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(54) Openable frameless door or window casement arrangement with insulated glazing

(57) An openable frameless door or window casement arrangement (100) with insulating glass unit, including at least a first (1) glass plate and a second (2) glass plate, a spacer (11) which is gas-tightly inserted generally along the edge between the first (1) and second (2) glass plates creating a plate interspace (16), a cordon of sealant (13) securing said glass plates together, and an outwardly opening generally U-shaped profile (10), which along the edge encompasses the spacer (11) and is positioned between said glass plates for receiving window hardware, whereby actuating elements pass through one of the glass plate through openings and facilitate access to the hardware.

According to the invention, the profile (10) is separated from the spacer (11) and it is concealed completely between the first (1) and the second (2) glass plates, the outermost edges of the profile being positioned inside the periphery of said glass plates.

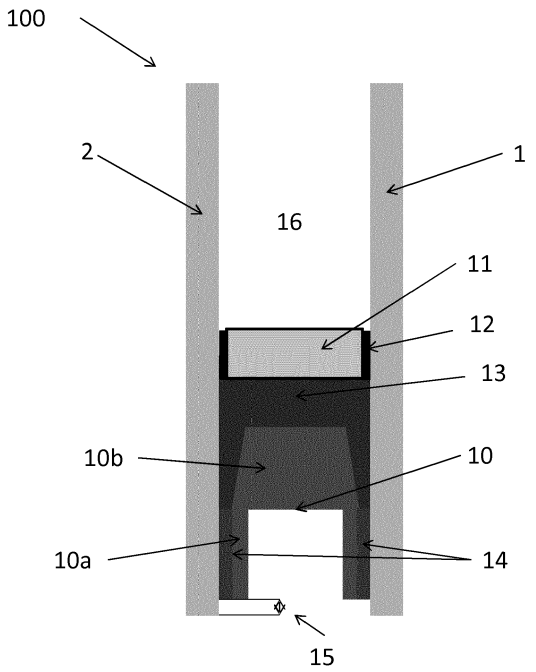

Figure 1

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Description

Technical Domain of the Invention

[0001] The present invention relates to an openable frameless door or window casement arrangement with insulated glazing.

Background of the Invention

[0002] The sufficient natural illumination of interior spaces, especially buildings, is one of key parameters for creating pleasant and healthy environment for people. The daylight is the most interesting source of such illumination and it is important to have some transparent parts in building envelopes, to bring this light to the interior of the building. To achieve good level of illumination, highly transparent glazing is usually preferred. The glazing is usually multifunctional, having some optional functionalities to achieve required thermal insulation, solar control, safety, design, easy maintenance, acoustic comfort, security, fire resistance, communication and some others. Those functionalities are delivered thanks to different glass technologies and product, e.g. low-E and solar control coatings, glass substrate modification, functional and decorative layers on glass and inside of laminated structures, multiple glazing and multiple windows of facades structures. Adding such functionalities has usually certain impact on light transmittance of the glazing, in most of cases the decrease of the light transmittance. It means that light transmittance (along with other important parameters such as g-value and U-value) is carefully considered during the design of new buildings as well as in renovations of building envelopes, especially facades and windows. The usual objective is to use the glazing with high light transmittance, while keeping other necessary performance parameters and aesthetics on required level. Reachable light transmittance levels are known and actual industrial standard solutions are very close to those physical limits. While in new building design, it is just one of limiting factor and designer usually has some options to increase transparent part of the façade to bring more light and reach level of required Daylight Factor (DF) by improving Window To Wall Ration (WWR), it is quite difficult to modify WWR in most cases of renovations. During the renovation, WWR is usually predetermined by existing structure and modification of building envelop to improve WWR is a costly measure. In certain cases, it is even technically impossible to increase WWR, e.g. by increasing window size in weak supporting structure such as the wall. Additionally, WWR is usually negatively influenced by new structures of windows and frames. Modern window frames provides usually better thermal insulation than traditional frame and are mostly manufactured from plastic, metal, wood or composite materials. Such insulated frames have larger sections than traditional windows and thus have again negative impact on natural illumination (mainly described by DF). The frame size is even more problematic for openable windows and façade segments, due to the fact that frame consists of two parts, fixed frame and openable casement or wing.

[0003] The problem of reduced transparency taking into account from the state-of-the-art windows is solved by narrowing non-transparent part of the frame, thanks to eliminating openable casement frame and integrating window hardware into the Insulating Glass Unit (IGU). Along with that improvement in transparency, it also potentially improves window's aesthetics, by giving the window an appealing glassy look, reduces complexity of the window system, decreases window's weight and makes it more affordable to end consumer by means of reduction in materials volume, easier installation and lower transport costs. This solution provides the novelty way to use structural capacity of the glazing to avoid the classical double frame structure of an openable window.

[0004] Having a proportionally larger transparent surface allows designers to choose more freely glazing functionalities as the negative impact on light transmittance is compensated partially or fully by increased size of transparent window surface, and achieve requested performance even with quite complex multilayered and multifunctional glazing designs (e.g. triple glazing consisting of glass with solar control coating, low-e coating, laminated safety glass and partial decorative paint).

[0005] From a technical point of view, the largest complexity of such frameless window concepts is to identify the right way to integrate classical window hardware to connect the glazing to the fixed frame. Window hardware or fittings are these metallic parts (hinges, levers, sliding support,...) which are, in traditional windows, positioned between the casement frame and fixed frame, and by means of which the casement can be opened or closed.

