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(54) **A SPACER WITH DOUBLE SIDE SURFACES**

(57) it is an object of the present invention to provide a spacer profile for mounting between glass panes for forming a spacing between said glass panes, wherein said spacer comprises a body comprising an inner top surface directed towards an inner space when mounted between said panes, an outer surface opposite said inner surface, and a first and a second side surface connecting said inner surface and said outer surface. Further, a stiffening material is arranged on at least one side surface of said spacer, wherein said stiffening material extends along the length of said spacer. Thereby, the stiffening material makes the spacer stiff/rigid thus removing the risk of the spacer being bent and broken before the installation between the two glass panes and making the spacer easier to handle from production until actual mounting between panes.

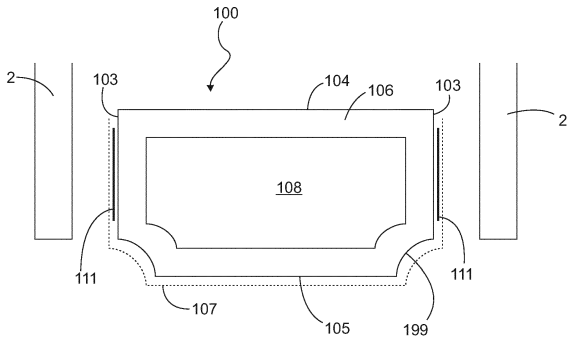

Fig. 1

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Description

Field of the Invention

[0001] The present invention relates to a spacer for forming a spacing between glass panes, wherein said spacer comprises a compartment enclosed by two side surfaces, an inner top surface and a lower outer surface.

Background of the Invention

[0002] It is well known to provide spacers in order to define the spacing between the panes of insulating glazing consisting of a plurality of parallel glass panes spaced apart by an insulating cavity.

[0003] A plurality of such spacers made of various materials and of various shapes is known in the art. Spacers made by roll forming of a metal foil are widely used in the art and considered one of the preferred alternatives because of their stability and their low gas diffusion properties.

[0004] Insulating Glass Units (IG units) having a plurality of glass panes are made by automatic manufacturing machines. Spacers are bent automatically to the desired size and shape and are arranged between two neighbouring glass panes. Spacers made of metal foils are easily bent and will remain in such bent position.

[0005] Furthermore, spacers made of metal foils have a high resistance against diffusion of gases and moisture penetration. Within the space between the neighbouring glass panes, a gas is arranged, for instance argon having good isolating properties. In order to avoid any loss of gas, the spacers delimiting the cavity need to be resistant against diffusion of such gaseous elements.

[0006] However, known spacers, which are exclusively made of metal, such as aluminium and galvanised steel, also have some disadvantages. Due to a relatively high heat conductivity of metal, spacers made of a metal foil still have a heat conductivity which may be too high under certain circumstances.

[0007] In order to reduce the heat conductivity further, it has been suggested to use plastic/polymer material for forming such spacers. However, plastic material has relatively high gas diffusion as compared to metal. Thus, it has been suggested to provide a metal foil over a plastic body. Such a spacer is shown in e.g. EP 0852280B2.

[0008] A further problem with spacers made of plastic material is their instability during the manufacturing process. In particular, a spacer bent to the desired frame shape may be slightly deformed during assembly because of the resiliency of plastic material. Thus, misalignments of the spacer during manufacturing are possible. In order to avoid this problem, it has been suggested in EP 852280 to use fibreglass-reinforced plastic material. Furthermore, plastics spacers including stabilising material in a plastic body have been proposed e.g. in WO 99/15753 or in WO 99/41481. However, these solutions also have some disadvantages. In particular, manufacturing is relatively complicated.

[0009] Similar spacers made from a body of plastic material are further known from DE 9 214 799, EP 1022424, EP 0947659 A2, EP 1233136 A1, WO 99/42693 or WO 03/074830. U.S. Pat. No. 5,630,306 discloses an insulating spacer which comprises a main body formed of a plastic material. Metallic leg members are attached to the plastic main body. While the problem of heat conduction and diffusion can be addressed with such spacer, some problems remain in connection with bending the spacer into the desired frame shape and later during assembly of an IG Unit. In particular, the lateral legs may be deformed during bending out of their plane so that an irregular shape may result therefrom. Such an irregular shape is particularly disadvantageous if a sealing contact between the spacer and a glass pane shall be achieved.

[0010] Another way of making spacers with a low heat conductivity could be by making the spacers from thin materials. Thereby, the amount of material is reduced, but this also results in a soft and flexible spacer being difficult to handle while mounting between panes.

[0011] Initially, spacer profiles are made as elongated elements which are then bent into a shape corresponding to the shape and dimensions of the glass panes between which the spacers are to be used. The process of creating a spacer with good insulating properties when mounting between panes and for handling of the elongated profiles from production via bending and finally mounting between the glass panes, introduces a dilemma. This dilemma is that on one hand, it is of interest to use thin material and thereby reducing heat transmission and making it easier to bend the profile according to the shape of the glass panes using the existing bending tools, and on the other hand, it is of interest to obtain a stiff profile which can be handled easily.

[0012] Based on the above, it is thereby a problem to create spacers having low heat conductivity across the spacer from one glass pane to the other glass pane and at the same time having a sufficient stiffness when handling them.

Summary of the Invention

[0013] It is therefore an object of the present invention to provide a spacer with an increased stiffness which solves the above-mentioned problems. More specifically, it is an object of the present invention to provide a spacer profile for mounting between glass panes for forming a spacing between said glass panes, wherein said spacer comprises a body comprising an inner top surface directed towards an inner space when mounted between said panes, an outer surface opposite said inner surface, and a first and a second side surface connecting said inner surface and said outer surface. Further, a stiffening material is arranged on at least one side surface of said spacer, wherein said stiffening material extends along the length of said spacer.

[0014] The stiffening material makes the spacer

stiff/rigid thus removing the risk of the spacer being bent and broken before the installation between the two glass panes and making the spacer easier to handle from production until actual mounting between panes.

