmospheric pressure is between 4-30 mW/mK, or such as between 5-15 mW/mK or such as between 6-10 mW/mK. E.g. with the thermal conductivity measured at 20 degrees Celsius.

[0012] In one or more embodiments, the first aerogel layer comprises one or more aerogel sheets. In particular, the first aerogel layer is not provided in the form of flowable granular, powder or other particulate form of the aerogel. In one or more embodiments, the aerogel sheet(s) is preferably self-supporting sheet(s), e.g. being either rigid or flexible sheets of aerogel. The aerogel layer/sheet may be configured to retain the shape of a sheet after manufacture. In one or more embodiments, the first aerogel layer may comprise one or more sheets of aerogels, each sheet may comprise two opposing major sheet surfaces.

[0013] In one or more embodiments, the first aerogel layer is made of a single sheet. The sheet may comprise a first major sheet surface arranged against, preferably fixed to, a major glass surface of a glass pane of the insulated glazing unit. The sheet may comprise a second major sheet surface, being opposite the first major sheet surface, which second major sheet surface may exposed in a gap of the insulated glazing unit. Alternatively, the second major sheet surface may be arranged against, preferably fixed to, a major glass surface of a glass pane of the insulated glazing unit.

[0014] In one or more embodiments, a plurality of aerogel sheets may make up the first aerogel layer. The aerogel sheets may be arranged in parallel with neighbouring major sheet surfaces facing one another so as to form an aerogel layer stack. Preferably, the major extent of the stack is arranged in parallel with a major extent of one of the glass panes of the insulated glazing unit. The stack may comprise a first outermost major stack surface, being a major sheet surface of one of the sheets, which is to be positioned against, and preferably fixed to, a major glass surface of the insulated glazing unit. An opposite second outermost major stack surface of the aerogel layer stack, being a major sheet surface of one of the other sheets of the stack, may be arranged as an exposed surface in the gap of the insulated glazing unit or positioned against, e.g. fixed to, another major glass surface of the insulated glazing unit.

[0015] In one or more embodiments, at least 90%, such as at least 95% or such as at least 98% of the first aerogel layer is made of aerogel. In one or more embodiments, the aerogel layer consists of aerogel. In the triple insulated glazing unit, the first aerogel layer may have its hollow cavities filled with a gas, such as krypton, argon or air. In one or more embodiments, the aerogel layer is substantially uniform in structure throughout the entire first aerogel layer.

[0016] In one or more embodiments, the hollow cavities of the first aerogel layer is of a size less than 100 nm, such as less than 75 nm, or such as less than 50 nm. The cavities are preferably small compared to the wavelength light e.g. less than 50 nm, or preferably less than 20 nm.

[0017] In one or more embodiments, the first aerogel layer and/or the first low emissivity coating is located in a gap of the triple insulated glazing unit. By low-emittance coating is included a low-emittance or low-emissivity surface coating. Any suitable low-E coating can be used. In one or more embodiments, the low emissivity coating provide a layer on the major glass pane surface, which is less than 1000 nm, such as less than 500 nm in thickness, wherein the thickness is measured between major surfaces of the low emissivity coating.

[0018] In one or more embodiments, the first aerogel layer and the first low-emissivity coating are located in different gaps of the triple insulated glazing unit.

[0019] In one or more embodiments, the low-emissivity coating is located in the first gap and the first aerogel layer is located in the second gap, or vice versa. In one or more embodiments, the aerogel layer and the low-emissivity coating are located on different major glass surfaces of triple insulated glazing unit.

[0020] In one or more embodiments, the first aerogel layer and the first low emissivity coating is separated by the intermediate second glass pane.

[0021] In one or more embodiments, the intermediate second glass pane may be of a thickness being lower than the thickness of the first and/or third glass pane. The thickness is preferably measured between major glass surfaces of a pane, along a line extending perpendicular to the major surfaces. The thickness of the intermediate second glass pane may be reduced so as to save on cost and weight of the glazing unit.

[0022] In one or more embodiments, one or more of the glass panes of the insulated glazing unit is of a thickness between 1-4 mm, such as between 1.5-3.5 mm. One or more of the glass panes may be a tempered (e.g. thermally tempered) glass pane e.g. of a thickness below 4 mm, such as below 3 mm or such as below 2 mm, e.g. between 1-2 mm. The glass panes may be of the same or different thicknesses. In one or more embodiments, the first and/or third glass pane is of a thickness between 3-4 mm. In one or more embodiments, the second glass pane may be of a smaller thickness, such as between 2-3 mm.

[0023] In one or more embodiments, the triple insulated glazing unit comprises a second low-emissivity coating located on a different major glass surface than the first low-emissivity coating.

[0024] In one or more embodiments, the first aerogel layer and a second low emissivity coating are located in the same gap of the triple insulated glazing unit.

[0025] In one or more embodiments, the first low emissivity coating is located on the second major glass surface, third major glass surface, fourth major glass surface or the fifth major glass surface. In one or more embodiments, the second low emissivity coating is located on the second major glass surface, third major glass surface, fourth major glass surface or the fifth major glass surface Advantageously, the first and/or second low emissivity coating is thereby protected by a layer of glass provided by one or more of the glass panes.

[0026] In one or more embodiments, the aerogel layer(s) and the low emissivity coating(s) of the triple insulated glazing unit are spaced apart by at least 2 mm, such as at least 5 mm, or such as at least 8 mm.

[0027] In one or more embodiments, the first low-emissivity coating is located on the third major glass surface.

[0028] In one or more embodiments, the second low-emissivity coating is located on the fifth major glass surface.

[0029] Preferably, the first low emissivity coating and the second low emissivity coating are both located on a major glass surface directed in the same direction, such that when installed, the low emissivity coating are located on major glass pane surfaces, which are both directed towards the sun.

[0030] In one or more embodiments, the first aerogel layer is located on the second major glass surface, third major glass surface, fourth major glass surface or the fifth major glass surface. Advantageously, the aerogel layer is thereby protected by a layer of glass provided by one or more of the glass panes.

[0031] In one or more embodiments, the first aerogel layer is located on the second or fourth major glass surface. Advantageously, by these arrangements of the aerogel layer, the third and fifth major surfaces can be covered by the low emissivity coating without interfering with aerogel layer. It can be particularly advantageous for the cold and/or temperate climate to provide the low emissivity coating(s) on the third and/or fifth major surfaces, when the first major surface is to be installed as directed towards the exterior environment including the sun.

[0032] In one or more embodiments, the first aerogel layer is located on the second major glass surface. In one or more embodiments, the first aerogel layer is located on the second major glass surface. This potentially has the added advantage of preventing or decreasing the formation of condensation on the first major surface of the first glass pane, as the aerogel layer provides the advantage of ensuring a relatively high temperature at the second major surface of the first glass pane.

[0033] In one or more embodiments, the first low-emissivity coating is located on the third major glass surface and the first aerogel layer is located on the second major glass surface. Optionally, the second low-emissivity coating is located on the fifth major glass surface.

[0034] In one or more embodiments, a first low-emissivity coating is located on the third major glass surface and a second low-emissivity coating is located on the fifth major glass surface and a first aerogel layer is located on the second major glass surface.

[0035] In one or more embodiments, the first aerogel layer is located on the fourth major glass surface.

[0036] This arrangement has the advantageous of increasing the protection of the aerogel layer, since it is located on the intermediate second glass pane. Furthermore, the second major glass surface may advantageously be covered by a different coating.

[0037] In one or more embodiments, the triple insulated glazing unit comprises one or more solar control coatings (SCC). E.g. the second major glass surface may advantageously be covered by a different coating, such as a solar control coating provided as a heat mirror.

[0038] In one or more embodiments, a solar control coating is designed to limit the amount of solar heat that passes through the glazing and into a building so as to keep buildings cooler and reduce energy consumption related to air conditioning.

[0039] In one or more embodiments, the solar control coating is highly reflective in the infrared wavelength region. It may be made of thin layer(s) of metals or alloys, such as silver.

[0040] In one or more embodiments, a solar heat gain coefficient (SHGC) is a measure of the fraction of solar radiation admitted through the glazing unit and is expressed as a number between 0 and 1. For hot climates a low solar heat gain coefficient is preferable, such as below 0.4. For cold climates a high solar heat gain coefficient is preferable, such as above 0.3, e.g. between 0.3 and 0.6.

[0041] By the invention of the present disclosure, coatings and insulating layers may be combined to provide different combinations of SHGC-values suitable for different applications e.g. different locations within the building and/or different climates. E.g. more than one low emissivity coating and/or aerogel layer may be provided e.g. with the purpose of lowering the heat transfer through the glazing unit. A solar control coating may be added to a glass surface of the insulated glazing unit in combination with low emissivity coating(s) and aerogel layer(s), with the purpose of providing a high solar heat gain coefficient and making the glazing unit even more applicable for cold climates.

[0042] In one or more embodiments, the first low-emissivity coating is located on the third major glass surface and the first aerogel layer is located on the fourth major glass surface.

[0043] In one or more embodiments, a low-emissivity coating is located on the third major glass surface and a second low-emissivity coating is located on the fifth major glass surface and the first aerogel layer is located on the fourth major glass.

[0044] Advantageously, the first low emissivity coating and the second low emissivity coating are both located on a major glass surface facing in the same direction, such that when installed, the low emissivity coating may both be directed towards the sun.

[0045] Furthermore, by placing the first aerogel layer on the fifth glass surface, the aerogel layer is potentially more protected from hail and other impacts on the first and/or third glass panes.

[0046] In one or more embodiments, the triple insulated glazing unit further comprises one or more further aerogel layers, including a second aerogel layer. The second aerogel layer may comprise any of the features and associated benefits as described in one or more embodiment(s) of the present disclosure regarding the first aerogel layer.

[0047] In one or more embodiments, the second aerogel layer is preferable separate from the first aerogel layer. The second aerogel layer is preferably arranged in a different gap and/or on a different major glass surface of the triple insulated unit than the first aerogel layer. In one or more embodiments, the second aerogel layer is located in the same gap as the first aerogel layer. In one or more embodiments, a major surface of the first aerogel layer and an opposing and neighbouring major surface of the second aerogel layer are separated, e.g. by a gap and/or by a glass pane of the triple insulated glass unit.

[0048] In one or more embodiments, the first aerogel layer is located in the first gap and the second aerogel layer is located in the second gap, or vice versa.

[0049] In one or more embodiments, the first aerogel layer may be located on the fourth major glass surface, while the second aerogel layer may be located on the second major glass surface. Additionally, the first low-emissivity coating may be located on the third major glass surface, while an optional second low emissivity coating may be located on the fifth major glass surface, or vice versa.

[0050] In one or more embodiments, the first aerogel layer may be arranged so that it fills a void existing in the first or second gap of the triple insulating glazing unit. The void may be filled in at least the thickness direction of the gap, extending perpendicular to the major extent of the glass panes. In one or more embodiments, at least 40%, such as at least 60 % or such as at least 80 % of the void may be filled by the first aerogel layer. In one or more embodiments, the entire void, e.g. in the thickness direction, may be filled by the first aerogel layer.

[0051] In one or more embodiments, void may be defined as an un-occupied space in a gap, e.g. to be filled with a gas, e.g. it may be defined between opposing major glass pane surfaces, between a major glass pane surface and a coating or layer, such as a first or second low emissivity coating or a solar coating.

[0052] In one or more embodiments, the first aerogel layer extends from the first glass pane or the third glass pane to the intermediate second glass pane.

[0053] In one or more embodiments, the first aerogel layer may extend from a coating, such as coating comprising a solar coating, on the first glass pane or from the first glass pane to the intermediate second glass pane, or to a coating on the intermediate second glass pane, such as a coating comprising the first or second low emissivity coating.

[0054] In one or more embodiments, the first aerogel layer may extend from a coating, such as coating comprising a first or second low emissivity coating, on the third glass pane or from the third glass pane to the intermediate second glass pane, or to a coating on the intermediate second glass pane, such as a coating comprising a solar coating.

[0055] In one or more embodiments, the first aerogel layer may be of an aerogel thickness below 15 mm, such as below 12 mm, or such as below 10 mm.

[0056] In one or more embodiments, the first aerogel layer is of an aerogel thickness below 1.3 mm, such as below 1.1 mm or such as below 1.0 mm.