[0006] Some ideas can be found in the building interior market, where fitting products have been developed for frameless doors (i.e. for showers). In these applications, the fittings which are required for the rotational movement of the glazing, are clamped thereto or screwed thereon by means of bore holes. However, these solutions are not fully adapted for multiple glazed units (with standard gas leakage and moisture penetration properties) nor for widely used sliding windows nor for widely used tilt/turn windows (for which are used specific so called turning/tilting fittings, by means of which the window or door casing arrangement can be pivoted or tilted relative to the mating frame in accordance with the position of an actuating handle, whereby in a third position of the actuating handle, by means of the fitting there can be achieved a fixed latching in the mating frame, as a result of which there is achieved a sealed condition with respect to the exterior through the utilization of encompassing seals).

[0007] Therefore, it is of interest to be able to create openable (typically tilt and turn) frameless door and window casement arrangements which are able to contain an insulated glazing with standard gas leakage and moisture penetration properties. For this purpose, proposals

have already been made. The European patent EP 1 863 999 B1 discloses a casement arrangement whose glass plates are spaced apart on the edge by a support profile on which pivot fittings are mounted through fastening portions passing through cutouts in one of the panes. First of all, this arrangement does not permit the utilization of a turning/tilting fitting. Secondly, the "glassy" aesthetics, which is wanted for this product, is impaired significantly due to two reasons: 1) the support profile is not fully concealed between the glass sheets, and lies partly outside the periphery of both glass sheets, and 2) cutouts in one of the panes are needed for each pivot fitting. The German Publication DE-U1-9304381 discloses an arrangement with a spacer which is glued together with both glass plates and carries a peripheral groove in its outwardly facing section, which serves for the receipt of a fitting, especially a turning/tilting fitting. However, the integration of the fitting directly in the spacer involves that loads applied to the fitting (i.e. weight of the opened glazing, actuation of the fitting,...) can strongly impair the spacer in its ability to maintain inert gas inside the glazed unit. Under certain conditions, the loads are also so high that the glass edge can splinter, which is similarly undesired. A further disadvantage is that the sealant adhesive is exposed to environmental influences, especially to sun rays, as a result of which there is encountered an intense ageing which again, in turn, leads to embrittlement and thereby to a loss in sealing ability. Finally, it must be noted that the coloration which may be necessary due to technological reasons for the adhesive connection and for the spacer can lead to significant adverse aesthetic influences. Moreover the edge of the adhesive connection which is in general visible through the glass plate is not configured quite linearly, which is also undesired due to aesthetic reasons. The Canadian Publication CA 2260070 presents a solution to overcome above disadvantage and discloses a frameless door or window casement arrangement with insulated glazing in which a U-shaped profile receives the fittings, and surrounds the spacer but is separated from it. Disclosed arrangement is not optimal and still presents weaknesses, such as: 1) the profile is visibly not concealed fully between the glass sheets, a flange is put against the small plate periphery so that the profile lies partly outside the periphery of the small glass plate; what i) impairs the "glassy" aesthetics of the casement when it is opened, ii) stresses the small glass sheet due to differential thermal dilatations between glass and profile, iii) the flange of the profile, lying against glass edge, has such an accurate shape that the choice of the material for the profile is limited to extrudable materials like plastics, 2) the profile only serves as a receptacle for the fitting, without any other requirement, what is insufficient to achieve acceptable resistance to racking forces that could be applied to the casement when improperly used. In addition to these structural weaknesses, solutions presented in CA 2260070 do not address the problem of the thermal insulation of the window. In particular, the peripheral linear thermal transmittance is negatively impacted by the introduction of profiles and hardware on the edge of the glazing. No solution is presented to overcome this problem.

[0008] In summary, and for reasons presented above, none of current propositions or solutions for frameless window or door casement is believed to fulfill correctly the standard requirements of a window, both structurally and thermally. Furthermore, none of these solutions offers the frameless window a significant natural light illumination increase as well as a total glassy look either the window is closed or opened.

Summary of the Invention

[0009] Accordingly, it is an object of the present invention to provide an openable frameless door or window casement arrangement with durable insulating glass unit, maintaining long-term gas and water tightness, and which fulfills high levels of performances characterizing doors or windows (mechanical resistance, thermal insulation,...), while offering a significantly increased transparent surface as well as a total glassy look to the casement, especially its edges, either the casement is in closed or in open position.

[0010] According to a first aspect of the invention, there is provided an openable frameless door or window casement arrangement with insulating glass unit, including at least a first glass plate and a second glass plate, a spacer which is gas-tightly inserted generally along the edge between the first and second glass plates creating a plate interspace, a cordon of sealant securing said glass plates together, and an outwardly opening generally U-shaped profile, which along the edge encompasses the spacer and is positioned between said glass plates for receiving window hardware, whereby actuating elements pass through one of the glass plate through openings and facilitate access to the hardware, characterized in that the profile is separated from the spacer, and is concealed completely between the first and second glass plates, the outermost edges of the profile being positioned inside the periphery of both the glass plates. It is understood that a generally U-shaped profile means that the profile has cross section which resembles broadly to a U-shape.

[0011] A key particularity of the present invention, as compared to previously described solutions, is that the profile is formed and inserted between the glass plates in such a way that this profile is concealed completely by the glass plates from both sides of the casement, and does not lie against any of the glass plate edges.

[0012] Key advantages of this configuration disclosed in the present invention, compared to previous frameless casement concepts, are multiple:

1) from an aesthetical point of view, the profile is not directly visible to the building occupants when the casement is opened, what strongly contributes to a total glassy and uncluttered aspect of the casement, especially on the edges. What is perceived by people

inside the building is an insulating glass with no protrusion of any other material.

2) from a technical point of view, due to the fact that the profile does not lie against any of the glass plate edges, there is no risk of applying unwanted stresses on glass when profile is pushed to its final position in the casement, or no risk of stresses in glass due to differential thermal dilatations between glass and profile.