[0015] Tests have shown that by arranging a stiffening material on each side surface of said spacer, a significant increase of the stiffness of the spacer is obtained. This stiffness is obtained without compromising the very important thermal properties of the spacer. The stiffening material may be arranged on one or both side surfaces. The stiffening material may be embodied in the given side surface, rather than arranged on said side surface. Nonetheless, the wording of the present document reflects that the stiffening material is arranged on the side surface, but this should not be thought of as limiting the case where such stiffening material is embedded in the side surface.

[0016] A spacer according to the present invention may be made of a non-metallic material. Such a spacer has very good thermal properties and can become stiff and easy to handle due to the stiffening material on the side surface. Further, even after bending the frame to be mounted between the panes, the frame becomes stable and maintains its shape, which is also referred to as a high corner stability of the frame. Further, the risk of bending down the elongated profile parts in the frame is significantly reduced. A solution is described, where the adhesive, e.g. butyl, to be applied before connecting the spacer to the glass panes may easily be applied.

[0017] Thereby, after production, the long elongated spacers are quite stiff and any subsequent handling of the spacers is significantly easier. The subsequent handling could be the transport from the production facility to the window manufacturer, but also at the window production facility, the steps of handling the elongated spacers as well as spacers bent to fit between panes of a specific window are easier.

[0018] The side surfaces are adapted to be connected to the glass panes, e.g. through being substantially flat or being surface-treated to receive an adhesive. The stiffening material on the side surface(s) onto which the glass panes are to be connected does not affect the properties of the inner top surface and the lower outer surface.

[0019] The stiffening material is added to the spacer and is mainly for enhancing the stiffness and possibly other properties of an already fully functional spacer. It is therefore relevant to distinguish between the spacer and the stiffening material. The purpose of the stiffening material is to increase the constructional stability of the spacer during handling in the manufacturing process and possibly during transportation. The stiffening material may be made of a metal such as iron, due to its low cost and high rigidity. However, the use of aluminium is foreseen within the scope of the invention, aluminium providing a light, yet rigid solution. Other metals are likewise foreseen within the scope of the invention.

[0020] The stiffening material may be attached to a spacer comprising thin surface structures, e.g. where the walls constituting the body of the spacer are made of thin walls, e.g. metal or polymer walls. The stiffening material increases the constructional stability of the spacer thus allowing the thin walls to be made even thinner.

[0021] The stiffening material may be considered an additional layer to the spacer, e.g. a layer not fundamentally necessary to the spacer, but a layer increasing the structural stability of said spacer during handling. Despite referring to a stiffening material, it is understood that such material may be split up into multiple layers, such that one side surface is supplied with one layer of stiffening material, and a second side surface is supplied with a second layer of stiffening material.

[0022] In an embodiment of the invention, the spacer may comprise a gas-impermeable metal foil at least extending from the first side surface to the second side surface of the body of the spacer, and wherein the at least one stiffening material is arranged between said gas-impermeable metal foil and said body.

[0023] The use of a gas-impermeable metal foil ensures that gas, e.g. argon, provided within an inner space encapsulated by the glass panes and the spacer, cannot diffuse through said spacer. The metal foil may extend across the inner surface or the outer surface of said spacer, or across both surfaces. Then, the stiffening material may be arranged between such metal foil and the body of the spacer. In other words, the stiffening material is sandwiched between the metal foil and the body of the spacer.

[0024] Thereby, the metal foil is in contact with the glass panes, which is considered common practice, and therefore, the stiffening material does not affect the properties of the spacer.

[0025] In an embodiment of the invention, the stiffening material may have a thickness of at least 0.01 mm, or at least 0.5 mm, or at least 1.0 mm.

[0026] The disclosed thicknesses will render the spacer stiff to various degrees. Irrespective of the thickness of the stiffening material, a spacer comprising said stiffening material would be stiffer than a spacer without such stiffening material.

[0027] Irrespective of the thickness of the stiffening material, the heat conductivity across the spacer from one pane to the other pane is always low or unchanged. The thickness may depend on the desired end use of the spacer. However, the presence of a stiffening material of any thickness nonetheless provides a certain stiffness/rigidity to said spacer.

[0028] In an embodiment of the invention, the stiffening material may cover all of the respective side surface(s).

[0029] With the stiffening material covering all of the side surfaces, the spacer will be very stiff.

[0030] In an embodiment of the invention, the stiffening material may cover less than 75%, preferably less than 50%, and most preferably less than 30% of the respective side surface(s).

[0031] With the stiffening material covering just a share of the side surfaces, the spacer will be stiffened but still

be very light.

[0032] In an embodiment of the invention, the stiffening material may cover parts of the inner top surface and/or parts of the lower outer surface.

[0033] With the stiffening material covering parts of the inner top surface and/or the lower outer surface, said stiffening material will have a bend causing the spacer to be even stiffer. A bend as described will serve as an additional stiffening feature.

[0034] In an embodiment of the invention, the stiffening material may be arranged on an inside of the spacer.

[0035] By an inside of the spacer should be understood, that said spacer comprises an inner compartment defined by the inner surface, the outer surface, and the two side surfaces. Commonly, said inner compartment is filled with a moisture-absorbent substance, e.g. moisture-absorbent granules. Thus, according to the present embodiment of the invention, the inside walls of said compartment, preferably the inside walls of the compartment corresponding to the two side surfaces, may be equipped with stiffening material.

[0036] When the stiffening material is situated/arranged on the inside of the spacer, the spacer can be made without any outside joints, e.g. if the spacer is extruded. Then, water cannot penetrate between the spacer and the stiffening material and cause the stiffening material to detach. Thereby, the time until the spacer and glass panes have to be replaced may be extended.

[0037] In an embodiment of the invention, the stiffening material may be arranged on the outside of the spacer.

[0038] By an outside of the spacer should be understood that said spacer comprises an inner compartment which constitutes the inside. Thus, an outside of the spacer is any surface in contact with the surroundings.