[0057] The aerogel thickness may be measured from a first major surface of the first aerogel layer to an opposing second major surface of the aerogel layer, e.g. along a direction perpendicular to a major glass surface of the glass panes.

[0058] In one or more embodiments, the first aerogel layer is of an aerogel thickness (T1), which is below 10 %, such as below 8%, or such as below 6% of the thickness of the gap.

[0059] The gap thickness may be measured from a first exposed major glass surface to an opposing exposed major glass surface, e.g. from the second major glass surface to the third major glass surface or from the fourth major glass surface to the fifth major glass surface, generally along a direction perpendicular to the major glass surfaces, preferably the exposed major glass surface.

[0060] In one or more embodiments, the gap may comprise a gap thickness being between 10 and 20 mm. In one or more embodiments, the gap thickness is between 10-16 mm, preferably between 12-14 mm.

[0061] In one or more embodiments, the aerogel layer may be of an aerogel thickness between 3 and 15 mm, such as between 5 and 12 mm.

[0062] In one or more embodiments, the first gap and/or the second gap contains a gas, such as argon or krypton.

[0063] In one or more embodiments, the gas may be an inert gas, such as a gaseous argon, gaseous krypton, air, or a mixture thereof.

[0064] In one or more embodiments, the first aerogel layer may be silica-based or polymer-based. Alternatively, the first aerogel layer may be cellulose-based, e.g. from plants. Advantageously, cellulose-based aerogel layers may be more flexible, which may be advantageous for the installation of the aerogel and during the lifetime of the insulated glazing unit, as the flexibility may reduce the risk of breaking the aerogel layer.

[0065] In one or more embodiments, the first and/or second aerogel layer may be formed on a major glass pane surface of the triple insulating glazing unit, or it may be preformed as a layer, e.g. a sheet or film, and arranged on a major glass pane surface.

[0066] In one or more embodiments, the first aerogel layer is made of a silica-based or cellulose-based aerogel.

[0067] Advantageously, a first aerogel layer of lower carbon footprint may be provided by the silica-based and cellulose-based aerogels, while still having low thermal conductivity, e.g. below 30 mW/mK, providing heat insulating benefits.

[0068] In one or more embodiments, the second aerogel layer may be made of the same material as the first aerogel layer or be of a different aerogel material.

[0069] In one or more embodiments, the first aerogel layer may be supported by a glass pane of the insulated glazing unit. In one or more embodiments, the aerogel layer is adhered to a major glass surface of one of the glass panes. The adhesion may be provided by one or more layers, strips, dots or the like of adhesive material, e.g. by lamination. Preferably the adhesive is optically transparent and do not have any significant impact on the visibility of through the insulated glazing unit.

[0070] In one or more embodiments, each low emissivity coating has the ability to modulate the insulation properties of the insulated glazing unit by transmitting and reflecting selected wavelengths of electromagnetic radiation. The low emissivity coating may preferably be arranged to slow down radiation heat transfer, e.g. it may be arranged to reflect solar near infrared radiation away from the building during warm months and reflect long-wave radiation from the building back into the building during cold months.

[0071] In one or more embodiments, the low emissivity coatings typically comprises a single or a stack of different coating layers, each coating layer is carefully selected based on their optical properties such that the low emissivity stack reflects and transmits specific parts of the visible and infrared spectrum. Low emissivity coatings may be deposited on the glass surface using a variety of different soft and hard coat deposition methods such as pyrolytic or sputtering methods.

[0072] In one or more embodiments, the first low-emissivity coating (8a) and/or the second low emissivity coating (8b) comprises

- one or more layers of a transparent conductive oxide (TCO), such as fluorine-doped tin oxide (FTO), antimony-doped tin oxide (ATO), or mixed indium tin oxide (ITO), or of
- one or more dielectric layers and one or more metal layers, such as one or more silver layers.

[0073] In one or more embodiments, the low emissivity coating may comprise stack of coating layers typically comprising metals, metal oxides, and metal nitrides. The stack may comprise coating layers made of one or more inorganic oxides, such as titanium oxide (TiOx) or Zinc oxide (ZnOx) or zinc stannate (ZnSnOx).

[0074] In one or more embodiments, the low emissivity coating comprises aluminium (Al) e.g. providing ZnO2:Al, TiO2:Al or ZnSnO2:Al, wherein the aluminium preferably amounts to less 5%.

[0075] In one or more embodiments, one or more of the oxide layer(s) are produced by a physical vapour deposition (PVD) method. In the PVD method the sputtering target may comprise aluminium to make the target more conductive in the coating process for making oxide layer, e.g. producing a ZnO2:Al, TiO2:Al or ZnSnO2:Al coating.

[0076] In one or more embodiments, the low emissivity coating layer may comprise a stack of coating layers comprising one or more of the following dielectric layers: zirconium dioxide (ZrO2) (which may be arranged as a uppermost coating layer), silicon nitride (Si3N4), tin oxide (SnOx), a layer comprises Ni and/or Cr such as nickel chrome oxide (NiCrOx), titanium oxide (TiOx), such as titanium dioxide, zinc oxide (ZnOx), such as mixed zinc tin oxide (ZnSnOx), or such as ZnO2, aluminium oxide (AlOx), zinc aluminium oxide (ZnAlOx), bismuth oxide (BiOx), a mixed silicon zirconium nitride (SiZrN), silicon oxynitride (SixNyOz), niobium oxide (NbO) or any other suitable dielectric material.

[0077] In one or more embodiments, the low emissivity coating includes a stack that may comprise a sequence of the following coating layers listed from the innermost coating layer to the outermost coating layer, wherein the outermost coating layer is defined as the layer exposed to the gap: SixNyOz, TiOx, SnOx, ZnOx, Ag, NiCrOx, SnOx, Si3N4 and ZrOx (e.g. ZrO2).

[0078] In one or more embodiments, the stack of coating layers may comprise at least one IR-reflective layer, such as a layer of silver (Ag), gold (Au) or any other suitable IR reflective material, however silver layer(s) are preferred. There may be one or more of the mentioned dielectric or IR-reflective layers that reoccur in the coating stack sequence.

[0079] In one or more embodiments, the low emissivity coatings include one or two silver layers each sandwiched between two layers of a transparent dielectric film. Generally, by increasing the number of silver layers the total infrared reflection may be increased.

[0080] In one or more embodiments, the first low emissivity coating may be a transparent conductive oxide while the second emissivity coating may be a stack comprising one or more dielectric layers and one or more IR-reflective layers, or vice versa. In one or more embodiments, the first low emissivity coating and the second low emissivity coating are of the same type, and optionally furthermore may be identical.

[0081] By the invention of the present disclosure, a triple insulated glazing unit is provided, which enables multiple combinations of coating/layer types and coating/layer locations to be provided within the glazing unit, in turn producing a wide range of glazing properties, in particular a wide range of heat insulating properties, potentially being optimum for different glazing locations within the building and/or different climates.

[0082] In one or more embodiments, an Ug-value is a measure of how quickly heat transfers through the glazing unit and may expresses how good an insulator the glazing is.

[0083] In one or more embodiments, the triple insulated glazing unit has an Ug-value below 0.9 W/m2K, such as below 0.8 W/m2K, such as below 0.7 W/m2K, such as below 0.6 W/m2k or such as below 0.5 W/m2K.

[0084] The Ug-value are measured with the triple insulated glazing unit horizontally arranged, e.g. with the major extent of the triple insulated glazing unit arranged substantially parallel with the horizontal plane. The Ug-value characterises the heat transfer through the glazing unit, typically at the central part of the glazing unit. The lower the Ug-value, the greater is the insulating value.

[0085] In one or more embodiments, the gaps of the triple insulated glazing unit is filled with argon, and provides an Ug-value below 0.9 W/m2K. In one or more embodiments, the gaps of the triple insulated glazing unit is filled with krypton, and provides an Ug-value below 0.9 W/m2K. The Ug-value below 0.9 W/m2K may for example be obtained with each gap being preferably at least 15 mm in height and the first aerogel layer being at least 5 mm in height.

[0086] In one or more embodiments, an Ug-value below 0.7 W/m2K may for example be obtained with each gap being preferably at least 15 mm in height, filled with argon or krypton and the first aerogel layer being at least 10 mm in height.

[0087] In one or more embodiments, an Ug-value below 0.6 W/m2K may for example be obtained with each gap being preferably at least 15 mm in height, filled with argon or krypton and the first aerogel layer being at least 15 mm in height.

[0088] In one or more embodiments, an Ug-value below 0.5 W/m2K may for example be obtained with each gap being preferably at least 15 mm in height, filled with argon or krypton and the first aerogel layer being at least 20 mm in height.

[0089] In one or more embodiments, the triple insulated glazing unit is configured to provide an Ug-value measured at a horizontal orientation, which differs with less than 0.3 W/m2K, such as with less than 0.2 W/m2K, or such as with less than 0.1 W/m2K from an Ug-value of the triple insulated glazing unit measured at a vertical orientation. In one or more embodiments, the triple insulated glazing unit is configured to provide an Ug-value measured at a horizontal orientation, which differs with less than 0.35 W/m2K, such as with less than 0.25 W/m2K, or such as with less than 0.15 W/m2K from an Ug-value of the triple insulated glazing unit measured at a vertical orientation. The horizontal orientation refers to the position in which the major extent of the glazing is substantially parallel to the horizontal plane and the vertical orientation refers to the position in which the major extent of the glazing is substantially parallel to the vertical plane.

[0090] By the present invention a potentially more even distribution of Ug-values may be provided across installation angle of the triple insulated glazing unit. The invention may provide an Ug-value being more independent on installation angle of the glazing unit. E.g. the rate of change in Ug-value with installation angle, such as a rate of decrease in Ug-value generated by moving the glazing unit from a majorly horizontal position towards a majorly vertical position, may be decreased by the present invention.

[0091] In one or more embodiments, the triple insulated glazing unit is configured to provide a reduced change in Ug-value, when the triple insulated glazing unit is moved between different installation angles, compared to a change in Ug-value of a reference triple insulated glazing unit when moved between different installation angles, wherein the reference triple insulated glazing unit is differing only from the triple insulated glazing unit by being devoid of aerogel layer(s). E.g. the reference glazing unit is preferably provided with the same types of glass panes, edge seals and types and arrangements of low emissivity coatings etc.

[0092] In one or more embodiments, the triple insulated glazing unit may be configured to provide a smaller difference in Ug-value between a majorly vertical position and a majorly horizontal position of the triple insulated glazing unit, compared to a difference in Ug-value between a majorly vertical position and majorly horizontal position of a reference triple insulated glazing unit differing only by the present invention by being devoid of aerogel layer(s).

[0093] In one or more embodiments, the triple insulated glazing unit may be configured to provide a smaller increase in Ug-value, when the triple insulated glazing unit is moved from a majorly vertical position towards a majorly horizontal position of the triple insulated glazing unit, compared to an increase in Ug-value of a reference triple insulated glazing unit differing only by the present invention by being devoid of aerogel layer(s), when moved from a majorly vertical position towards a majority horizontal position.

[0094] In one or more embodiments, a majorly horizontal position is provided at installation angles between 0° and up to but excluding 45°, the horizontal orientation being provided at installation angle of 0°. In one or more embodiments, a majorly vertical position is provided at installation angles from 90° and down to but excluding 45°, the vertical orientation being provided at installation angle of 90°. In one or more embodiments, the increase/difference in Ug-value may be measured at 0° and at 90° from horizontal.

[0095] A second aspect of the invention relates to a building aperture cover, such as a window, wherein the building aperture cover comprises a triple insulated glazing unit according to any of the preceding claims, and one or more frame structures providing a frame enclosing the triple insulated glazing unit.

[0096] In one or more embodiments, the frame is arranged about the periphery of the triple insulated glazing unit, and may comprise of one or more frame structures, e.g. a top, a bottom and two side frame structures, structurally connected to provide the frame. In one or more embodiments, the frame structure(s) may comprise an elongated frame profile arranged to provide a frame opening extending in a frame opening plane defined between the elongated frame profiles.

[0097] In one or more embodiments, the frame structure(s) may e.g. be a wood material structure. In other embodiments, the frame structure may be made from a plastic material such as a PVC (polyvinyl chloride) or PP (polypropylene) plastic material, it may be composite material such as a glass or carbon fibre material, the frame structure may be made from a plastic material with fibres embedded to obtain a more strong/rigid profile and/or the like. Also, in one or more embodiments, the frame structure of the frame may be made from a metal such as aluminium or another suitable metal alloy.