[0013] The profile is outwardly opening with a general U-shape, whose cavity is oriented generally in parallel to the glass plates, and is carefully dimensioned to receive window hardware projections. It has been observed that limiting the gap between the hardware projections entering the cavity and the inner walls of the U-shape had a beneficial impact on the product stability by avoiding any misleading movement of the hardware projections. In other words, the dimensions of the U-shape must be adapted for each hardware. For instance, for hardware projections of 12,3mm (width) by 9,4mm (height), known for commercially available tilt & turn hardware, the width of the cavity will be chosen equal (12,3mm) or slightly higher than hardware projections, to be sure that hardware projections can be inserted, and also the height of the cavity will be chosen equal (9,4mm) or slightly higher than hardware projections, to be sure that hardware projection applies to the U-shape basis with minimal gap.

[0014] Actuation of the hardware for the opening or closure of the window/door is typically made with actuating element, such as a handle, which is directly applied on one of the glass plates and connected to the hardware through at least one hole drilled in this glass plate and at least one opening made in the profile.

[0015] The insulating glass unit (IGU), as a basis of the casement, has a well-known double seal configuration, made of a first seal placed between the spacer and the glass plates, typically butyl or silicone strips, and a secondary seal encompassing the spacer, which sustain mechanical loads linked to high and low pressure cycles in the IGU. Separating the profile from the IGU spacer enables to keep unchanged the IGU fundamental structure, which is known to fulfill standard criteria for gas leakage and humidity penetration. Hole(s) in glass for actuating element connection is (are) obviously positioned so as to not disturb the IGU interspace and double seal configuration.

[0016] Pursuant to a further aspect of the invention, there is a non-zero gap between the outermost edges of the generally U-shaped profile and the periphery of both the glass plates. This gap can be used to conceal a part of the window or door hardware that would be aesthetically unpleasant for building occupants.

[0017] In case of a tilt and turn window or door for instance, this gap will be designed to allow to conceal the flat and continuous sections of the hardware between the two glass plates, so that the flat sections of the hardware are not protruding outside the insulating glass unit, and do not impair the glassy and uncluttered aspect of the window casement. As it is of interest to optimize the transparent surface of the window, or in other words, minimize the distance covered by opaque components on the periphery of the glazing, the optimum is to have a gap between the U-shaped profile and the periphery of glass plates, which is equal to the thickness of the flat sections of the hardware, typically 2 to 2,5mm.

[0018] According to another aspect of the invention, the profile receiving the hardware runs all along the insulating glass periphery as one single and continuous framing structure or as strongly connected segments forming a continuous framing structure.

[0019] In this way, the profile does not only serve as a receptacle for the window or door hardware; it also has a significant structural function. Having a continuous profile framing around the IGU enables to transfer loads applied on one point or on one profile segment to the whole framing. Best example is the self-weight of the casement when it is opened in turn position: the continuous framing structure enables to transfer the loads applied to the bottom segment to the other segments of the profile, and therefore to the hinges that are usually positioned on a side segment of the profile framing. Situation is similar for racking loads, that is the loads applied in a direction parallel to the plan of the casement.

[0020] In case that profile is made of several segments, segment lengths and shapes can be various. For instance (possibilities are not limited to the ones given hereafter), for a square or rectangular shaped casement, profile framing can be made of four straight segments connected in the four corners, or even two L segments connected in two corners. Profile segments are connected by at least one mean adapted to ensure durable structural connection: fastening with self-tapping screw or connector pieces, adhesive bonding with structural glue like silicone or structural tape like VHB tape, welding, soldering, brazing, or even a combination of them.

[0021] According to a further aspect of the invention, the profile receiving window hardware has a section which includes, in addition to the outwardly opening generally U-shaped section, at least a second section running on from the U-shaped section basis and which substantially increases the moment of inertia of the profile in direction parallel to the U-shape basis, and generally perpendicular to the glass plates, as well as the anchoring depth of the screws used to fix window hardware to the profile.

[0022] Adding a second section to the profile, running on from the U-shape basis, also strongly contributes to the structural capacity of the profile framing by increasing the moment of inertia of the profile, especially in the direction parallel to the U-shape basis (and generally perpendicular to the glass plates). As the U-shape is oriented substantially in parallel to the glass plates, it means that the profile deflects much less for loads applied in the direction parallel to the glass plates. These loads can be

self-weight of glass plates, or racking loads, as already emphasized in above paragraphs. The result is that the casement is much more stable, especially when it is opened.

[0023] The second beneficial effect of extending the profile with a second section, running on from the U-shape basis, is to increase the anchoring depth of screws that are typically used to fix hardware to the profile. Increasing anchoring height reduces the local stresses created in the profile by the screws. The risk of breakage or failure at screwing places is therefore strongly reduced.

[0024] The at least two sections of the profile can be made as a single section or they can be made of two separated sections. In the second case, profile sections are connected by at least one mean adapted to ensure durable structural connection: fastening with self-tapping screw, adhesive bonding with structural glue like silicone or structural tape like VHB tape, welding, soldering, brazing, or even a combination of them.

[0025] The section of the second profile section, extending from the U-shaped section, can be varied providing that i) it increases substantially the moment of inertia of the profile, ii) it increases the anchoring depth of the screws into the profile, iii) it allows for a durable and structural connection with the U-shaped section, among others: square, rectangular, trapezoidal, triangular, hollow or plain, I-shaped, C-shaped, U-shaped, H-shaped,...

[0026] Pursuant to another aspect of the invention, the profile is made of material with high bending strength, high Young modulus, thermal expansion closest to the glass, low water intake, temperature resistance between -20°C and 90°C and reasonable level of thermal conductivity.