[0039] When the stiffening material is situated/arranged on the outside of the spacer, said stiffening material can cover and make tight any longitudinal joint in the spacer e.g. if the spacer is made of two longitudinal U-shaped parts. With the stiffening material covering the longitudinal joints, it will be less likely that water will penetrate into the inside of the spacer, where the humidity will cause growth of mould or mildew. The stiffening material may be sandwiched between a possible metal foil and the body of the spacer. Thus, an outside of the spacer refers to the body of said spacer.

[0040] In an embodiment of the invention, the stiffening material may be glued or welded to the side surface(s).

[0041] Gluing the stiffening material to the side surfaces results in a very strong connection that will last for a long time and will also protect the area between the stiffening material and the side surfaces from being penetrated by water or humidity that might weaken the bond between said stiffening material and the side surfaces. Gluing the stiffening material to the spacer is a universal solution that works with most materials.

[0042] If metal foil is covering the side surfaces and the stiffening material is made of metal or has a metal outer layer, the stiffening material may be welded to said metal foil. Both gluing and welding are fast processes thus allowing a large throughput.

[0043] In an embodiment of the invention, each side surface of said spacer may comprise a second stiffening material, wherein said second stiffening material extends along the length of said spacer, and wherein said second stiffening material is not in contiguity with the stiffening material on the same side surface.

[0044] Thus, it is understood that two pieces of stiffening material, which are not in contiguity with each other, are arranged on each side surface of the spacer.

[0045] Thereby, the spacer according to this embodiment will be light and stiff, since each of the parallel stiffening materials may be made narrow, while together creating a stiff spacer.

[0046] In an embodiment of the invention, stiffening material on one side surface may not be in contiguity with stiffening material on the other side surface.

[0047] If the stiffening material is not directly connected to each other, the heat transfer from one pane and side surface to the other side surface and pane is much reduced without reducing the stiffness of the spacer.

[0048] The expression that two objects are "directly connected" means that the two objects connect to each other without any intermediate material. That the spacer connects the stiffening material does not mean that the stiffening material is directly connected.

[0049] In an embodiment, the stiffening material may be a metal strip.

[0050] The metal strip may for example be a metal strip having a thickness, a width, and a length. The thickness may be, as previously disclosed, at least 0.5 mm, or at least 0.7 mm, or at least 1.0 mm. The width may correspond to the height, or part of the height, of the side surface, e.g. 5-10 mm. The length may correspond to the length of the spacer, i.e. the metal strip extends along the length of the spacer. The length may for example be 1-5 meters. Thereby, said side surface may be covered by the metal strip.

[0051] In an embodiment, the stiffening material may be a strip mesh.

[0052] By a strip mesh is understood an object resembling commonly known strip mesh lath used in construction works. In other words, the strip mesh comprises a mesh structure, preferably made of a metal, such that openings are present in the strip. For example, the openings are diamond-shaped, triangular, or quadrangular, and bounded by metal strings making up the mesh.

[0053] Thereby, when embodying the strip mesh (the stiffening material) in the spacer in a position between a metal foil and the body of said spacer, the metal foil and the spacer are in contiguity with each other through the openings of the mesh. Thereby, the metal foil is attached to the body of the spacer through said openings thus resulting in a much stronger bond. Further, the stiffening material is stronger when attached to the body of the spacer, since the material (e.g. polymer) of said spacer extends partly through the openings of the mesh. Thus,

when embodied as a strip mesh, the stiffening material may be said to be embedded in an outer surface of the side surface. By the stiffening material being embedded in the body of the spacer, the width of said spacer may be unaffected by the presence of such stiffening material.

[0054] In an embodiment, the stiffening material may have a three-dimensional shape.

[0055] By a three-dimensional shape should be understood that previous embodiments consider the thickness to be negligible and thereby, the stiffening material to be two-dimensional. In the present embodiment, the stiffening material may extend in three dimensions, i.e. where said stiffening material has a length and a width, as in previous embodiments, and a depth, where said depth may be embodied as a zigzag shape, a staircase shape, box shape, or the like. In other words, the stiffening material may extend into the side surface of the spacer to different degrees.

[0056] Thereby, the structural stability of the stiffening material is enhanced thus increasing the overall stability of the spacer during handling.

[0057] In an embodiment, the stiffening material may have a zigzag shape in at least one direction.

[0058] For example, the stiffening material is zigzag-shaped along its width, i.e. when viewed from an end of the stiffening material, i.e. zigzagged in a direction parallel to the extension of the length of the stiffening material. According to another example, the stiffening material is zigzag-shaped along its length, i.e. zigzagged when viewed in a direction parallel to the extension of the width of the stiffening material.

[0059] Thereby, a specific three-dimensional shape capable of providing structural stability of the stiffening material thus increasing the overall stability of the spacer during handling is provided.

Brief Description of Drawings

[0060] The invention is explained in detail below with reference to the drawings, in which

Fig. 1 illustrates a cross section of a spacer according to the invention and a set of glass panes for illustrative purposes only,

Fig. 2 illustrates a cross section of a spacer according to the invention,

Fig. 3a illustrates a cross section and zoom-in of a spacer according to the invention,

Fig. 3b illustrates a further cross section and zoom-in of a spacer according to Fig. 3a,

Fig. 4 illustrates a perspective view of a spacer according to the invention,

Fig. 5 illustrates a perspective view of a spacer according to the invention,

Fig. 6a illustrates a perspective view of a possible embodiment of stiffening material according to the invention,

Fig. 6b illustrates a perspective view of a possible embodiment of stiffening material according to the invention,

Fig. 7 illustrates a cross section of a spacer according to prior art,

Fig. 8 is a schematic illustration of a cross section of a second spacer with stiffening material, where the stiffening material is arranged on the outside of the spacer,

Fig. 9 is a schematic illustration of a cross section of a spacer with stiffening material, where the stiffening material is arranged on the inside of the spacer,

Fig. 10 is a schematic illustration of a cross section of a spacer with stiffening material, where the stiffening material covers all of the side surfaces,

Fig. 11a is a schematic illustration of a cross section of a spacer with stiffening material, where the stiffening material covers the side surfaces as well as the inner top surface,