[0098] In one or more embodiments, the frame is a sash frame arranged to be connected to a window frame to be fixed in an aperture of a building. The sash frame is preferably arranged to be movably connected to the fixed frame, so that the sash frame may move relative to the fixed frame e.g. by a centre-hung or top-hung pivot hinge connection between the sash frame and the window frame.

[0099] In one or more embodiments, the aperture cover may be a facade window.

[0100] In one or more embodiments, the building aperture cover is installed at an installation angle between 0-55 degrees measured from horizontal.

[0101] In one or more embodiments, the aperture cover may be a roof window or a skylight. The angle may be defined, such as substantially correspond to, the roof pitch.

[0102] In one or more embodiments, if the building aperture cover comprises a movable sash frame, then the orientation of the window is determined when the movable sash frame is in a closed position.

[0103] In one or more embodiments, the building aperture cover is a roof window.

[0104] In one or more embodiments, the triple insulated glazing unit is orientated with the first major glass surface facing the exterior environment of the building.

[0105] Preferably, the first low emissivity coating(s) are located on a major glass surface directed towards the exterior of the building in which the building aperture cover is installed.

[0106] In one or more embodiments, when the triple insulated glazing unit is installed in a frame, the frame will typically overlap an edge portion of the triple insulated glazing unit, e.g. on one or both outermost major surfaces of the triple insulated glazing unit. Alternatively or additionally, the edge portion may be covered by other covering means of the building aperture cover, such as an enamel or a film. The triple insulated glazing unit may therefore be designed with the aerogel layer within this edge portion, so that it can be covered by the overlap created by the frame or other covering means, whereby the aerogel layer may thereby potentially be less visible to the user.

[0107] The frame may for example be arranged to provide a frame overlap by a certain amount/distance D1. Such overlap may help to provide an improved insulation performance of the insulated glazing, as the edge seal, e.g. metal material or a solder glass material may provide a "cold bridge" at the insulated glazing unit edge where it seals a gap of the insulated glazing unit. Potentially, the first and/or second aerogel layer located in the edge portion may raise the edge temperature and prevent or decrease condensation.

[0108] In one or more embodiments, the major extent of the triple insulated glazing unit can be divided into a vision portion and an edge portion , wherein the edge portion is arranged to separate the vision portion from an edge of the triple insulated glazing unit, and

wherein the first aerogel layer is preferably confined to the edge portion of the triple insulated glazing unit.

[0109] In one or more embodiments, the edge portion and the vision portion extend in parallel with a major glass surface of the triple insulated glazing unit.

[0110] In one or more embodiments, the edge portion is defined as an area of the triple insulated glazing unit to be covered, on the interior or exterior side of the insulated glazing unit, by a frame or other covering means, when the triple insulated glazing unit is installed in a building, e.g. in said frame.

[0111] The edge portion is preferably provided along at least a part or the entire periphery of the triple insulated glazing unit, e.g. the entire peripheral edge of the triple insulated glazing unit may be configured to be covered e.g. by a frame, when mounted in the frame provided by frame structure(s). In one or more embodiments, the triple insulated glazing unit may comprise a plurality of discrete edge portions, e.g. separated by extent(s) intended to be exposed, e.g. being at least a part of the vision portion.

[0112] In one or more embodiments, the triple insulated glazing unit comprises a plurality of edge portions, e.g. on each major glass surface. Edge portions of opposite major glass surfaces are typically covered by the same frame structure(s) of the frame, or the same covering means.

[0113] In one or more embodiments, also the second aerogel layer may be arranged in an edge portion, partly in an edge portion or outside and edge portion.

[0114] In one or more embodiments, the edge portion may have an edge portion width (W e) being less than 80 mm, such as less than 60 mm, or such as less than 40 mm.

[0115] The edge portion width is defined as extending from an edge of the triple insulated glazing unit to an edge of the vision portion, along measuring line being perpendicular to the edge of the triple insulated glazing unit.

[0116] The edge portion width may in embodiments of the present disclosure be

between 10 mm and 80 mm, such as between 20 mm and 60 mm.

[0117] The edge portion width may differ at the top, sides, bottom of the insulating glazing unit. This may depend on the frame design.

[0118] In one or more embodiments, the first aerogel layer may have an aerogel width (W_a) being less than 80 mm, such as less than 60 mm, or such as less than 40 mm.

[0119] The aerogel width may be measured perpendicularly from a first edge of the triple insulated glazing unit towards an opposite second edge of the triple insulated glazing unit, along a major surface of the triple insulated glazing unit.

[0120] The aerogel width may in embodiments of the present disclosure be between 5 mm and 80 mm, such as between 10 mm and 60 mm or such as between 20 mm and 45 mm.

[0121] In one or more embodiments, the first aerogel layer may be a first peripheral aerogel layer arranged along the periphery of the glass pane on which the first aerogel layer is located, preferably so that the first peripheral aerogel layer encloses a centre portion of the glass pane being devoid of the aerogel layer.

[0122] In one or more embodiments, the peripheral aerogel layer is provided by one or more elongated strips of aerogel layer arranged parallel to a neighbouring peripheral edge of the glass pane on which the aerogel layer is arranged. The peripheral aerogel layer may be made up of a plurality of discrete aerogel layer sections, possibly separated by a spacing, or the peripheral aerogel layer may be a single contiguous layer. In one or more embodiments, the peripheral aerogel layer may be partly or fully enclosing the centre portion.

[0123] In one or more embodiments, the centre portion extends in parallel with a major glass surface of the triple insulated glazing unit.

[0124] In one or more embodiments, the first aerogel layer covers more than 60%, such as more than 70%, such as more than 80%, or such as more than 90% of the most adjacent major glass surface within the insulated glazing unit. In one or more embodiments, the first aerogel layer is made up of one or more aerogel sheets arranged on top of one another, i.e. in a stack and/or of one or more aerogel layer sections arranged side by side, e.g. edge to edge.

[0125] In one or more embodiments, the triple insulated glazing unit is generally of a thickness much less than the width and the length thereof. E.g. the major extent of the triple insulated glazing unit may generally be spanned by the width and the length.

[0126] In one or more embodiments, one or more edge seals of the insulated glazing unit may comprise spacer bars. Such spacer bars, that may be common, comprises a metal profile, a composite profile, a structural foam or TPS (thermoplastic) and/or the like. Other spacer bars may be used. Spacer bar may in some embodiments comprise a desiccant for absorbing moisture. The edge seal(s) may preferably function as a gas barrier sealant to keep an insulating gas (commonly argon or krypton) in the insulating gap for the lifetime of the insulated glazing unit. The edge seal(s) may preferably also structurally hold the glass panes joined as a single, insulating glazing unit.

[0127] In one or more embodiments, the first gap is enclosed by a first edge seal and the second gap is enclosed by a second edge seal, e.g. a first edge seal extending from the first glass pane to the second glass pane and a second edge seal extending from the second glass pane to the third glass pane. In one or more embodiments, the first gap and the second gap is enclosed by an edge seal extending from the first glass pane to the third glass pane.

[0128] In one or more embodiments, the triple insulated glazing unit may comprise further glass panes, arranged in parallel with the first, second and third glass panes. Each further glass pane may be separated from the glass panes by a gap, which may be filled with inert gas, such as argon or krypton gas, so as to provide e.g. a quadruple insulated glazing unit.

[0129] In one or more embodiments, the further glass pane may be provided as a lamination glass sheet and laminated onto an outermost major surface of the triple insulated glazing unit, e.g. the first or sixth major glass surface of the triple insulated glazing unit, by means of a lamination layer.

[0130] In one or more embodiments of the present disclosure, the lamination glass sheet may be an annealed glass sheet or a tempered, such as thermally tempered, glass sheet. The lamination glass sheet may e.g. have a thickness between 1.5mm and 5mm, such as between 2mm and 4mm, e.g. around 3 mm. In one or more embodiments, the lamination layer is a polyvinyl butyral (PVB) layer or ethylene-vinyl acetate (EVA) layer.

[0131] Any suitable glass from which glass panes can be obtained may be used for the glass panes. Examples include a soda lime silica glass and an alkali aluminosilicate glass. In one or more embodiments, the glass panes of the triple insulated glazing unit may be float glass panes, e.g. tempered glass panes, such as thermally tempered glass panes, or they may be annealed glass panes or a combination thereof. In one or more embodiments, the one or more of the glass panes of the tripe insulated glazing unit may be made of annealed float glass, heat strengthened float glass or toughened float glass.

DRAWING

[0132] Aspects of the present disclosure will be described in the following with reference to the figures in which:

Fig. 1 shows a cross-sectional view of a triple insulated glazing unit according to a first embodiment of the invention,

Fig. 2 shows a cross-sectional view of a triple insulated glazing unit according to a second embodiment of the invention,

Fig. 3 shows a cross-sectional view of a triple insulated glazing unit according to a third embodiment of the invention,

Fig. 4 shows a cross-sectional view of a triple insulated glazing unit according to a fourth embodiment of the invention,

Fig. 5 shows a cross-sectional view of a triple insulated glazing unit according to a fifth embodiment of the invention,

Fig. 6 shows a cross-sectional view of a lower part of a window comprising a triple insulated glazing unit according to a sixth embodiment of the invention,

Fig. 7 shows a cross-sectional view of a lower part of an angled roof window comprising a triple insulated glazing unit according to the sixth embodiment of the invention, and

Fig. 8 shows graphs showing the relationship between Ug-value and installation angle of the triple insulated glazing unit of the fourth embodiment, i.e. Fig. 4 and of a triple insulated glazing unit with no aerogel layer.

DETAILED DESCRIPTION OF THE INVENTION

[0133] In relation to the figures described below, where the present disclosure may be described with reference to various embodiments, without limiting the same, it is to be understood that the disclosed embodiments are merely illustrative of the present disclosure that may be embodied in various and alternative forms. The figures are not to scale; some features may be exaggerated or minimized to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for e.g. teaching one skilled in the art to variously employ the present disclosure.

[0134] Figs. 1-5 illustrates a cross-sectional view of a triple insulated glazing unit 1 according to embodiments of the invention. The cross-sections shown depict a part of the triple insulated glazing unit 1 at an edge of the unit 1. The triple insulated glazing unit 1 comprises three glass panes 2, 3, 4 arranged in a stacked configuration, i.e. with major surfaces 2a, 2b, 3a, 3b, 4a, 4b arranged in parallel. Between a first glass pane 2 and an intermediate second glass pane 3 of the triple insulated glazing unit is defined a first gap 5, surrounded at the periphery of the glass panes 2, 3 by a first edge seal 10. Between the intermediate second glass pane 3 and a third glass pane 4 of the triple insulated glazing unit 1 is defined a second gap 6, surrounded at the periphery of the glass panes 3, 4 by a second edge seal 11. Preferably, the first glass pane provides an outer first major glass surface 2a and a second major glass surface 2b directed towards the first gap 5 and the second intermediate glass pane 3. The second intermediate glass pane 3 provides a third major glass surface 3a directed towards the first glass pane 2, and a fourth major glass surface 3b directed towards the second gap 6 and the third glass pane 4. The third glass pane 4 provides a fifth major glass surface 4a directed towards the second intermediate glass pane 3 and an outer sixth major glass surface 4b. These features are preferred common features for all the embodiments shown in Figs. 1-5.

[0135] Preferably, the triple insulated glazing unit 1 is to be mounted in a building aperture as a cover, e.g. window, such that the first glass pane 2 provides the outermost glass surface facing the outside of the building and such that the third glass pane 4 provides an innermost glass surface facing the inside of the building.

[0136] In one or more embodiments, the triple insulated glazing unit 1 comprises one or more aerogel layers, such as a first aerogel layer 7a, provided within a gap 5, 6 of the triple insulated glazing unit. The first aerogel layer 7a may be self-supporting, such as a self-supporting rigid sheet of aerogel or it may be supported by a glass pane surface 2b, 3a, 3b, 4a within the gap, e.g. it may be fixed to the glass pane surface 2b, 3a, 3b, 4a, for example by adhesion.