[0027] High bending strength helps the profile to sustain all loads applied to the casement (self-weight, racking, torsion,...). High Young modulus avoids the creation of slacks between the casement and the supporting structure due to repeated mechanical loads applied during the product lifecycle. Similarly, a low thermal expansion avoids the creation of slacks between the profile and the glazing due to cooling/heating cycles undergone by the product. Low water intake and temperature resistance ensures that the profile keeps its characteristics and performances all along the product lifecyle. Reasonable level of thermal conductivity allows to reduce thermal fluxes at the edge of the glazing, what is called the Psi-value of the glazing.

[0028] Preferably, profile is chosen among following materials: thin walled stainless steel, hardwood (i.e. oak), wood plastic composite (i.e. 60 wood /40 Polypropylene (PP) or 60 wood /40 High Density Polyethylene (HDPE)), stiff plastic (PolyEtherEtherKetone (PEEK), Polyamide (PA), Polyphenylene Sulfide (PPS), Polybutylene Terephtalate (PBT)), glass fiber (GF) reinforced plastic (PEEK GF30, PPS GF40, PBT GF30, PA6 GF30, Poly-Ester GF73 (weight)).

[0029] According to another aspect of the invention, the profile is bonded to both the first and second glass plates on a substantial portion of their peripheral zone, with the secondary seal of the insulating glass unit or other seal with structural function, or adhesive double-sided tape with structural function or a combination of them.

[0030] Bonding the profile to both the first and second glass plates is again beneficial on a stability point of view. For loads applied on glass plates in a direction which is parallel to them (self-weight or racking loads), loads are distributed all along the profile framing structure, what strongly reduces local mechanical stress in the profile. For connection of the profile to the glass plates, two types of bonding are preferred: sealants or double side adhesive tapes. As these bonding materials are implied in the product mechanical stability, they are chosen to ensure a structural function, meaning that they fulfill at least the three following criteria:

1) good adherence, with or without primer, on both glass and profile surfaces. This adherence is proven by cohesive failure of the seal or the tape during shear or tensile testing;

2) mechanical properties, especially Young modulus and design stress (in tension and shear), suitable to sustain stresses induced by the glazing pumping and de-pumping cycles, differential thermal dilatations between profile and glass, casement self-weight and additional loads that can occur during the product lifecycle (racking, static torsion,...);

3) chemical resistance to all possible ageing agents, especially UVs, water and temperature.

[0031] Examples of sealants with structural function are silicone, modified silicone, and polyurethane. One of examples of double-sided adhesive tape is VHB tape. If a combination of seal(s) and tape(s) is used, chemical compatibility between the components must be ensured.

[0032] It is preferable to have the highest possible bonding surface between the profile and the adjacent glass panes because it allows to reduce stresses in the bonding material by a better repartition of the loads.

[0033] According to another aspect of the invention, the openable frameless door or window casement arrangement is characterized in that the insulating glass unit is a stepped insulating glass.

[0034] Having a stepped insulating glass is particularly advantageous to have edge protection that prevents direct access of building occupants to the window or door hardware and opening/closing mechanisms what can be unsafe, especially for children. Step(s) can be on the whole periphery of the insulating glass as well as, on only a part of it. For tilt & turn hardware for instance, hardware mechanisms lie all around the casement, and therefore, all round the insulating glass. Thus, for tilt & turn hardware, step will preferably goes all around the insulating

glass: the insulating glass unit is a four-sides stepped unit (for rectangular or square shape). Double glazing units will be single-stepped, while triple glazing can be double-stepped, in case that the three glass plates are shifted compared to each other. The advantage of such glass step protection is that methods of fabrication of this kind of stepped units are already known by glazing manufacturers for façade applications and can directly be transferred to the present invention.

[0035] Pursuant to a further aspect of the invention, the openable frameless door or window casement arrangement is characterized in that at least one glass peripheral zone is covered with an opaque paint located inside the insulating glass and extending from the glass edge to the inner spacer wall level.

[0036] Painting the edge of insulating glass unit is a well-known technique in façade applications to hide unaesthetical elements located behind the glass. These elements can have a structural, tightness or other function. For the present concept, the opaque paint can be used to hide hardware or other window/door parts like tightness joints. More opaque is the paint, less the window hardware and tightness elements are visible to the building occupants. Preferably, the paint will be located on an inner surface of the glazing, so that it is protected from direct external ageing and wear factors (rain, sun, abrasion,...). More preferably it will extend from the edge of the glass to the level of the inner spacer wall so that it will hide not only the window unaesthetical elements but also the profile, the seals and/or tapes to maintain the profile to glass, and the glazing primary and secondary seals.

[0037] The paint can be of various types, organic or inorganic, as soon as 1) it can resist chemical and physical ageing and wear degradations, 2) it allows adhesion of typical structural sealants and tapes as described previously. For durability reasons, inorganic paints that can be tempered are preferred. Application methods will preferably be chosen among screen-printing and rollercoating. Most preferable solution is a CNC rollercoating technique which allows to deposit paint strips of various widths ranging from a few millimeters to more or less 30cm on glass periphery in very short cycle times. This method is advantageous compared to the screen-printing method because it allows to deal easily with all glass sizes without having to make a new screen for each different ordered glass size what is often required in the window residential market.

[0038] According to one aspect of the invention, the openable frameless door or window casement arrangement is characterized in that the insulating glass unit is a double glazing.

[0039] According to another aspect of the invention, the openable frameless door or window casement arrangement is characterized in that the insulating glass unit is a triple glazing.