Fig. 11b is a schematic illustration of a cross section of a spacer with stiffening material, where the stiffening material covers the side surfaces as well as the lower outer surface,

Fig. 11c is a schematic illustration of a cross section of a spacer with stiffening material, where one piece of stiffening material covers one side surface as well as the inner top surface, and another piece of stiffening material covers the other side surface as well as the lower outer surface,

Fig. 12 is a schematic illustration of a cross section of a spacer with stiffening material, where the stiffening material covers the side surfaces as well as the inner top surface and the lower outer surface,

Fig. 13 is a schematic illustration of a cross section of a spacer with stiffening material, where the stiffening material is arranged on the side surfaces as well as the inner top surface on the inside of the spacer,

Fig. 14 is a schematic illustration of a cross section of a spacer with stiffening material, where the stiffening material is arranged on the side surfaces as well as the inner top surface and the lower outer sur-

face on the inside of the spacer, and

Fig. 15 is a schematic illustration of a cross section of a spacer with stiffening material and a second stiffening material, where the stiffening material and the second stiffening material are arranged around the corners where the side surfaces and the inner top surface meet, and where the side surfaces and the lower outer surface meet.

Detailed Description of Drawings

[0061] Fig. 1 illustrates a cross section of a spacer 100 according to the invention and a set of glass panes 2 to be arranged adjacent to the side surfaces 103 of said spacer 100. The glass panes 2 are included for illustrative purposes only and should not be considered part of the invention. The spacer 100 comprises a body 106 comprising two side surfaces 103, an inside top surface 104, and a lower outer surface 105, and preferably a metal foil 107 covering at least said lower outer surface 105. The body 106 may be made of a polymer material. A transition region 199 may connect the side surfaces 103 to the lower outer surface 105. An inner compartment 108 may be bounded by said surfaces 103, 104, 105, 199. The inner compartment 108 may comprise a moisture-absorbent material. The expression "top" and "lower" in the inside top surface 104 and the lower outer surface 105 only relates to the drawings. Of course, the spacer can be turned around so that the inside top surface 104 is actually closer to the ground than the lower outer surface 105. The top surface is the surface pointing towards the inner space between the panes once assembled, and the lower outer surface is the surface opposite the top surface. The metal foil 107 is to reduce diffusion of moisture and gas into and out of the space formed between the panes 2 once assembled using a spacer 100. To reduce heat transfer from one glass pane 2 to the other pane 2, the metal foil 107 is made as thin as possible - so thin that the metal foil hardly contributes to the constructional stability of the spacer.

[0062] Thus, the stability of the spacer according to prior art relies on the stability of the polymer body 106 - an inherently flexible material. In some spacers, the lower outer surface 104 of the body may even be omitted and solely be covered by the metal foil 107 which further reduces the constructional stability of the spacer.

[0063] To increase the constructional stability, especially during handling prior to assembling with glass panes, the spacer 100 according to the invention comprises a stiffening material 111 arranged on each side surface 103. In the shown embodiment, the stiffening material 111 is sandwiched/arranged between the metal foil 107 and the side surface 103 and covers a majority of each side surface 103. In other embodiments, the stiffening material 111 may be arranged differently, see Figs. 8-15. Preferably, the stiffening material 111 is made of a rigid metal, e.g. iron, which is a low-cost option, aluminium, or similar metals. The stiffening material 111 ensures that the spacer 100 is less prone to buckling during handling. In other words, the stiffening material 111 serves to stiffen the spacer 100, such that a certain rigidity is maintained while handling. In other words, the stiffening material 111 is included in the spacer 100 for easing handling in the manufacturing process or during transport and not necessarily for giving the spacer 100 certain properties once assembled between a set of panes 2.

[0064] Fig. 2 illustrates a cross section of a spacer 100 according to the invention and similar to the spacer of Fig. 1, but where the arrangement of the metal foil 107 and stiffening material 111 has been amended slightly. According to this embodiment, the stiffening material 111 comprises a bend 111', such that said stiffening material 111, being primarily disposed on the side surface 103, comprises a part being embedded in the body 106 of the spacer 100. The metal foil 107 may likewise comprise a series of bends 107' which surround the bend 111' of the stiffening material 111. Thus, the metal foil 107 is likewise partly embedded in the body 106 of the spacer 100. Due to the way the metal foil 107 surrounds the stiffening material 111 within the body 106, said stiffening material 111 additionally serves to bond/fixate the metal foil 107 to the spacer 100 more strongly.

[0065] Fig. 3 illustrates a zoom-in on a side surface 103 of a spacer according to the invention. While in certain embodiments the stiffening material may comprise a metal strip, it may likewise comprise a strip mesh 112 likewise made of a metal. Thus, in general, the reference number "111" points to the stiffening material, whereas the reference number "112" points to a specific embodiment of the stiffening material, wherein said stiffening material is a strip mesh. Thus, the stiffening material 111 may be substituted by the stiffening material 112 (strip mesh) in all embodiments, and vice versa. Fig. 3a illustrates the situation where the stiffening material 112 is a strip mesh sandwiched between the side surface 103 and a metal foil 107. The metal foil 107 extends into the body 106 in an end portion in order to fasten said foil to the spacer in a better way. However, the metal foil may be arranged in other ways as discussed above. Fig. 3b illustrates a zoom-in on the region A of Fig. 3a. The stiffening material 112 being a strip mesh results in an alternating series of metal foil-body interfaces 109a and metal foil-stiffening material interfaces 109b. Such interfaces ensure that the metal 107 is adhered to the body 106 of the spacer in a better way and further that the stiffening material 112 is embedded in the body 106. Thereby, the stiffening material 112 is attached to the spacer more strongly.

[0066] Fig. 4 illustrates a perspective view of a spacer 100 according to the invention. On one or both side surfaces 103, a stiffening material 111 is arranged. A metal foil has not been drawn to maintain simplicity. Preferably, a metal foil covers all, or parts, of the stiffening material 111. The stiffening material 111 is drawn as a two-dimensional strip extending along the length of the spacer 100.