[0137] In one or more embodiments, the triple insulating glazing unit 1 may preferably further comprise a first low emissivity coating 8a arranged at a major glass surface 2a, 2b, 3a, 3b, 4a, 4b, preferably a major glass surface 2b, 3a, 3b, 4a directed towards a gap (5, 6) of the triple insulated glazing unit 1. Optionally, the triple insulating glazing unit 1 further comprises a second low emissivity coating, 8a preferably arranged at a different major glass surface 2a, 2b, 3a, 3b, 4a, 4b than the first low emissivity coating 8a. Preferably, the low emissivity coating(s) 8a, 8b are deposited on the major glass surface(s) 2a, 2b, 3a, 3b, 4a, 4b, and thereby fixed to the glass surface 2a, 2b, 3a, 3b, 4a, 4b.

[0138] Fig. 1 shows a cross-sectional view of a triple insulated glazing unit 1 according to a first embodiment of the invention. The triple insulated glazing unit 1 comprises a first low emissivity coating 8a at the third major glass pane surface 3a and a first aerogel layer 7a at the fifth major glass surface 4a.

[0139] Fig. 2 shows a cross-sectional view of a triple insulated glazing unit 1 according to a second embodiment of the invention. The triple insulated glazing unit 1 comprises a first low emissivity coating 8a at the third major glass pane surface 3a, a second low emissivity coating 8b at the fifth major glass surface 4a and a first aerogel layer 7a also located at the fifth major glass surface 4a. The present embodiment of Fig. 2 exploits the idea that most insulated units 1 are to be covered at an edge thereof, in most cases by a frame. The triple insulated glazing unit 1 comprises an edge portion 13 extending from a first edge of the triple insulating glazing unit 1 and towards the opposing parallel extending second edge of the triple insulating glazing unit 1 and thereby providing an edge portion width W e. The edge portion width W_e is generally small compared to the width of the glazing unit measured between the parallel extending first and second edges, e.g. the edge portion width W_e may be less than 80 mm. The edge portion 13 is preferably dimensioned to correspond to an overlap width D1 provided by a frame structure 102 of a frame for the triple insulated glazing unit 1, see e.g. Fig. 6. The overlap width D1 may alternatively, or in combination with the frame structure 102, be provided by other covering means, e.g. paint or maskings. Preferably, and as shown in Fig. 2, the aerogel layer 7a can be hidden away in the edge portion 13 is it later may be covered, and thereby a vision portion 14, being uncovered, may be devoid of the first aerogel layer 7a. The vision portion 14 may generally be thought of as the area of the glazing unit 1, which the user can see through.

[0140] The aerogel layer may be of an aerogel layer width W_a which is smaller than the edge portion width W e, however, preferably the aerogel width W_a corresponds so at least 70% of edge portion width W_e, such as at least 80 % of the edge portion width or such as at least 90% of the edge portion width. In one or more embodiments, the aerogel width W_a is between 20 and 80 mm. In one or more embodiments, along a major extent, e.g. width, of the triple insulated glazing unit, the aerogel layer 7a may enclose a centre portion 15 of the triple insulated glazing unit 1, which is devoid of aerogel, as seen in Fig. 2.

[0141] Fig. 3 shows a cross-sectional view of a triple insulated glazing unit according to a third embodiment of the invention. The triple insulated glazing unit 1 comprises a first low emissivity coating 8a at the third major glass pane surface 3a and a first aerogel layer 7a at the fourth and fifth major glass surface 3b, 4a. Preferably, the first aerogel layer 7a extends from the fourth major glass surface 3b, across the gap 6 and to the fifth major glass surface 4a so as to substantially fill the entire gap 6, at least in the thickness direction thereof. Additionally or alternatively, the triple insulated glazing unit 1 may comprises a first low emissivity coating 8a at the fifth major glass pane surface 4a and a first aerogel layer 7a at the second and third major glass surface 2b, 3a, such as extending from the second major glass surface 2b, across the gap 5 and to the fourth major glass surface 3b so as to substantially fill the entire gap 5, at least in the thickness direction thereof (not shown). In one or more embodiments, the first aerogel layer 7a may be attached to one or both major glass pane surfaces on each side thereof, e.g. the fourth and/or the fifth major glass surface 3b, 4a.

[0142] Fig. 4 shows a cross-sectional view of a triple insulated glazing unit 1 according to a fourth embodiment of the invention. The triple insulated glazing unit 1 comprises a first low emissivity coating 8a at the fifth major glass pane surface 4a and a first aerogel layer 7a at the second major glass pane surface 2b and a second low emissivity coating 8b at the third major glass surface 3a.

[0143] Fig. 5 shows a cross-sectional view of a triple insulated glazing unit 1 according to a fifth embodiment of the invention. The triple insulated glazing unit 1 comprises a first low emissivity coating 8a at the third major glass pane surface 3a and a first aerogel layer 7a at the fourth major glass pane surface 3b and a second low emissivity coating 8b at the fifth major glass surface 4a.

[0144] Fig. 6 and Fig. 7 show a cross-sectional view of a lower part of a building aperture cover 100 being a window, comprising the triple insulated glazing unit 1 according to a sixth embodiments of the invention. The sixth embodiment comprises a triple insulated glazing unit 1 according to the second embodiment of the invention, which has further comprises a lamination sheet 9, such as a lamination glass sheet. The glazing unit 1 comprises a first, second and third glass panes 2, 3, 4 arranged in parallel with gaps 5, 6 in between. Alternatively, any other embodiments of the triple insulating glazing unit 1 may be mounted in said building aperture cover 100, with or without additional lamination sheet(s) 9. The lamination sheet 9 is preferably provided on the innermost surface of the triple insulated glazing unit 1, which in the present embodiment is the third glass pane 4. The lamination sheet 9 may be attached to the third glass pane 4 by a lamination layer, such as polyvinyl butyral (PVB) layer or ethylene-vinyl acetate (EVA) layer.

[0145] The building aperture cover 100 of Figs. 6 and 7 may be any type of window, such as a skylight window, however in the present embodiment, the building aperture cover 100 comprises frame structure(s) 102 providing a sash frame 103 and a frame structure(s) 102 providing a fixed frame 104. The sash frame 103 is movable relative to the fixed frame 104, such that the window can be opened and closed, e.g. by means of a handle 105 as shown.

[0146] As can be seen in Figs. 6 and 7, the frame structure 102 of the sash frame 103 overlaps an edge region 13 of the triple insulated glazing unit 1, thereby obstructing the transmittance of light through this edge region 13 of the glazing unit 1. The overlap width D1 is indicated in Fig. 6. In some cases, an aerogel layer may not be fully transparent and may obscure the visibility through the glass panes 2, 3, 4, when arranged between them. However, such visual obstruction is of less interest in the edge region 13, since the visibility through this region is already obstructed by the presence of the frame structure 102. Consequently, by confining the first aerogel layer 7a in the edge region 13, the triple insulated glazing unit can provide a building aperture cover 100 in which the visibility through the transparent regions of the cover 100, i.e. a vision region 14 as indicated in Fig. 6, is substantially unaffected, while simultaneously providing a triple insulating glazing unit 1 of increased thermal insulation efficiency, compared to traditional triple insulated glazing units, due to the presence of the aerogel layer 7a.

[0147] Fig. 7 shows a cross-sectional view of a lower part of an angled building aperture cover 100, e.g. a roof window. The building aperture cover 100 is installed at an angle A1 relative to a horizontal plane.

[0148] In one or more embodiments of the present disclosure, the first and second gap 5, 6 may each be enclosed by an edge seal 10, 11 or they may both be enclosed by a single seal, e.g. extending from the first glass pane 2 to the third glass pane 4. The edge seals 10, 11 of the insulated glass unit 1 may in embodiments of the present disclosure comprise spacer bars. Such spacer bars, that may be common, comprises a metal profile, a composite profile, a structural foam or TPS (thermoplastic) and/or the like. Other spacer bars may be used. Spacer bar may in some embodiments comprise a desiccant for absorbing moisture. The edge seal 10, 11 functions as a gas barrier sealant to keep an insulating gas (commonly argon or krypton) in the insulating gap 5, 6 for the lifetime of the insulated glass unit. The edge seal(s) 10, 11 may also structurally hold the glass panes 2-4 joined as a single, insulating glass unit 1.

[0149] Along a major extent(s) of the triple insulated glazing unit, e.g. length and width, the low emissivity coating may in embodiments of the present disclosure preferably extend to but not between the edge seal 10, 11 and the glass surfaces to which it seals. The same may be the case for the aerogel layer 7a, and any optional solar coatings.

[0150] In one or more embodiments, the first aerogel thickness T1 may be below 15 mm, such as below 1.3 mm, such as below 1.1 mm or such as below 1.0 mm. E.g. as seen in Fig. 4, the first aerogel 7a layer may provide a first aerogel thickness T1 in a gap 5, e.g. extending from the second major glass surface 2b towards the third major glass surface 3a and having a free surface exposed in the gap 5. In one or more embodiments, the first aerogel layer thickness T1 is between 4 and 12 mm, such as between 5-10 mm. In one or more embodiments of the present disclosure, the aerogel thickness, may be above 15 mm, such as above 16 mm, such as extending between opposing major glass surfaces (3b, 4a) of the triple insulated glazing unit, e.g. as seen in Fig. 3.

[0151] Fig. 8 shows two graphs representing the relationship between Ug-value and installation angle of two triple insulated glazing units. The lowermost graph, named "Fig 4" shows the relationship between Ug-value and installation angle of a triple insulated glazing unit of the fourth embodiment, i.e. the embodiment shown in Fig. 4 of the drawings of the present disclosure, with an aerogel layer being 5mm in thickness. The uppermost graph, named "Fig 4 no sheet" shows the relationship between Ug-value and installation angle of a triple insulated glazing unit similar to the fourth embodiment, but different in that the triple insulated glazing unit does not comprise the aerogel layer.

[0152] As seen in Fig. 8, the aerogel layer advantageously decreases the Ug-value. With no aerogel sheet, i.e. in the graph named "Fig 4 no sheet", the Ug-value is 0.52 at vertical instalment of the triple insulated glazing unit and the Ug-value is 0.84 at horizontal instalment of the triple insulated glazing unit. With the 5mm aerogel sheet arranged as shown in Fig. 4, i.e. in the graph named "Fig 4", the Ug-value is 0.40 at vertical instalment of the triple insulated glazing unit and the Ug-value is 0.57 at horizontal instalment of the triple insulated glazing unit.

[0153] Furthermore, the variation in Ug-value with installation angle is smaller in the triple insulated glazing unit with the aerogel layer than in the triple insulated glazing unit without the aerogel layer. The present invention may thereby provide more robust Ug-value with less angle influence.

[0154] The present disclosure further relates to the following items:

ITEMS LIST

[0155]

1. A triple insulated glazing unit (1), comprising a first glass pane (2), an intermediate second glass pane (3) and a third glass pane (4) arranged in parallel, wherein the triple insulated glazing unit (1) comprises a first aerogel layer (7a) arranged on a major glass surface (2a, 2b, 3a, 3b, 4a, 4b) of one of the glass panes (2, 3, 4).

2. The triple insulated glazing unit (1), according to any of the preceding items, further comprising a first low-emissivity coating (8a) arranged on a major glass surface (2a, 2b, 3a, 3b, 4a, 4b) of one of the glass panes (2, 3, 4).

3. The triple insulated glazing unit (1), according to any of the preceding items, wherein the first glass pane (2) comprises a first major glass surface (2a) and a second major glass surface (2b), wherein the first major glass surface (2a) is facing an outside environment (12) of the triple insulated glazing unit (1) and the second major glass surface (2b) is facing a first gap (5) of the triple insulated glass unit.

4. The triple insulated glazing unit (1), according to any of the preceding items, wherein the intermediate second glass pane (3) comprises a third major glass surface (3a) and a fourth major glass surface (3b), wherein the third major glass surface (3a) is facing the first gap (5) while the fourth major glass surface (3b) is facing a second gap (6) of the triple insulated glass unit.

5. The triple insulated glazing unit (1), according to any of the preceding items, wherein the third glass pane (4) comprises a fifth major glass surface (4a) and a sixth major glass surface (4b), wherein the fifth major glass surface (4a) is facing the second gap (6) and the sixth major glass surface (4b) is facing the outside environment (12) of the triple insulated glazing unit (1).

6. The triple insulated glazing unit (1), according to any of the preceding items, wherein the first gap (5) and second gap (6) are enclosed by one or more edge seals (10 ,11).