[0040] Triple glazing unit is usually more thermally insulating than a double glazing unit with Ug values that can easily reach 0,6 W/m^2K or even 0,5 W/m^2K. As the frameless casement window described in the present invention has a larger glazed surface compared to a traditional window, the thermal insulation advantage brought by the frameless design is larger and larger as the insulating glass unit is thermally insulating. Therefore, the frameless casement is even more advantageous for the final customer if based on a triple glazing.

[0041] According to a further aspect of the invention, the openable frameless door or window casement arrangement is characterized in that the middle glass pane of the triple glazing is a thin thermally or chemically tempered glass with thickness lower than 2mm.

[0042] Reduction of weight of windows has become an important care, especially for window installers. Indeed, reducing the weight allows to use less people to install a window or to use less hindering equipment to mount the window. A way to reduce window weight is to use thinner glass. However, thinner glass means less mechanical resistance, especially for loads applied perpendicularly to the glass, for instance wind or snow loads. Using thermally or chemically tempered thin glass as the middle pane of the triple glazing allows to reduce significantly the weight of the glazing without impairing in a critical way the mechanical resistance. Preferably, the thin glass pane will be thinner than 2mm.

[0043] Interestingly, the openable frameless door or window casement arrangement is characterized in that the triple glazing has a second spacer which is gas-tightly inserted generally along the edge between the second and third glass plates creating a second plate interspace, a second cordon of sealant securing said glass plates together, and a second profile, which along the edge encompasses the second spacer and is positioned between said glass plates for reinforcing the casement stability or receiving other functionality, characterized in that the second profile is separated from the second spacer, and is positioned between the second and third glass plates in an identical way as the first profile between the first and second glass plate.

[0044] It means that the second profile is also completely concealed between the second and the third glass plate. As it is separated from the first profile, it can ensure another function, typically reinforcement or new functionality integration, without disturbing the mechanical function of the first profile. Examples of these functionalities are tightness gaskets, LED or other illuminating devices, or even electronic processing units for touch glass.

[0045] Second profile will not mandatorily be made of the same material as the first profile but preferably the second profile material will be chosen among similar materials as the first profile to fulfill the same durability, adhesion and mechanical requirements. Similarly to the first profile, the second profile is separated from the spacer, in order to avoid disturbing the traditional tightness function of the spacer.

[0046] According to another aspect of the invention, the openable frameless door or window casement ar-

rangement is characterized in that the two spacers of the triple glazing have the same size and are positioned at the same level inside the IGU. Resulting aesthetics is much more pleasant to building occupants.

[0047] Pursuant to a further aspect of the invention, the openable frameless door or window casement arrangement is characterized in that spacers are warm-edge spacers.

[0048] Use of warm-edge spacers is preferred to reduce thermal fluxes at the edge of the insulating glass what is particularly critical for frameless window or door casements. Indeed, the difference between a traditional window and a frameless casement window, as described in the present invention, is that the edge of the glazing is not embedded in a frame in the frameless casement case. Thus, thermal fluxes through the edge of the glazing are more sensible in the frameless situation. Spacers are known to be the weak part of the glazing edge, because there are traditionally made of thermally conductive materials like metals (aluminum, steel or stainless steel). For a certain number of years now, warm-edge spacers, often made of plastics tightened and/or reinforced with a metallic foil, are used to reduce thermal fluxes at glazing edge (what is called the Psi-value). For frameless casement, the use of warm-edge spacers is strongly preferred.

[0049] According to another aspect of the invention, the openable frameless door or window casement arrangement is characterized in that at least one of the glass plate is a safety glass, chosen among tempered glass or laminated glass.

[0050] As the casement is intended to be used in building envelopes, residential or not (public buildings, offices,...), a safety glass might be suitable to ensure protection of people from injuries and falls. For a double glazing, it may concern both the glass panes; and for the triple glazing, it may concern the three glass plates; even if, in most safety cases, the external and the internal panes could be required to be safety glasses. There are two types of safety glasses : tempered glass and laminated glass.

[0051] For tempered glass, the glass may be considered as a safety glass, because it has a resistance that can reach 5 times the resistance of non-tempered glass, and because breakage leads to the formation of small (and not harmful) pieces. There are two options: thermally toughened (according to EN 12150-2: 2000), thermally toughened and heat soaked (according to EN 14179-2: 2005). It is useful to mention that these toughening processes are compatible with silk-printing or enameling processes, which would be needed in the present concept, if glass edges are rendered opaque to hide profiles, hardware,... ; and they are also compatible with drilling processes needed to make openings to give access to hardware.

[0052] Laminated glass consists of two or more glass sheets assembled by a polymeric film, such as polyvinylbutyral (PVB) or ethylenevinylacetate (EVA). It provides the same safety but in a different way as the tempered glass. In case of breakage, glass pieces remain attached to the polymeric film, avoiding people injuries, and maintaining the separation active.

[0053] The use of safety glass for the present frameless casement invention is even more interesting than for traditionally framed casements, because the insulating glass unit has no peripheral protection in the frameless casement situation, by contrast with a classical double framed window and is more likely to be subjected to contacts and shocks linked to human activities inside or outside the building. For safety reasons, it is therefore of interest that the glass plates, at least the glass plate(s) that are the most subjected to these risks, are heat-treated to have enhanced resistance to mechanical and thermal shocks. As an example, for a usual inwardly opening window or door, the inwardly located glass plate is the most subjected to these risks. Therefore, this glass plate will preferably be a safety glass.

[0054] Preferably, glass plates will be edge-grinded, especially those who need to be heat-treated. Edge grinding renders sharp edges into smooth edges which are much more safer for people who could come in contact with the casement, in particular with the edge of the casement.