The strip further includes a width, said width corresponding more or less to the height of the side surface 103. A coordinate system has been included, where the length of the spacer extends along the x-axis. Thus, the length of the spacer is the direction in which cross sections of the spacer 100 reveal an inner compartment 108 and are also indistinguishable.

[0067] Fig. 5 illustrates a perspective view of a spacer 100 according to the invention. On one or both side surfaces 103, a stiffening material 112, embodied as a strip mesh, is arranged. Again, a metal foil has not been drawn to maintain simplicity. The stiffening material 112 embodied as a strip mesh results in certain advantages as discussed in relation to Fig. 3 above.

[0068] Fig. 6 illustrates two possible three-dimensional embodiments of the stiffening material 113, 114. Previously, the case of a plane two-dimensional stiffening material 111 and a stiffening material embodied as a strip mesh 112 has been discussed. The embodiments as shown in Figs. 6a-6b illustrate a further development of such stiffening materials. More specifically, Fig. 6a illustrates a stiffening material 113 having a zigzagged shape 113' in the x-direction as supported by the coordinate system included in the illustration. Fig. 6b illustrates a similar situation, but where the stiffening material 114 has a zigzagged shape 114' in the z-direction again supported by the coordinate system. Common for the embodiments shown in Fig. 6a and 6b is the fact that the stiffening material 113 and 114 fluctuates in the y-direction, which is preferably normal to the side surface of a spacer once mounted, as previously illustrated. The stiffening material, 113 and/or 114, may both be based on a solid strip or on a strip mesh. The purpose of having a three-dimensionally shaped stiffening material is the fact that such shaping enhances the rigidity of the spacer, since the introduced bends reduce the tendency to buckling of the stiffening material in itself which is then transferred to a further reduced tendency to buckling of the spacer. Other shapes are foreseen within the scope of the invention, e.g. where the stiffening material is box-shaped or staircase-shaped.

[0069] Fig. 7 shows a cross section of a spacer 1 according to prior art positioned between two panes 2, such as glass panes. The spacer is connected to the glass panes e.g. by gluing. The spacer 1 has two side surfaces 3, an inside top surface 4, and a lower outer surface 5. The spacer comprises a body 6 making up the side surfaces 3 and the inside top surface 4, and a metal foil 7 covering the lower outer surface 5 and the side surfaces 3. Thus, the spacer resembles the spacer of Fig. 1. Again, the expression "top" and "lower" in the inside top surface 4 and the lower outer surface 5 only relates to the drawings. Of course, the spacer can be turned around so that the inside top surface 4 is actually closer to the ground than the lower outer surface 5. The top surface is the surface pointing towards the inner spacing between the panes, and the lower outer surface is the surface opposite the top surface.

[0070] Even though the spacers in Figs. 8-15 are only represented by rectangles, the spacers preferably have the features of Fig. 1 or Fig. 7, or the spacers may have any other known construction.

[0071] In Figs. 7 - 15, the spacers are shown with stiffening material. For illustrative purposes only, a gap is shown between the stiffening material and the spacers. The stiffening material is connected to the spacer, e.g. by gluing or welding.

[0072] Fig. 8 shows the spacer 1 with stiffening material 21 on the side surfaces 3 on the outside of the spacer. In one embodiment, the stiffening material 21 could over approximately 50 percent of the side surfaces 3. The general idea is that the stiffening material should contribute to the stiffness of the elongated spacer and therefore, the stiffening material should cover more than 15 % of the side surface to contribute to the stiffness of the elongated spacer. Further, by adding a stiffening material to the side surfaces of the spacer it is possible to modify the material properties of the side surfaces adding materials being optimised for connection to the material of the panes.

[0073] As an alternative to the embodiment in Fig. 8, Fig. 9 illustrates an embodiment where the stiffening material 31 is arranged on the inside of the spacer 1, i.e. on a surface within the inner compartment shown in Fig. 1. In this embodiment, the attachment properties of the side surface (when attached to the panes) of the spacer are not influenced by adding the stiffening material 31.

[0074] In Fig. 10, stiffening material 41 is arranged on the outside of the spacer 1 and covering the entire side surfaces 3. This will result in a very stiff spacer 1 with a large contact surface 42 to be connected to the panes.

[0075] In Fig. 11a, stiffening material 51 is arranged on the outside of the spacer 1 thus covering the side surfaces 3 and extending around the corner 52 to the inside top surface 4. The stiffening material 51 has an angle or edge 52 that makes the stiffening material 51 and the spacer 1 stiff in both directions along the short sides of the spacer perpendicular to the longitudinal axis of the spacer 1. The longitudinal axis is along the length of the spacer 1.

[0076] In Fig. 11b, the stiffening material 51 is arranged on the outside of the spacer 1 thus covering the side surfaces 3 as well as the lower outer surface 5. The advantages are the same as for the embodiment shown in Fig. 11a.

[0077] In Fig. 11c, one stiffening material 51 is arranged on the outside of the spacer 1 thus covering one side surface 3 as well as the inside top surface 4, and a second stiffening material 51 is arranged on the outside of the spacer 1 thus covering one side surface 3 as well as the lower outer surface 5. The advantages are the same as for the embodiment shown in Fig. 11 a.

[0078] In Fig. 12, stiffening material 61 is arranged on the outside of the spacer 1 thus covering the side surfaces 3 as well as at least parts of the inside top surface 4 and the lower outer surface 5. The stiffening material

61 has at least two edges 62 making said stiffening material 61 and the spacer 1 very stiff in both directions along the short sides of the spacer perpendicular to the longitudinal axis of the spacer 1.

[0079] In Fig. 13, stiffening material 71 is arranged on the inside of the spacer 1. Edges 72 of stiffening material 71 are provided where said stiffening material 71 contacts the inside of the inside top surface 4. This embodiment has the same advantages as the embodiment shown in Figs. 9 and 11a.

[0080] In Fig. 14, stiffening material 81 is arranged on the inside of the spacer 1. Edges 82 of stiffening material 81 are provided where said stiffening material 81 contacts the inside of the inside top surface 4 and the inside of the lower outer surface 5. This embodiment has the same advantages as the embodiments shown in Figs. 9 and 12.