7. The triple insulated glazing unit (1) according to any of the preceding items, wherein the first aerogel layer (7a) is of an aerogel thickness (T1) below 1.3 mm, such as below 1.1 mm or such as below 1.0 mm.

8. The triple insulated glazing unit (1) according to any of the preceding items, wherein the first gap (5) and/or the second gap (6) is filled with argon.

9. The triple insulated glazing unit (1) according to any of the preceding items, wherein the first gap (5) and/or the second gap (6) is filled with krypton.

10. The triple insulated glazing unit (1) according to any of the preceding items, wherein the first aerogel layer may be silica-based, cellulose and/or polymer-based.

11. The triple insulated glazing unit (1) according to any of the preceding items, wherein the first low-emissivity coating (8a) and/or the second low emissivity coating (8b) comprises

- one or more layers of a transparent conductive oxide (TCO), such as fluorine-doped tin oxide (FTO), antimony-doped tin oxide (ATO), or mixed indium tin oxide (ITO), or of
- one or more dielectric layers and one or more metal layers, such as one or more silver layers.

12. The triple insulated glazing unit (1) according to any of the preceding items, wherein the triple insulated glazing unit has an Ug-value below 0.9 W/m2K, such as below 0.8 W/m2K, such as below 0.7 W/m2K, such as below 0.6 W/m2k or such as below 0.5 W/m2K.

13. The triple insulated glazing unit (1) according to any of the preceding items, wherein the major extent of the triple insulated glazing unit (1) is divided into a vision portion (14) and an edge portion (13), wherein the edge portion (13) is arranged to separate the vision portion (14) from an edge of the triple insulated glazing unit (1_e), and wherein the first aerogel layer (7a) is confined to the edge portion (13) of the triple insulated glazing unit (1).

14. The triple insulated glazing unit (1) according to item 13, wherein the edge portion (7a) has an edge portion width (W e) being less than 80 mm, such as less than 60 mm, or such as less than 40 mm.

15. The triple insulated glazing unit (1) according to any of the preceding items, wherein the first aerogel layer (7a) has an aerogel width (W_a) being less than 80 mm, such as less than 60 mm, or such as less than 40 mm.

16. The triple insulated glazing unit (1) according to any of the preceding items, wherein the first aerogel layer (7a) is a first peripheral aerogel layer (7a_per) arranged along the periphery of the glass pane (2, 3, 4) on which the first aerogel layer (7a, 7a_per) is located, so that the first peripheral aerogel layer (7a_per) encloses a centre portion (15) of the glass pane (2, 3, 4) being devoid of the aerogel layer (7a_per).

17. The triple insulated glazing unit (1) according to any of the items 2-16, comprising a second low-emissivity coating (8b), preferably located on a different major glass surface (2a, 2b, 3a, 3b, 4a, 4b) than the first low-emissivity coating (8a).

18. The triple insulated glazing unit (1) according to any of the preceding items, comprising a first glass pane (2), an intermediate second glass pane (3) and a third glass pane (4) arranged in parallel,

wherein the first glass pane (2) comprises a first major glass surface (2a) and a second major glass surface (2b), wherein the first major glass surface (2a) is facing an outside environment (12) of the triple insulated glazing unit (1) and the second major glass surface (2b) is facing a first gap (5) of the triple insulated glass unit,
wherein the intermediate second glass pane (3) comprises a third major glass surface (3a) and a fourth major glass surface (3b), wherein the third major glass surface (3a) is facing the first gap (5) while the fourth major glass surface (3b) is facing a second gap (6) of the triple insulated glass unit,
wherein the third glass pane (4) comprises a fifth major glass surface (4a) and a sixth major glass surface (4b), wherein the fifth major glass surface (4a) is facing the second gap (6) and the sixth major glass surface (4b) is facing the outside environment (12) of the triple insulated glazing unit (1),
wherein the first gap (5) and the second gap (6) are enclosed by one or more edge seals (10 , 11),
wherein the triple insulated glazing unit (1) comprises a first aerogel layer (7a) and a first low-emissivity coating (8a), wherein each of the first low-emissivity coating (8a) and the first aerogel layer (7a) is arranged on a major glass surface (2a, 2b, 3a, 3b, 4a, 4b) of one of the glass panes (2, 3, 4) and
wherein the first low-emissivity coating (8a) is located on the third major glass surface (3a) the first aerogel layer (7a) is located on the second major glass surface (2b).

19. The triple insulated glazing unit (1) according to any of the items 1-17, comprising a first glass pane (2), an intermediate second glass pane (3) and a third glass pane (4) arranged in parallel,

wherein the first glass pane (2) comprises a first major glass surface (2a) and a second major glass surface (2b), wherein the first major glass surface (2a) is facing an outside environment (12) of the triple insulated glazing unit (1) and the second major glass surface (2b) is facing a first gap (5) of the triple insulated glass unit,

wherein the intermediate second glass pane (3) comprises a third major glass surface (3a) and a fourth major glass surface (3b), wherein the third major glass surface (3a) is facing the first gap (5) while the fourth major glass surface (3b) is facing a second gap (6) of the triple insulated glass unit,

wherein the third glass pane (4) comprises a fifth major glass surface (4a) and a sixth major glass surface (4b), wherein the fifth major glass surface (4a) is facing the second gap (6) and the sixth major glass surface (4b) is facing the outside environment (12) of the triple insulated glazing unit (1),

wherein the first gap (5) and the second gap (6) are enclosed by an edge seal (10 ,11),

wherein the triple insulated glazing unit (1) comprises a first aerogel layer (7a) and a first low-emissivity coating (8a), wherein each of the first low-emissivity coating (8a) and the first aerogel layer (7a) is arranged on a major glass surface (2a, 2b, 3a, 3b, 4a, 4b) of one of the glass panes (2, 3, 4) and

wherein the first low-emissivity coating (8a) is located on the third major glass surface (3a) and the first aerogel layer (7a) is located on the fourth major glass surface (3b).

20. The triple insulated glazing unit (1) according to any of the items 18-19, wherein the second low-emissivity coating (8b) is located on the fifth major glass surface (4a).

21. The triple insulated glazing unit (1) according to any of the items 1-17, comprising a first glass pane (2), an intermediate second glass pane (3) and a third glass pane (4) arranged in parallel,

wherein the first glass pane (2) comprises a first major glass surface (2a) and a second major glass surface (2b), wherein the first major glass surface (2a) is facing an outside environment (12) of the triple insulated glazing unit (1) and the second major glass surface (2b) is facing a first gap (5) of the triple insulated glass unit,

wherein the intermediate second glass pane (3) comprises a third major glass surface (3a) and a fourth major glass surface (3b), wherein the third major glass surface (3a) is facing the first gap (5) while the fourth major glass surface (3b) is facing a second gap (6) of the triple insulated glass unit,

wherein the third glass pane (4) comprises a fifth major glass surface (4a) and a sixth major glass surface (4b), wherein the fifth major glass surface (4a) is facing the second gap (6) and the sixth major glass surface (4b) is facing the outside environment (12) of the triple insulated glazing unit (1),

wherein the first gap (5) and the second gap (6) are enclosed by one or more edge seals (10 , 11),

wherein the triple insulated glazing unit (1) comprises a first aerogel layer (7a) and a first low-emissivity coating (8a), wherein each of the first low-emissivity coating (8a) and the first aerogel layer (7a) is arranged on a major glass surface (2a, 2b, 3a, 3b, 4a, 4b) of one of the glass panes (2, 3, 4) and

wherein the first low-emissivity coating (8a) is located on the fifth major glass surface (4a) the first aerogel layer (7a) is located on the second major glass surface (2b).

22. The triple insulated glazing unit (1) according to any of the items 1-17, comprising a first glass pane (2), an intermediate second glass pane (3) and a third glass pane (4) arranged in parallel,

wherein the first glass pane (2) comprises a first major glass surface (2a) and a second major glass surface (2b), wherein the first major glass surface (2a) is facing an outside environment (12) of the triple insulated glazing unit (1) and the second major glass surface (2b) is facing a first gap (5) of the triple insulated glass unit,

wherein the intermediate second glass pane (3) comprises a third major glass surface (3a) and a fourth major glass surface (3b), wherein the third major glass surface (3a) is facing the first gap (5) while the fourth major glass surface (3b) is facing a second gap (6) of the triple insulated glass unit,

wherein the third glass pane (4) comprises a fifth major glass surface (4a) and a sixth major glass surface (4b), wherein the fifth major glass surface (4a) is facing the second gap (6) and the sixth major glass surface (4b) is facing the outside environment (12) of the triple insulated glazing unit (1),

wherein the first gap (5) and the second gap (6) are enclosed by one or more edge seals (10 , 11),

wherein the triple insulated glazing unit (1) comprises a first aerogel layer (7a) and a first low-emissivity coating (8a), wherein each of the first low-emissivity coating (8a) and the first aerogel layer (7a) is arranged on a major glass surface (2a, 2b, 3a, 3b, 4a, 4b) of one of the glass panes (2, 3, 4) and wherein the first low-emissivity coating (8a) is located on the fifth major glass surface (4a) and the first aerogel layer (7a) is located on the fourth major glass surface (3b).

23. The triple insulated glazing unit (1) according to any of the items 1-17, comprising a first glass pane (2), an intermediate second glass pane (3) and a third glass pane (4) arranged in parallel,

wherein the first glass pane (2) comprises a first major glass surface (2a) and a second major glass surface (2b), wherein the first major glass surface (2a) is facing an outside environment (12) of the triple insulated glazing unit (1) and the second major glass surface (2b) is facing a first gap (5) of the triple insulated glass unit,
wherein the intermediate second glass pane (3) comprises a third major glass surface (3a) and a fourth major glass surface (3b), wherein the third major glass surface (3a) is facing the first gap (5) while the fourth major glass surface (3b) is facing a second gap (6) of the triple insulated glass unit,
wherein the third glass pane (4) comprises a fifth major glass surface (4a) and a sixth major glass surface (4b), wherein the fifth major glass surface (4a) is facing the second gap (6) and the sixth major glass surface (4b) is facing the outside environment (12) of the triple insulated glazing unit (1),
wherein the first gap (5) and the second gap (6) are enclosed by one or more edge seals (10 , 11),
wherein the triple insulated glazing unit (1) comprises a first aerogel layer (7a) and a first low-emissivity coating (8a), wherein each of the first low-emissivity coating (8a) and the first aerogel layer (7a) is arranged on a major glass surface (2a, 2b, 3a, 3b, 4a, 4b) of one of the glass panes (2, 3, 4) and
wherein the first low-emissivity coating (8a) is located on the third major glass surface (3a) and the first aerogel layer (7a) is located on the fourth or fifth major glass surface (3b, 4a).

24. The triple insulated glazing unit (1) according to item 23, wherein the second low-emissivity coating (8b) is located on the second major glass surface (2b).

25. The triple insulated glazing unit (1) according to any of the items 1-17, comprising a first glass pane (2), an intermediate second glass pane (3) and a third glass pane (4) arranged in parallel,

wherein the first glass pane (2) comprises a first major glass surface (2a) and a second major glass surface (2b), wherein the first major glass surface (2a) is facing an outside environment (12) of the triple insulated glazing unit (1) and the second major glass surface (2b) is facing a first gap (5) of the triple insulated glass unit,
wherein the intermediate second glass pane (3) comprises a third major glass surface (3a) and a fourth major glass surface (3b), wherein the third major glass surface (3a) is facing the first gap (5) while the fourth major glass surface (3b) is facing a second gap (6) of the triple insulated glass unit,
wherein the third glass pane (4) comprises a fifth major glass surface (4a) and a sixth major glass surface (4b), wherein the fifth major glass surface (4a) is facing the second gap (6) and the sixth major glass surface (4b) is facing the outside environment (12) of the triple insulated glazing unit (1),
wherein the first gap (5) and the second gap (6) are enclosed by one or more edge seals (10 , 11),
wherein the triple insulated glazing unit (1) comprises a first aerogel layer (7a) and a first low-emissivity coating (8a), wherein each of the first low-emissivity coating (8a) and the first aerogel layer (7a) is arranged on a major glass surface (2a, 2b, 3a, 3b, 4a, 4b) of one of the glass panes (2, 3, 4) and
wherein the first low-emissivity coating (8a) is located on the fifth major glass surface (4a) and the first aerogel layer (7a) is located on the second or third major glass surface (2b, 3a).