[0055] Other options, such as heat insulation with low-e coatings, inert gas filling (such as argon, krypton, or a mix of the two), solar control coatings, reinforced acoustic insulation with acoustic laminated glass, or active control with electrochromic, thermochromic or photochromic films,... are also compatible with the present concept to improve the performances of the window or door casement, but are not described more in the frame of this inventive concept.

[0056] Once the IGU has been assembled with profile, hardware is screwed to the profile along the insulating glass periphery, and the resulting assembly is then ready to be installed in a fixed frame.

Description of the drawings

[0057] The invention will now be further described with reference to the accompanying drawings, in which:

Figure 1 shows a partial cross-section of an openable frameless window casement arrangement with double insulating glazing according to a first embodiment of the invention.

Figure 2 shows a partial plan view of an openable frameless window casement arrangement with double insulating glass unit, similar as the one depicted in Figure 1, seen from the actuating side of the window (side from which window user will be allowed to open or close the window).

Figure 3 illustrates schematically another plan view of such an openable frameless window casement

arrangement with double insulating glazing according to a first embodiment of the invention, wherein profile is i) built up from one single and continuous framing structure and ii) built up from straight segments which are strongly connected in the corners.

Figure 4 shows a partial cross-section of an openable frameless window casement arrangement with double insulating glazing according to a second embodiment of the invention, wherein glass plates are stepped, and the largest glass pane's peripheral zone has been enameled.

Figure 5 shows a partial cross-section of an openable frameless window casement arrangement with triple insulating glazing according to a first embodiment of the invention.

Figure 6 shows a partial cross-section of an openable frameless window casement arrangement with triple insulating glazing according to a second embodiment of the invention.

[0058] ***Figure 1*** illustrates an inventive openable frameless window casement arrangement 100, according to a first embodiment of the invention. The casement is constructed from a double insulating glass unit, made of a first glass plate 1 and a second glass plate 2. A spacer 11 of commercially usual constructional type, consisting of a hollow profile element formed of metal, or preferably of a plastic and metal composite, of rectangular (or close from rectangular) cross-section, is gas-tightly inserted between the glass plates 1 and 2 by means of butyl or silicone adhesive strips 12 at a certain, generally small, distance from the outer edges of the glass plates. The inner space of the spacer 11 is preferably at least partially filled with a moisture-absorbent material, whereby the inner space stands in connection with the insulating glass interspace 16, through holes perforated in the inner spacer wall 11a. Alternatively, the spacer 11 is a flexible cordon which is typically made of a polymeric foam, such as silicone foam.

[0059] A secondary seal 13 is provided all around the insulating glass unit 100 between the glass plates 1 and 2, encompassing the spacer 11. As a result, the interspace 16 between glass plates 1 and 2 is sealed with respect to the exterior according to a typical double seal configuration which ensures gas and moisture tightness with respect to the exterior.

[0060] Pursuant to the first embodiment of the invention, an outwardly opening generally U-shaped profile 10 is positioned between glass plates 1 and 2 in such a way that the profile 10 is separated from the spacer 11, at least by the secondary seal 13, and is completely concealed between glass plates 1 and 2, meaning that the outermost edges of the profile 10 are positioned inside the outermost periphery of said glass plates 1 and 2. The profile 10 is shaped in this way to be able to receive typical window and door hardware. The advantages of inserting the profile completely between glass plates have been emphasized above, among others: improved aesthetics, and less risk of glass breakage upon hardware fixation,...

[0061] Preferably, the gap 15 between the outermost edges of the profile 10 and the outermost periphery of glass plates 1 and 2 is equal to the thickness of the flat section of the hardware with a tolerance of +/-1mm, preferably with a tolerance of +/-0,5mm. In this way, the flat sections of the hardware will not protrude (or insignificantly) outside the insulating glass unit, and will not impair the glassy and uncluttered aspect of the window casement, while optimizing the transparent surface of the window.

[0062] Pursuant to first embodiment, the profile 10 receiving window hardware has a section which includes, in addition to the outwardly opening generally U-shaped section 10a, at least a second section 10b running on from the U-shaped section basis, and which substantially increases the moment of inertia of the profile in direction parallel to the U-shape basis (perpendicular to the glass plates), as well as the anchoring depth of the screws used to fix window hardware to the profile. In **Figure 1,** both sections 10a and 10b are made of a single section. The section 10b has a trapezoidal shape which possibly multiply the moment of inertia of the U-shaped section by a factor 5 to 30, significantly increases the anchoring depth of the screws used to fix hardware and offers a supplementary advantage, which is a facilitated sealant flowing between profile and glass. Profile 10 is preferably made of material with high bending strength, high Young modulus, thermal expansion closest to the glass, low water intake, temperature resistance between -20°C and 90°C and reasonable level of thermal conductivity. Examples of such materials have already been cited : thin-walled stainless steel, hardwood, composite materials such as plastic-wood composites, or glass fiber reinforced plastics.

[0063] As represented on **Figure 1,** profile 10 is structurally maintained to both glass plates 1 and 2 with the combined action of the secondary seal 13 and double-sided adhesive tape 14. In a first embodiment of the invention, and the invention is not restricted to this configuration, profile section 10b is generally embedded in the secondary seal 13, while U-shaped section is fixed to adjacent glass surfaces with double-sided adhesive tape 14. As both the secondary seal and the double-sided adhesive tape can be implied in the structural stability of the casement, secondary seal 13 will be chosen among structural insulating glass sealants, typically silicone; while tape will be chosen among structural tapes, typically VHB tape.