[0081] In Fig. 15, stiffening material 91 is arranged around the corners 92 of the spacer 1. Since the stiffening material 91 covers all the corners, the spacer 1 is very stiff.

Reference numbers

[0082]

A	Zoom-in region
1	Spacer
2	Glass pane
3	Side surfaces
4	Inside top surface
5	Lower outer surface
6	Body of spacer 1
7	Metal foil
21	Stiffening material
31	Stiffening material
41	Stiffening material
42	Contact surface of stiffening material 41
51	Stiffening material
52	Edge of stiffening material 51
61	Stiffening material
62	Edge of stiffening material 61
71	Stiffening material
72	Edge of stiffening material 71
81	Stiffening material
82	Edge of stiffening material 81
91	Stiffening material
92	Corner of spacer 1
100	Spacer
103	Side surfaces
104	Inside top surface
105	Lower outer surface
106	Body of spacer 100
107	Metal foil
107'	Bend of metal foil 107
108	Inner compartment of spacer 100
109a	Metal foil - body interface
109b	Metal foil - stiffening material interface
111	Stiffening material
111'	Bend of stiffening material 111
112	Stiffening material
113	Stiffening material
113'	Zigzag-'shape in x-direction
114	Stiffening material
114'	Zigzag shape in z-direction

Claims

1. A spacer (1, 100) for forming a spacing between glass panes, wherein said spacer (1, 100) comprises a body (106) comprising a first and a second side surface (3, 103), an inner top surface (4, 104) and a lower outer surface (5, 105), **characterised in that** a stiffening material (111, 112, 113, 114, x1) is arranged on at least one side surface (3, 103) of said spacer (1, 100), wherein said stiffening material extends along the length of said spacer (1, 100).

2. A spacer according to claim 1, **characterised in that** said spacer comprises a gas-impermeable metal foil extending at least from the first side surface to the second side surface of said body, and wherein the at least one stiffening material is arranged between said gas-impermeable metal foil and said body.

3. A spacer according to claims 1 or 2, **characterised in that** the stiffening material has a thickness of at least 0.01 mm, or at least 0.5 mm, or at least 1.0 mm.

4. A spacer according to any of the preceding claims, **characterised in that** the stiffening material covers all of the respective side surface(s).

5. A spacer according to any of the preceding claims, **characterised in that** the stiffening material covers less than 75%, preferably less than 50%, and most preferably less than 30% of the respective side surface(s).

6. A spacer according to any of the preceding claims, **characterised in that** the stiffening material covers parts of the inner top surface and/or parts of the lower outer surface.

7. A spacer according to any of the preceding claims, **characterised in that** the stiffening material is arranged on an inside of the spacer.

8. A spacer according to any of claims 1 to 6, **characterised in that** the stiffening material is arranged on an outside of the spacer.

9. A spacer according to any of the preceding claims, **characterised in that** the stiffening material is glued or welded to the side surface(s).

10. A spacer according to any of the preceding claims, **characterised in that** each side surface of said spacer comprises a second stiffening material, wherein said second stiffening material extends along the length of said spacer, and wherein said second stiffening material is not in contiguity with the stiffening material on the same side surface.

11. A spacer according to any of the preceding claims, **characterised in that** stiffening material on one side surface is not in contiguity with stiffening material on the other side surface.

12. A spacer according to any of the preceding claims, **characterised in that** the stiffening material is a metal strip.

13. A spacer according to any of claims 1 to 11, **characterised in that** the stiffening material is a strip mesh.

14. A spacer according to any of the preceding claims, **characterised in that** the stiffening material has a three-dimensional shape.

15. A spacer according to any of the preceding claims, **characterised in that** the stiffening material has a zigzag shape in at least one direction.