26. The triple insulated glazing unit (1) according to any of the item 25, wherein the second low-emissivity coating (8b) is located on the fourth major glass surface (3b).

27. The triple insulated glazing unit (1) according to any of the items 1-17, 19, 21, 23 or 25, wherein the first aerogel layer (7a) extends from the first glass pane (2) or the third glass pane (4) to the intermediate second glass pane (3).

28. The triple insulated glazing unit (1) according to any of the items 1-17, 18, 20, 22, 24 or 26, wherein the first aerogel layer (7a) extends from the first low emissivity coating (8a) or the second low emissivity coating (8b), across a gap (5, 6) of the triple insulated gazing unit (1) and to an opposing glass pane (2, 3, 4).

29. The triple insulated glazing unit (1) according to any of the items 3-17, wherein the first aerogel layer (7a) and the first low-emissivity coating (8a) are located in different gaps (5, 6) of the triple insulated glazing unit (1).

30. The triple insulated glazing unit (1) according to any of the items 2-17, wherein the first aerogel layer (7a) and the first low emissivity coating (8a) is separated by the intermediate second glass pane (3).

31. The triple insulated glazing unit (1) according to any of the items 1-17, wherein the first aerogel layer (7a) is located on the second major glass surface (2b).

32. The triple insulated glazing unit (1) according to any of the items 1-17, wherein the first aerogel layer (7a) is located on the third major glass surface (3a).

33. The triple insulated glazing unit (1) according to any of the items 1-17, wherein the first aerogel layer (7a) is located on the fourth major glass surface (3b).

34. The triple insulated glazing unit (1) according to any of the items 1-17, wherein the first aerogel layer (7a) is located on the fifth major glass surface (4a).

35. The triple insulated glazing unit (1) according to any of the items 2-34, wherein the first aerogel layer (7a), and/or optionally a second aerogel layer, (7b) is located in the same gap (5, 6) as the first and/or second low emissivity coating (8a, 8b), such as on the same major glass surface (2a, 2b, 3a, 3b, 4a, 4b) of the first or second low emissivity coating (8a, 8b).

36. The triple insulated glazing unit (1) according to item 35, wherein the first and/or second aerogel layer (7a, 7b) is located on the same major glass pane surface (2a, 2b, 3a, 3b, 4a, 4b) as a low emissivity coating (8a, 8b), preferably in a side-by-side configuration with the low emissivity coating (8a, 8b).

37. The triple insulated glazing unit (1) according to item 36, wherein the first aerogel layer (7a) is positioned together with the first low emissivity coating (8a) on the third or fifth major glass pane surface (3a, 4a), e.g. such that the low emissivity coating (8a) is located majorly in the vision portion (14), while the first aerogel layer (7a) is located majorly in, or confined to, the edge portion (13).

38. The triple insulated glazing unit (1) according to any of the preceding items, wherein the triple insulated glazing unit (1) is configured to provide an Ug-value measured at a horizontal orientation, which differs with less than 0.3 W/m2K, such as with less than 0.2 W/m2K, or such as with less than 0.1 W/m2K from an Ug-value of the triple insulated glazing unit (1) measured at a vertical orientation.

39. The triple insulated glazing unit (1) according to any of the preceding items, wherein the triple insulated glazing unit (1) is configured to provide a reduced change in Ug-value, when the triple insulated glazing unit (1) is moved between different installation angles (A1), compared to a change in Ug-value of a reference triple insulated glazing unit when moved between different installation angles (A1), wherein the reference triple insulated glazing unit is differing only from the triple insulated glazing unit (1) by being devoid of aerogel layer(s).

40. A building aperture cover (100), such as a window, wherein the building aperture cover (100) comprises a triple insulated glazing unit (1) according to any of the preceding items, and one or more frame structures (102) providing a frame enclosing the triple insulated glazing unit (1).

41. The building aperture cover (100) according to item 40, installed at an installation angle (A1) between 0-55 degrees measured from horizontal.

42. The building aperture cover (100) according to any of the items 40-41, wherein the building aperture cover (100) is a roof window.

43. The building aperture cover (100) according to any of the items 40-42, wherein the triple insulated glazing unit (1) is orientated with the first major glass surface facing the exterior environment of the building.

44. The building aperture cover (100) according to any of the items 40-43, wherein a frame structure (102) and/or covering means covers and edge portion (13) of the triple insulated glazing unit (1).

45. The building aperture cover (100) according to item 44, wherein at least the first aerogel layer (7a) is located exclusively within the edge portion (13).

REFERENCE LIST

[0156]

1	triple insulated glazing unit
2	first glass pane
2a	first major glass surface
2b	second major glass surface
3	intermediate second glass pane
3a	third major glass surface
3b	fourth major glass surface
4	third glass pane
4a	fifth major glass surface
4b	sixth major glass surface
5	first gap
6	second gap
7a	first aerogel layer
7b	second aerogel layer

8a	first low-emissivity layer
8b	second low-emissivity layer
9	lamination sheet, such as a lamination glass sheet
10	first edge seal
11	second edge seal
12	outside environment
12a	exterior environment of the outside environment
12b	interior environment of the outside environment
13	edge portion
14	vision portion
15	centre portion
100	building aperture cover
102	frame structure
103	sash frame structure
104	fixed frame structure
105	handle
A1	installation angle
D1	overlap width
T1	first aerogel layer thickness
W_a	first aerogel width
W_e	edge portion width

Claims

1. A triple insulated glazing unit (1) comprising a first glass pane (2), an intermediate second glass pane (3) and a third glass pane (4) arranged in parallel,

wherein the first glass pane (2) comprises a first major glass surface (2a) and a second major glass surface (2b), wherein the first major glass surface (2a) is facing an outside environment (12) of the triple insulated glazing unit (1) and the second major glass surface (2b) is facing a first gap (5) of the triple insulated glass unit,
wherein the intermediate second glass pane (3) comprises a third major glass surface (3a) and a fourth major glass surface (3b), wherein the third major glass surface (3a) is facing the first gap (5) while the fourth major glass surface (3b) is facing a second gap (6) of the triple insulated glass unit,
wherein the third glass pane (4) comprises a fifth major glass surface (4a) and a sixth major glass surface (4b), wherein the fifth major glass surface (4a) is facing the second gap (6) and the sixth major glass surface (4b) is facing the outside environment (12) of the triple insulated glazing unit (1),
wherein the first gap (5) and second gap (6) are enclosed by one or more edge seals (10 ,11), and
wherein the triple insulated glazing unit (1) comprises a first aerogel layer (7a) and a first low-emissivity coating (8a), wherein each of the first low-emissivity coating (8a) and the first aerogel layer (7a) is arranged on a major glass surface (2a, 2b, 3a, 3b, 4a, 4b) of one of the glass panes (2, 3, 4).

2. The triple insulated glazing unit (1) according to claim 1, wherein the first aerogel layer (7a) and the first low-emissivity coating (8a) are located in different gaps (5, 6) of the triple insulated glazing unit (1).

3. The triple insulated glazing unit (1) according to any of the preceding claims, wherein the first aerogel layer (7a) and the first low emissivity coating (8a) is separated by the intermediate second glass pane (3).

4. The triple insulated glazing unit (1) according to any of the preceding claims, comprising a second low-emissivity coating (8b) located on a different major glass surface (2a, 2b, 3a, 3b, 4a, 4b) than the first low-emissivity coating (8a).

5. The triple insulated glazing unit (1) according to any of the preceding claims, wherein the first aerogel layer (7a) and a second low emissivity coating (8b) are located in the same gap (5, 6) of the triple insulated glazing unit (1).

6. The triple insulated glazing unit (1) according to any of the preceding claims, wherein the first low-emissivity coating (8a) is located on the third major glass surface (3a).

7. The triple insulated glazing unit (1) according to any of the claims 4-6, wherein the second low-emissivity coating (8b) is located on the fifth major glass surface (4a).

8. The triple insulated glazing unit (1) according to any of the preceding claims, wherein the first aerogel layer (7a) is located on the fourth major glass surface (3b).

9. The triple insulated glazing unit (1) according to any of the preceding claims, wherein the first aerogel layer (7a) extends from the first glass pane (2) or the third glass pane (4) to the intermediate second glass pane (3).

10. The triple insulated glazing unit (1) according to any of the preceding claims, wherein the first aerogel layer (7a) is of an aerogel thickness (T1) below 1.3 mm, such as below 1.1 mm or such as below 1.0 mm.

11. The triple insulated glazing unit (1) according to any of the preceding claims, wherein the first gap (5) and/or the second gap (6) contains a gas, such as argon or krypton.

12. The triple insulated glazing unit (1) according to any of the preceding claims, wherein the first aerogel layer (7a) is made of a silica-based or cellulose-based aerogel.

13. The triple insulated glazing unit (1) according to any of the preceding claims, wherein the first low-emissivity coating (8a) and/or the second low emissivity coating (8b) comprises

- one or more layers of a transparent conductive oxide (TCO), such as fluorine-doped tin oxide (FTO), antimony-doped tin oxide (ATO), or mixed indium tin oxide (ITO), or of
- one or more dielectric layers and one or more metal layers, such as one or more silver layers.

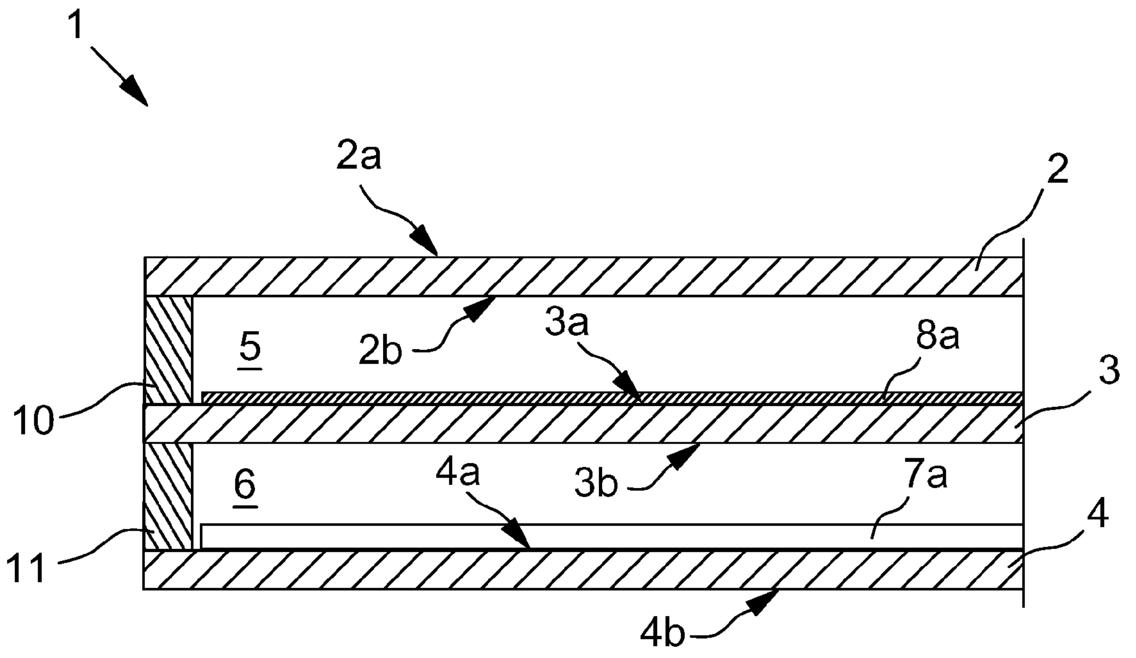
14. The triple insulated glazing unit (1) according to any of the preceding claims, wherein, the triple insulated glazing unit has an Ug-value below 0.9 W/m2K, such as below 0.8 W/m2K, such as below 0.7 W/m2K, such as below 0.6 W/m2k or such as below 0.5 W/m2K.

15. A building aperture cover (100), such as a window, wherein the building aperture cover (100) comprises a triple insulated glazing unit (1) according to any of the preceding claims, and one or more frame structures (102) providing a frame enclosing the triple insulated glazing unit (1).

16. The building aperture cover (100) according to claim 15, installed at an installation angle (A1) between 0-55 degrees measured from horizontal.

17. The building aperture cover (100) according to any of the claims 15-16, wherein the building aperture cover (100) is a roof window.

18. The building aperture cover (100) according to any of the claims 15-17, wherein the triple insulated glazing unit (1) is orientated with the first major glass surface (2a) facing the exterior environment of the building.