[0064] **Figure 2** shows a partial plan view of an openable casement arrangement according to a first embodiment described in **Figure 1.** Double seal 12 and 13 of the insulating glass unit (IGU), as well as the adhesive tape 14 extend continuously along the IGU periphery. Emphasized in **Figure 2** is the hole 50 drilled in one of

the glass plate(s) 1 and 2, as well as the opening 60 made in the profile for the passage of actuating elements, i.e. handles (which are not represented here), for the actuation of the window/door hardware. For a sake of simplicity, only one drilled hole 50, of a circular/oval shape, was represented on the picture, but it is understood that other drilling schemes may be envisioned for this purpose. In another arrangement of such through bore holes, three holes might be needed: a middle somewhat larger bore for the through passage of the actuating element, and two neighboring somewhat smaller bores for the fastening elements of the actuating element. Further bores are not required in accordance with the present state of the technology for turning/tilting fittings.

[0065] **Figure 2** clearly illustrates that hole(s) 50 drilled in glass for actuating element connection is (are) positioned so as to not disturb the IGU interspace 16 and double seal configuration 12 and 13.

[0066] **Figure 3** schematically illustrates that profile 10, used in openable casement arrangement 100 such as depicted in **Figure 1,** runs all along the insulating glass periphery as one single and continuous framing structure (i) or as strongly connected segments forming a continuous framing structure (ii). Advantage of these configurations have already been reviewed: having a continuous profile framing around the IGU enables to transfer loads applied on one point or on one profile segment to the whole framing.

[0067] Pursuant to this embodiment of the invention, in particular the situation (ii) (to which the invention is not limited), profile 10 is made of 4 straight segments 10a, 10b, 10c, 10d, which are connected in the 4 corners of the openable casement arrangement 10 by connector pieces 70, which ensure durable and structural connection. For instance, these connector pieces may be designed with non-return teeth, just as angle connectors used in the abutment of spacer segments used in insulating glass units. Alternatively these connector pieces may be replaced by screws, typically self-tapping screws, which are also known to ensure durable and structural connection.

[0068] **Figure 4** illustrates an inventive openable frameless window casement arrangement 100, according to a second embodiment of the invention. The casement is constructed from a stepped double insulating glass unit, made of a first glass plate 1 and a second glass plate 2, the first glass plate having a step 17 compared to the second glass plate.

[0069] Having this openable frameless casement arrangement 100 constructed on a stepped insulating glass is particularly advantageous to have edge protection that prevents direct access of building occupants to the window or door hardware and opening/closing mechanisms, what can be unsafe, especially for children. **Figure 4** is only a partial cross-section of the casement 100, but it is understood that illustrated step 17 can be on the whole periphery of the insulating glass, as well as, on only a part of it. In such a construction, the frameless casement has a stairs like structure, which is also particularly suitable to mimic existing openable framed casement edge shapes, especially turn and tilt&turn window/door casements.

[0070] Also emphasized in **Figure 4,** is the paint 80 covering the peripheral zone of the first glass plate 1 with step 17, on surface oriented towards the interior of the insulating glass unit. The paint extends from the outermost edge of the glass plate 1 to the inner spacer wall level. Such a "frame" painting enables to hide unaesthetical elements located behind the glass plate 1 from said side of the window/door casement: butyl strips 12, secondary seal 13, adhesive tape 14 and hardware mainly. The paint 80 is located on the inner surface of the glazing, so that it is protected from direct external ageing and wear factors (rain, sun, abrasion,...).

[0071] Preferably, the paint 80 will be an opaque enamel and the glass plate 1 will be tempered after the enameling process. Sintered enamels are known to have high durability, which is particularly suitable for this application, and are compatible with the other components : seals and tapes. More preferably, the enamel will be applied with a CNC-rollercoating technology.

[0072] ***Figure 5*** illustrates an inventive openable frameless window casement arrangement 100 with a stepped triple insulating glass unit, according to a first embodiment of the invention. This frameless casement is obtained by the addition of a third glass plate 3, and a second spacer 21 which is gas tightly inserted between the second glass plate 2 and the third glass plate 3 with butyl or silicones strips 22 and a secondary seal 23. A second interspace 26 is formed between the second glass plate 2 and third glass plate 3. Such a triple glazing construction significantly improves the thermal insulation of the casement, by providing a Ug value (heat transfer coefficient of the glazing) that can easily reach 0,5 or 0,6 W/m^2K, without impairing the structural function brought by the profile 10 inserted between first and second glass plates 1 and 2.

[0073] Preferably spacers 11 and 12 are warm-edge spacers to reduce heat conduction at the edge of the glazing. Preferably spacers 11 and 21 have the same size and are positioned at the same level inside the triple glazing unit, what strongly improves the aesthetics of the product, by providing one single opaque level at the periphery of the casement.

[0074] Interestingly, the triple glazing has double step, meaning that second glass plate 2 has a step 27 compared to third glass plate 3, and first glass plate 1 has a step 17 compared to second glass plate 2. Again, in such a construction, the frameless casement has a stairs like structure, which is particularly suitable to mimic existing openable framed casement edge shapes, especially turn and tilt&turn window/door casements.

[0075] ***Figure 6*** illustrates an inventive openable frameless window casement arrangement 100 with a stepped triple insulating glass unit, according to a second embodiment of the invention. Difference between this

embodiment of the invention and the previous one illustrated in **Figure 5** is that a second profile 20, separated from the first profile 10, along the edge encompasses the second spacer 21 and is positioned between second and third glass plates 2 and 3. The second profile 20 is separated from the second spacer 21, is positioned between the second and third glass plates 2 and 3, and is attached to said glass plates in a similar way as the first profile 10 between the first and second glass plate 1 and 2. This means that preferably, the profile 20 is bonded to both the second and third glass plates on a substantial portion of their peripheral zone, with the secondary seal of the insulating glass unit or other seal with structural function, or adhesive double-sided tape with structural function, or a combination of them. In embodiment illustrated in **Figure 6,** is used the combined bonding action of the secondary seal 23 and double sided adhesive tape 24.