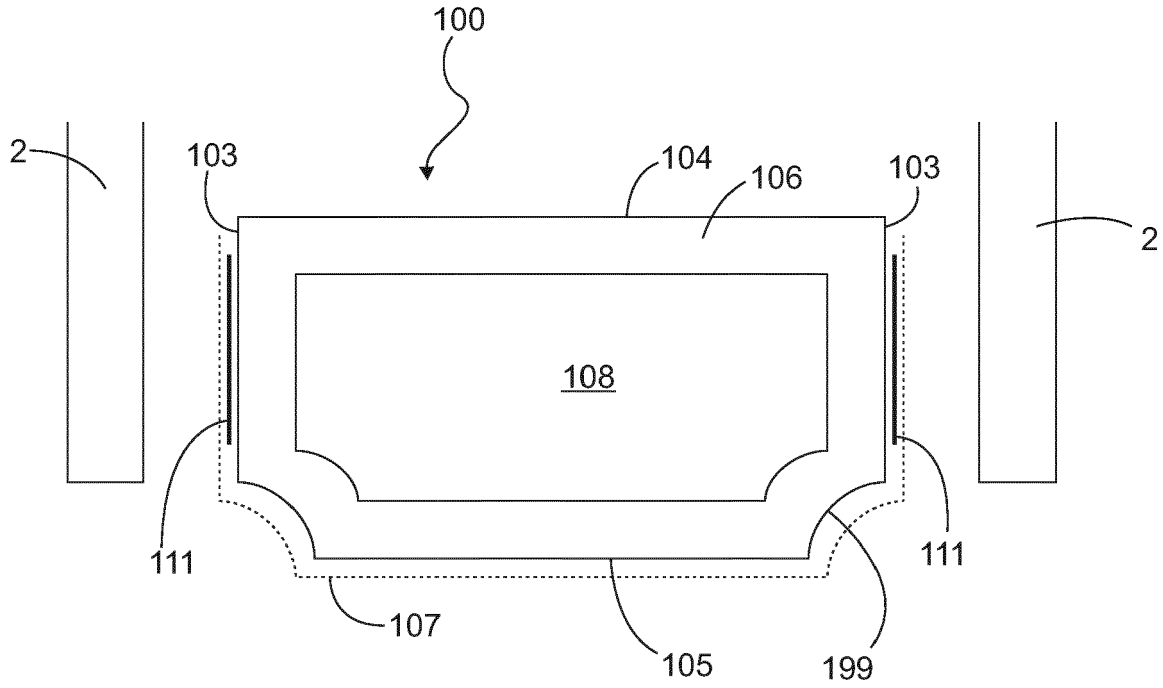

Fig. 1

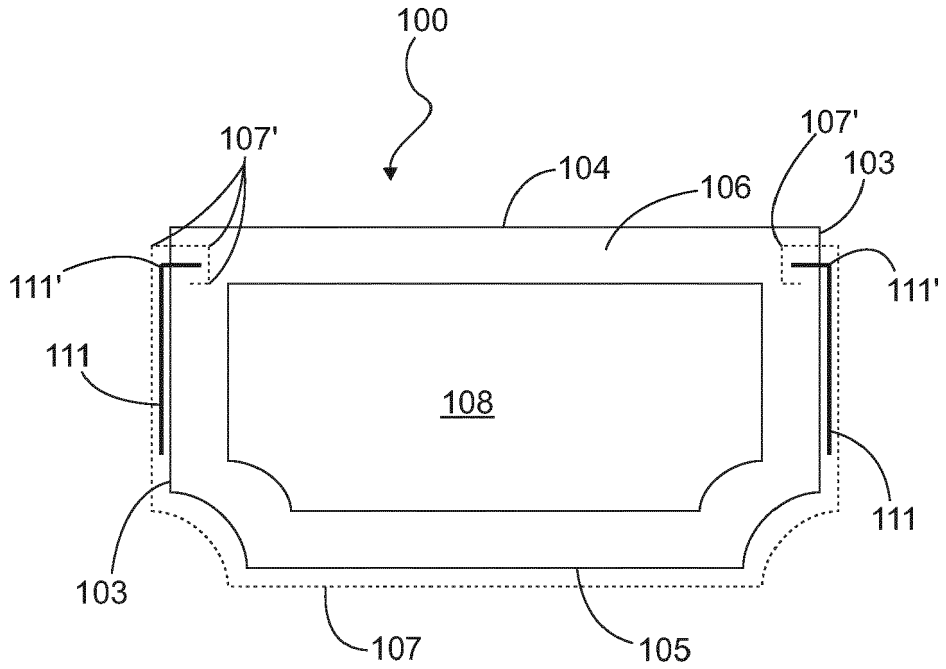

Fig. 2

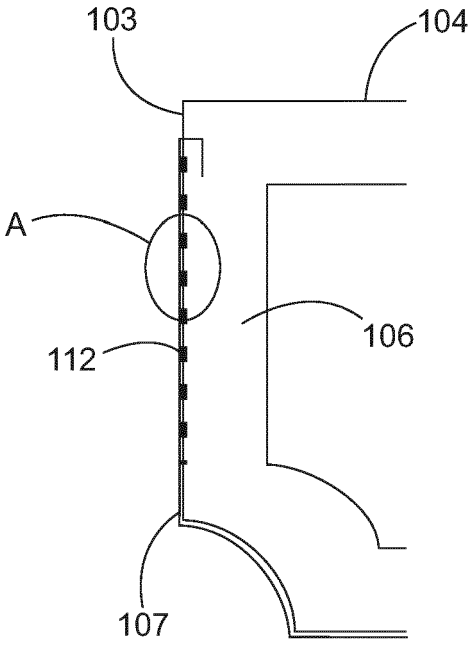

Fig. 3a

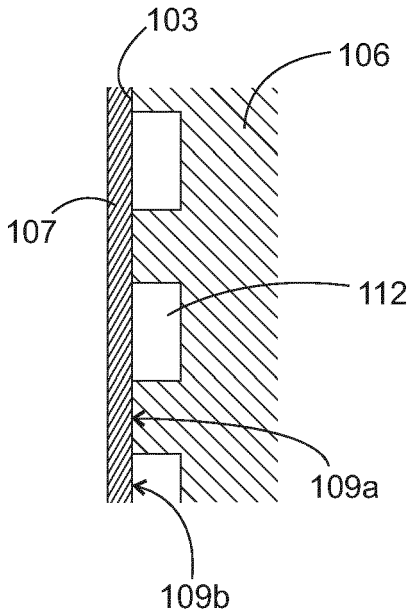

Fig. 3b

Fig. 3

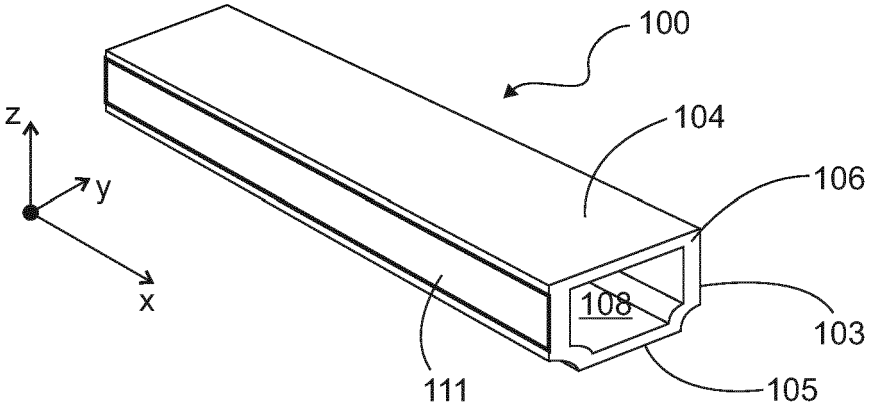

Fig. 4

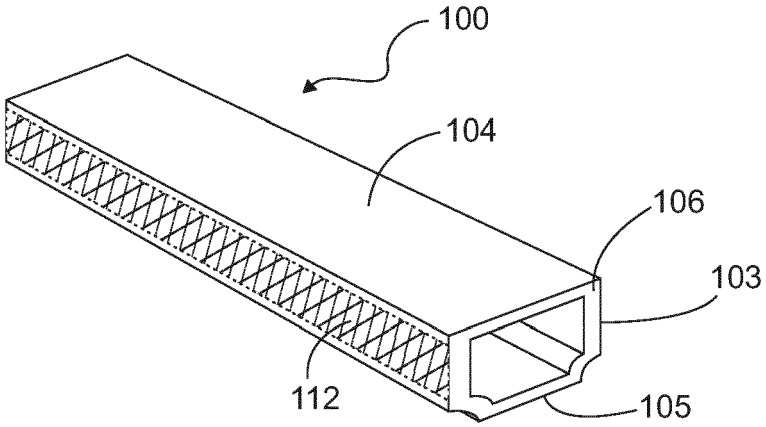

Fig. 5

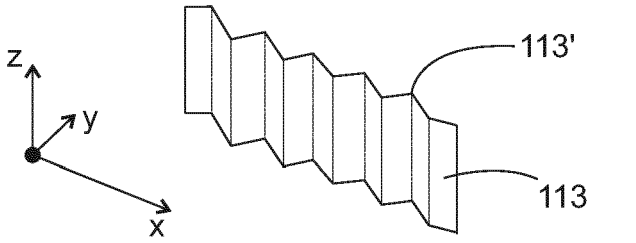

Fig. 6a

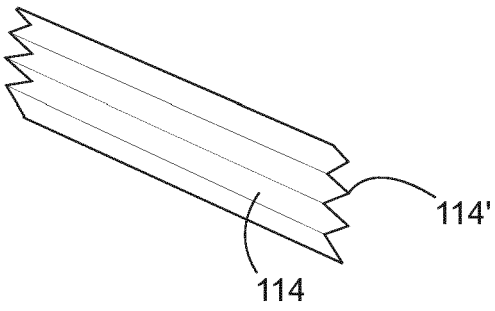

Fig. 6b

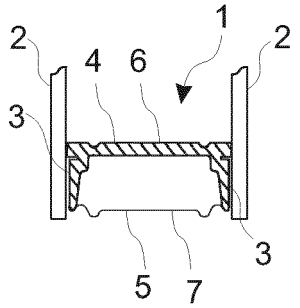

Fig. 7

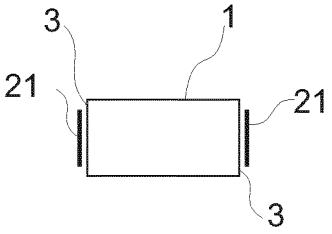

Fig. 8

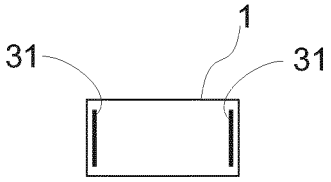

Fig. 9

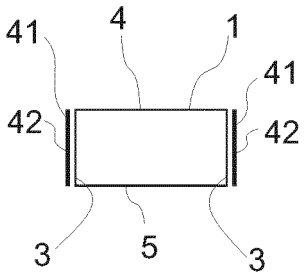

Fig. 10

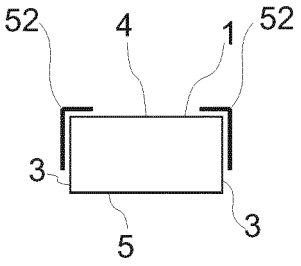

Fig. 11a

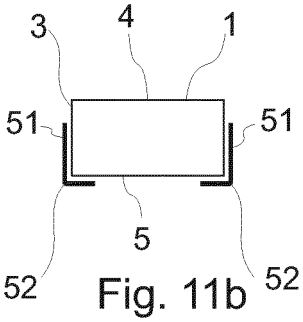

Fig. 11b

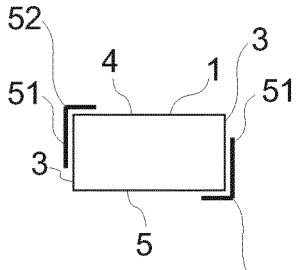

Fig. 11c

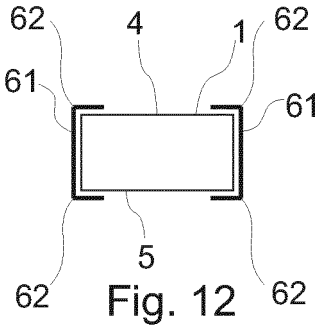

Fig. 12

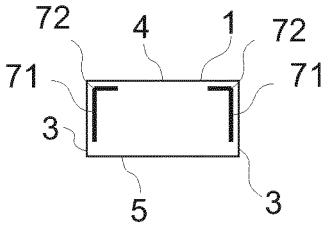

Fig. 13

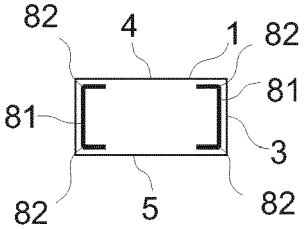

Fig. 14

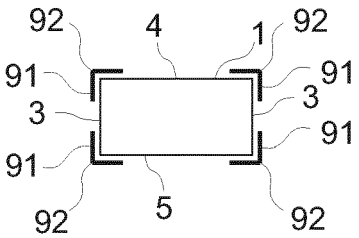

Fig. 15

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EUROPEAN SEARCH REPORT

Application Number
EP 18 16 7693

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	EP 3 241 972 A1 (TECHNOFORM GLASS INSULATION HOLDING GMBH [DE]) 8 November 2017 (2017-11-08) * figures 6,7 * * paragraph [0042] - paragraph [0047] *	1-15	INV. E06B3/663
X	US 2005/100691 A1 (BUNNHOFER EWIN [DE] ET AL) 12 May 2005 (2005-05-12) * the whole document *	1-15	
X	DE 199 61 902 A1 (ENSINGER WILFRIED [DE]) 5 July 2001 (2001-07-05) * the whole document *	1-15	
X	DE 20 2015 105146 U1 (ENSINGER GMBH [DE]) 18 January 2016 (2016-01-18) * figures 10,11,13,19-31,42a-46 *	1,2,4-8, 10-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			E06B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	3 October 2018	Blancquaert, Katleen

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03-10-2018

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