1
2a
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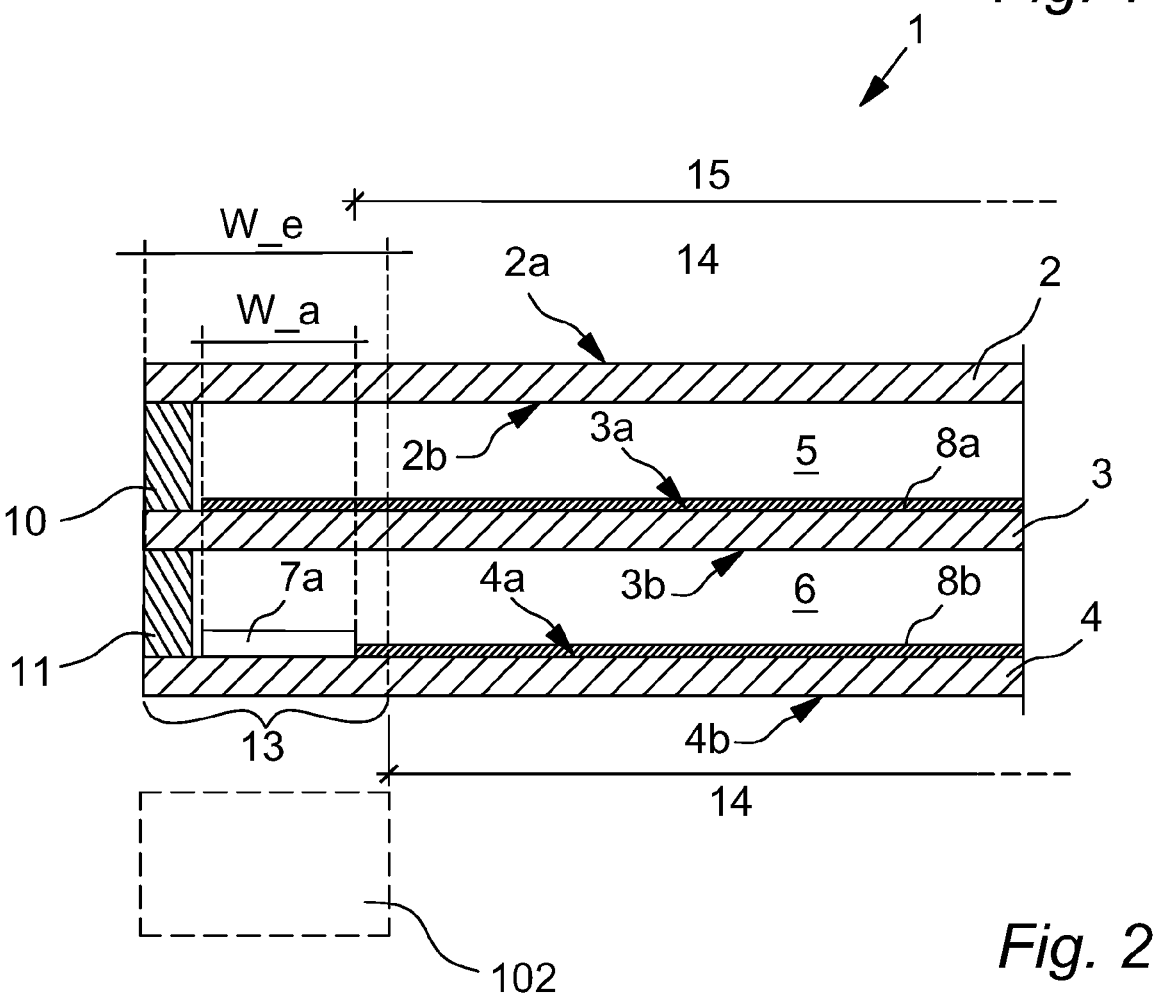
2b
3a
8a
5
10
3
6
4a
3b
7a
11
4
4b

Fig. 1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15
W_e
14
2a
2
W_a
2b
3a
5
8a
10
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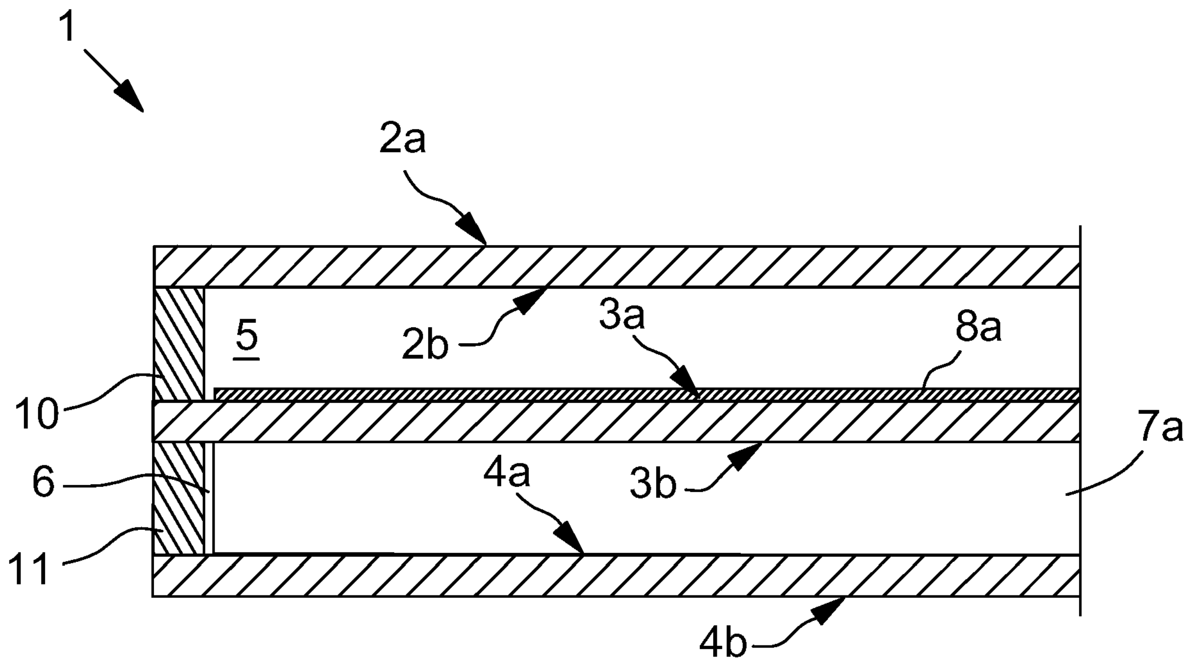
11
4
13
4b
14
102

Fig. 2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6
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3b
7a
11
4b

Fig. 3

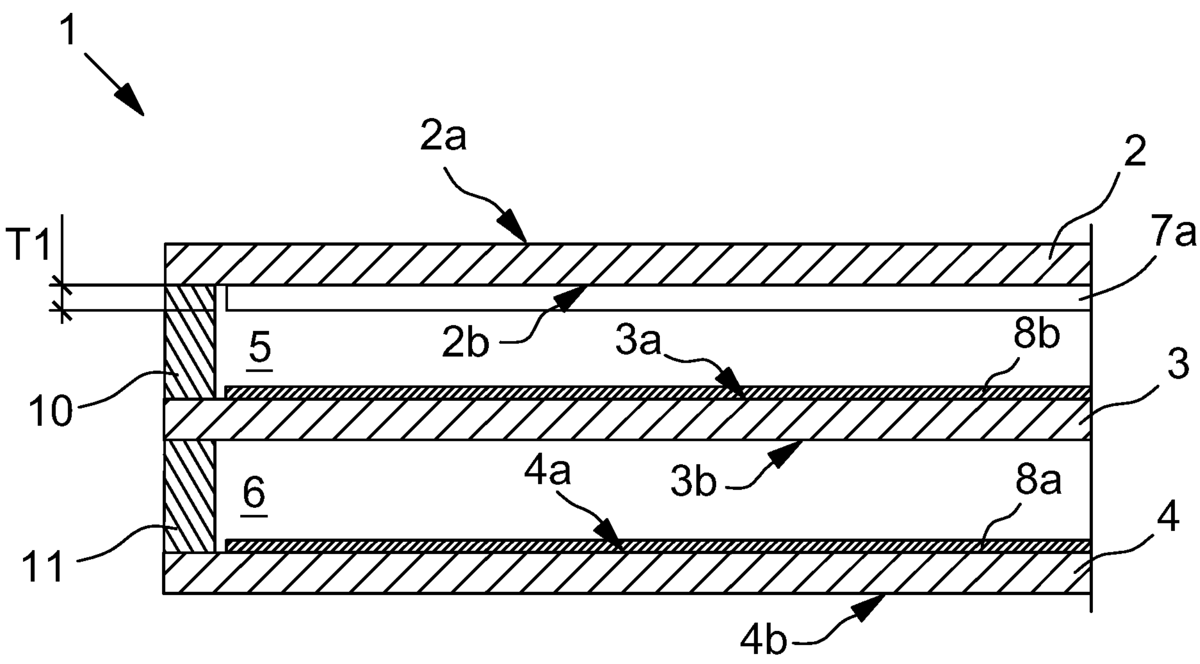
1
2a
2
7a
T1
2b
5
3a
8b
3
10
6
4a
3b
8a
4
11
4b

Fig. 4

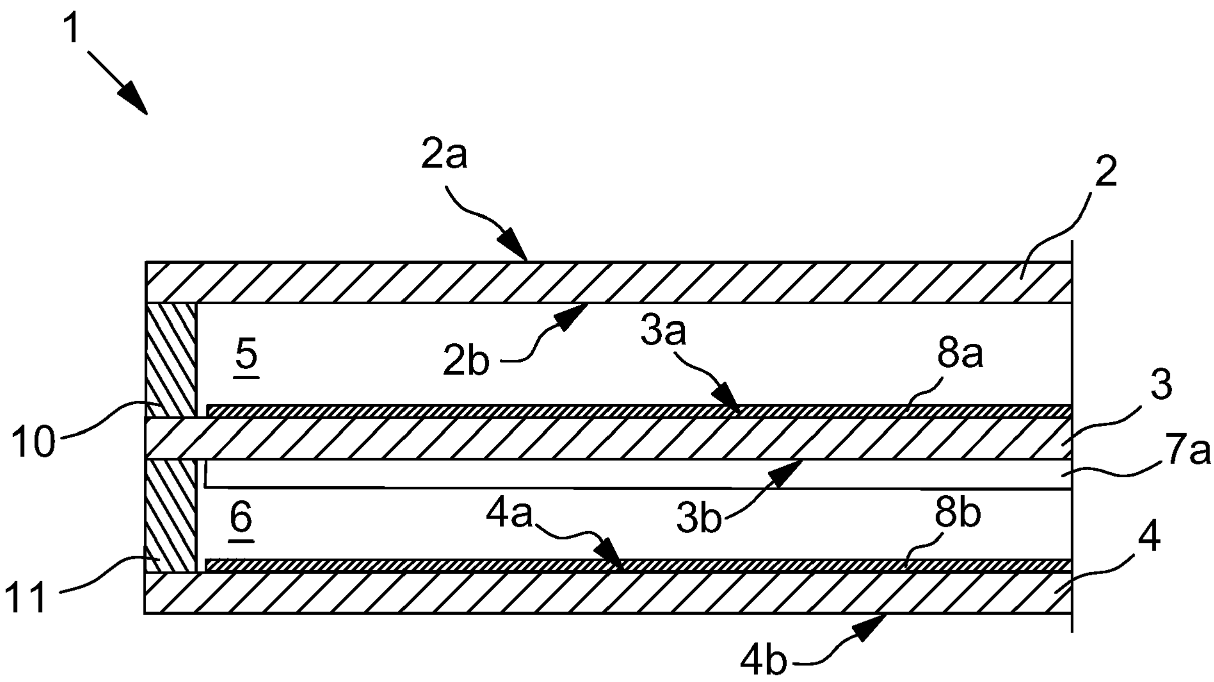

Fig. 5

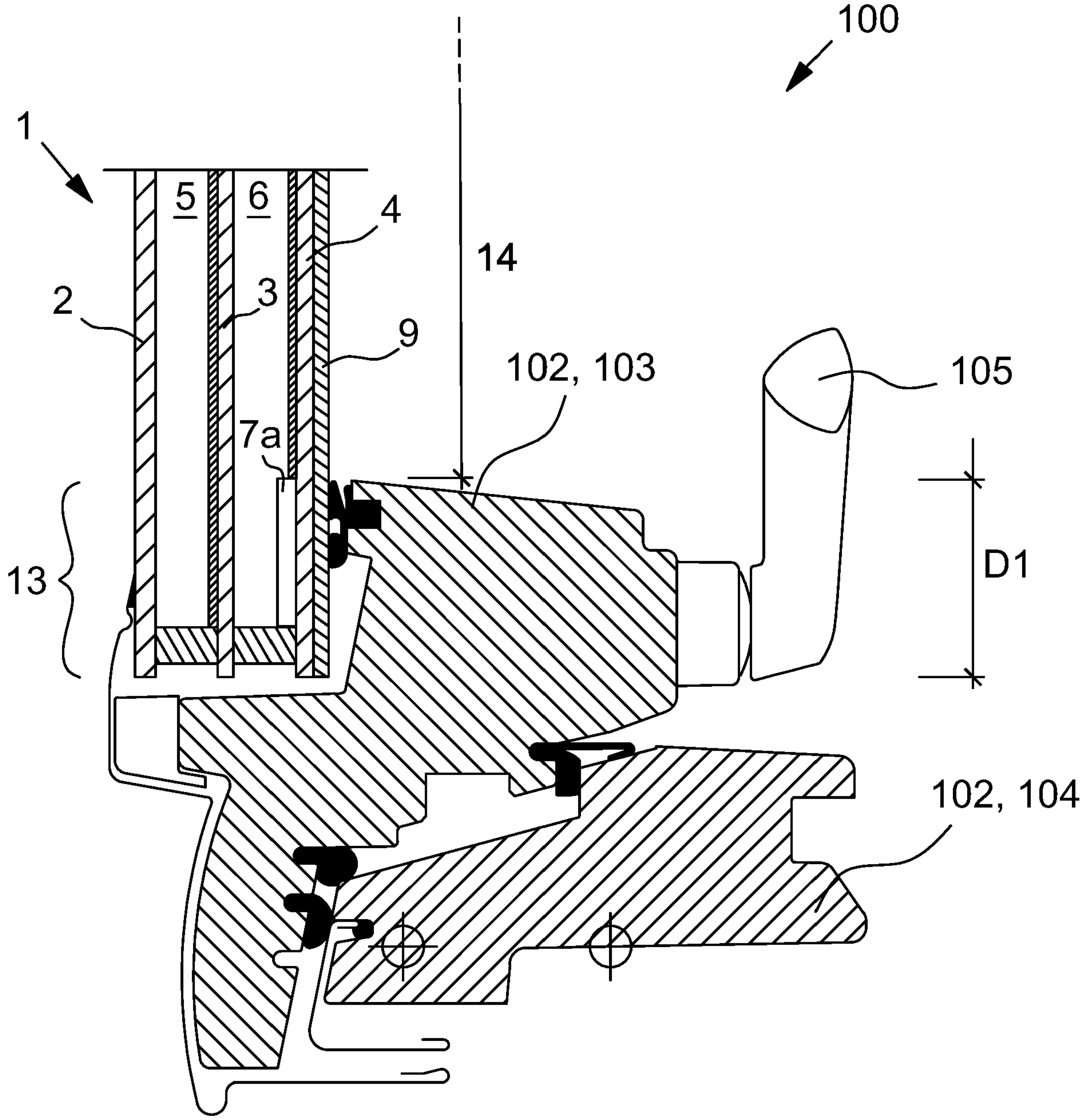

Fig. 6

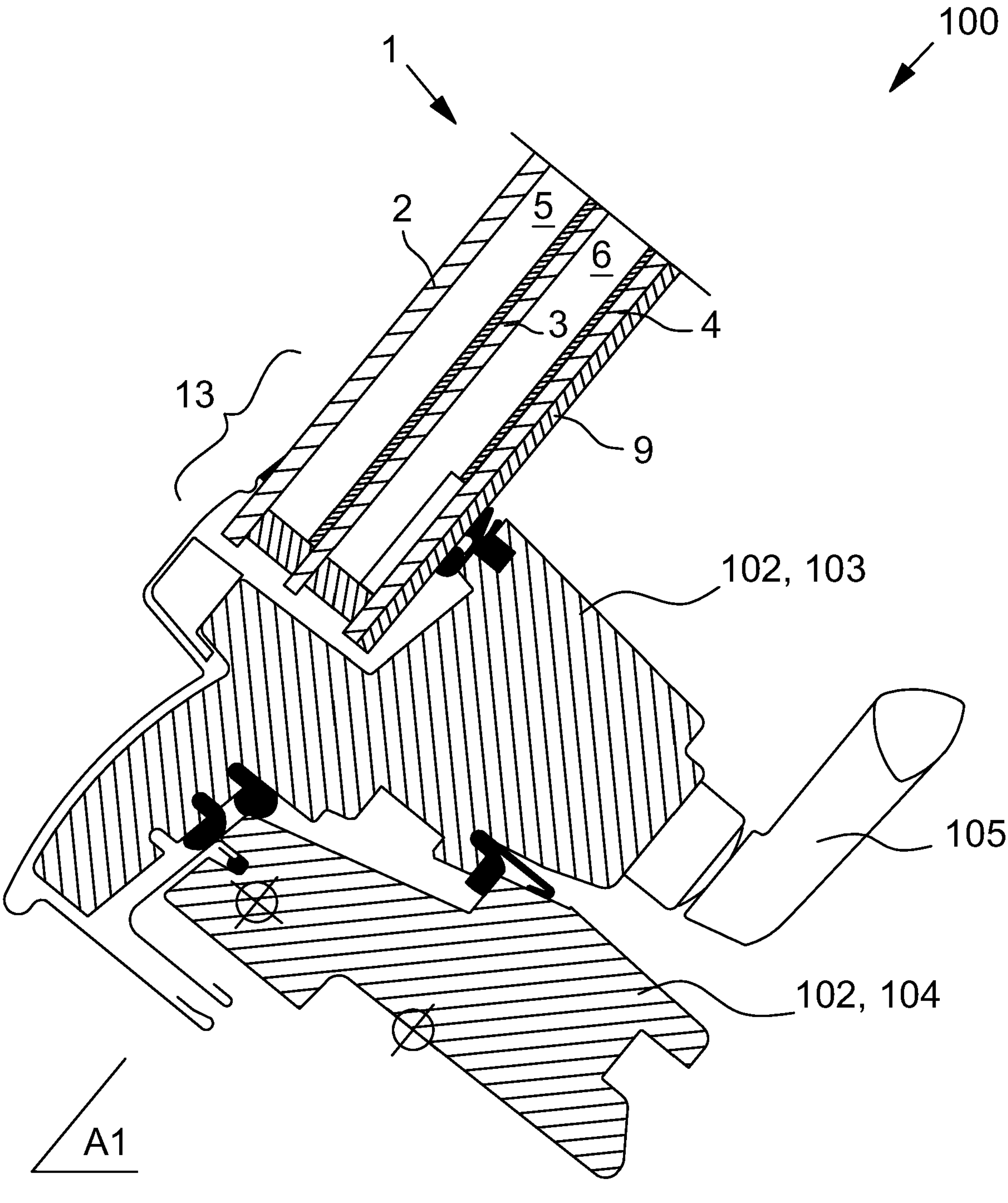

Fig. 7

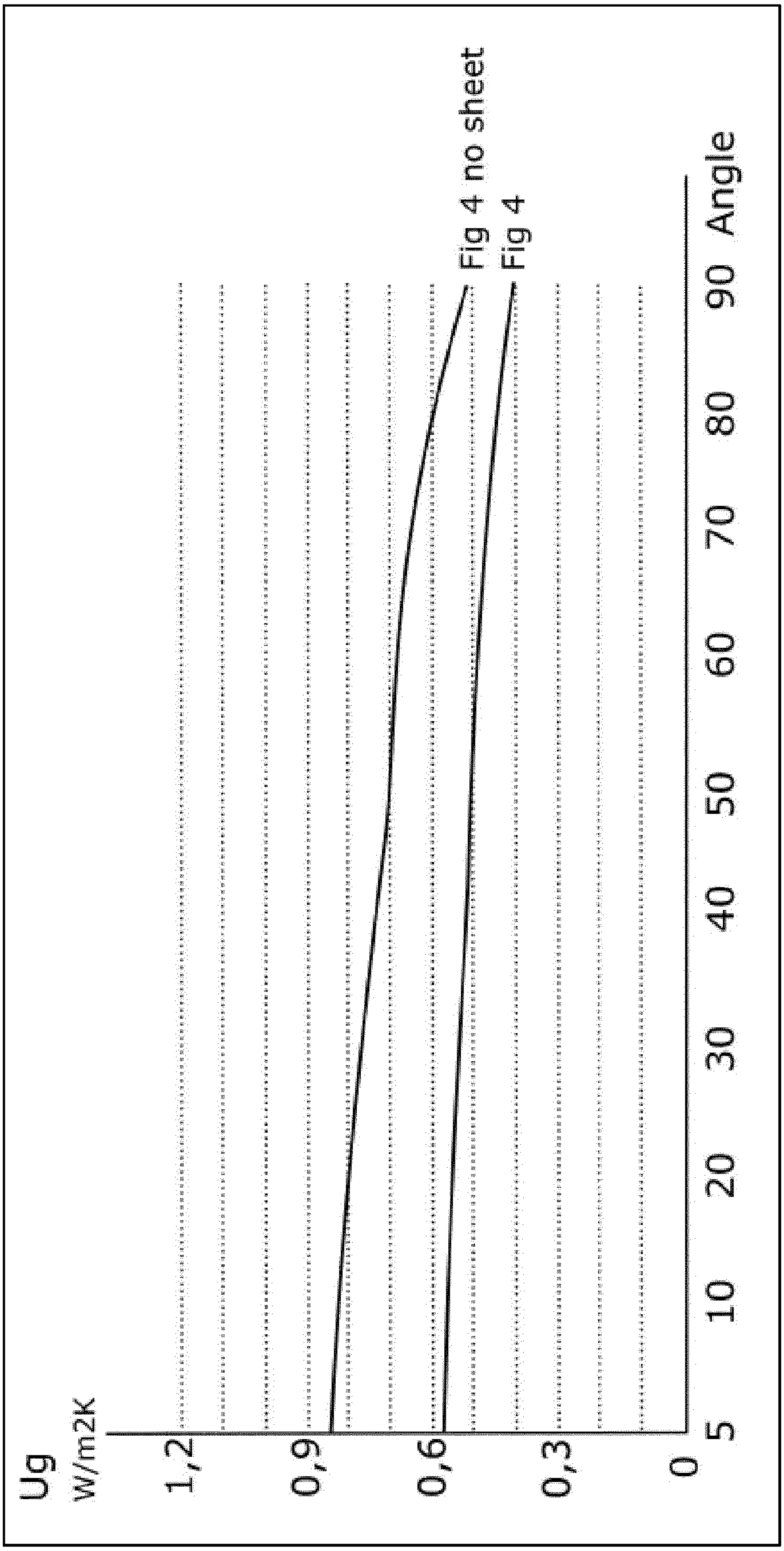
Ug
W/m2K
1,2
0,9
0,6
0,3
0
5
10
20
30
40
50
60
70
80
90
Angle
Fig 4 no sheet
Fig 4

Fig. 8

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 19 4587

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2022/042369 A1 (BURROWS KEITH JAMES [US]) 10 February 2022 (2022-02-10) * paragraph [0037]; figure 1 * -----	1-8, 10-18	INV. E06B3/67 E06B3/663 E04D13/03 E04D13/035
X	CN 109 989 679 A (CHANGSHA XINGNA AEROGEL CO LTD) 9 July 2019 (2019-07-09) * figure 1 * -----	1,9, 12-16,18	
X	CN 109 184 489 A (UNIV NORTHEAST PETROLEUM) 11 January 2019 (2019-01-11) * figures 4, 6 * -----	1,9, 11-18	
X	US 8 402 716 B2 (TINIANOV BRANDON D [US]; WHITING KENT [US] ET AL.) 26 March 2013 (2013-03-26) * figure 2 * -----	1,9, 12-16,18	

TECHNICAL FIELDS SEARCHED (IPC)

E06B
E04D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	22 November 2022	Crespo Vallejo, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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