[0076] The second profile 20 is completely concealed between the second 2 and the third glass plate 3, meaning that the outermost edges of the profile 20 are positioned inside the outermost periphery of the smallest of glass plates 2 and 3, in this case glass plate 3. As it is separated from the first profile 10, it can ensure another function, typically reinforcement or new functionality integration, without disturbing the mechanical function of the first profile. Examples of these functionalities are tightness gaskets, LED or other illuminating devices, or even electronic processing units for touch glass.

[0077] Second profile 20 will not mandatorily be made of the same material as the first profile 10 but preferably the second profile 20 material will be chosen among similar materials as the first profile to fulfill the same durability, adhesion and mechanical requirements. Similarly to the first profile 10, the second profile 20 is separated from the spacer 21, in order to avoid disturbing the traditional tightness function of the spacer 21.

[0078] None of these figures illustrate the fact that insulating glass units can be coated or can integrate very different functionalities, typically low emissivity coatings and solar control coatings. Obviously these coatings will help improving heat insulation properties and adjusting light and energy rays penetration inside buildings.

[0079] Furthermore, it is also to be mentioned that in none of the figures are illustrated the commercially usual fitting and the fixed frame adapted to receive the openable window casement arrangements described on **Figures 1 to 6.** However, it is understood that such casement arrangements have logically to be combined with a fixed/mating frame, by means of hardware, to be a complete window product as introduced in the present document.

[0080] The mating frame is fabricated from typical materials known for this application: wood, plastics (such as Polyvinylchloride (PVC), Polyurethane (PU)), metals (such as steel or aluminum) or combinations of these; and can be completed with thermally insulating material (for Aluminum frames typically) or mechanical reinforcement material (for plastics frames typically). It has a geometry adapted to receive the openable window casement arrangements as described in the present invention.

Claims

1. Openable frameless door or window casement arrangement (100) with insulating glass unit, including at least a first (1) glass plate and a second (2) glass plate, a spacer (11) which is gas-tightly inserted generally along the edge between the first (1) and second (2) glass plates creating a plate interspace (16), a cordon of sealant (13) securing said glass plates together, and an outwardly opening generally U-shaped profile (10), which along the edge encompasses the spacer (11) and is positioned between said glass plates for receiving window hardware, whereby actuating elements pass through one of the glass plate through openings and facilitate access to the hardware, **characterized in that**:

   a. the profile (10) is separated from the spacer (11),
   b. the profile (10) is concealed completely between the first (1) and the second (2) glass plates, the outermost edges of the profile being positioned inside the periphery of said glass plates.

2. Openable frameless door or window casement arrangement (100) according to claim 1, **characterized in that** there is a non-zero gap (15) between the outermost edges of the generally U-shaped profile, and the periphery of the first (1) and second (2) glass plates.

3. Openable frameless door or window casement arrangement (100) according to anyone of preceding claims, **characterized in that** the profile (10) receiving the hardware runs all along the insulating glass periphery as one single and continuous framing structure or as strongly connected segments forming a continuous framing structure.

4. Openable frameless door or window casement arrangement (100) according to anyone of preceding claims, **characterized in that** the profile (10) receiving window hardware has a section which includes, in addition to the outwardly opening generally U-shaped section, at least a second section (10b) running on from the U-shaped section basis, and which substantially increases the moment of inertia of the profile in direction parallel to the U-shape basis (perpendicular to the glass plates), as well as the anchoring depth of the screws used to fix window hardware to the profile.

5. Openable frameless door or window casement arrangement (100) according to anyone of preceding claims, **characterized in that** the profile (10) is made of material with high bending strength, high Young modulus, thermal expansion closest to the glass, low water intake, temperature resistance between -20°C and 90°C and reasonable level of thermal conductivity.

6. Openable frameless door or window casement arrangement (100) according to anyone of preceding claims, **characterized in that** the profile (10) is bonded to both the first (1) and second (2) glass plates on a substantial portion of their peripheral zone, with the cordon of sealant (13) of the insulating glass unit or other seal with structural function, or adhesive double-sided tape with structural function, or a combination of them.

7. Openable frameless door or window casement arrangement (100) according to anyone of preceding claims, **characterized in that** the insulating glass unit is a stepped insulating glass, including at least a first (1) and second (2) glass plates, wherein the profile (10) is concealed completely between the first (1) and the second (2) glass plates, the outermost edges of the profile being positioned inside the periphery of the smallest of said glass plates.

8. Openable frameless door or window casement arrangement (100) according to anyone of preceding claims, **characterized in that** the insulating glass unit includes at least one glass peripheral zone covered with an opaque paint (80) located inside the insulating glass unit and extending from the glass edge to the inner spacer wall (11a) level.

9. Openable frameless door or window casement arrangement (100) according to anyone of preceding claims, **characterized in that** the insulating glass unit is a triple glazing.

10. Openable frameless door or window casement arrangement (100) according to anyone of preceding claims, **characterized in that** the middle (2) glass pane of the triple glazing is a thin thermally or chemically tempered glass with thickness lower than 2mm.

11. Openable frameless door or window casement arrangement (100) according to anyone of preceding claims, **characterized in that** the triple glazing has a second spacer (21) which is gas-tightly inserted generally along the edge between the second (2) and third (3) glass plates creating a second plate interspace (26) , a second cordon of sealant (23) securing said glass plates together, and a second profile (20), which along the edge encompasses the second spacer (21) and is positioned between said glass plates for reinforcing the casement stability and/or receiving other functionality, **characterized in that** the second profile (20) is separated from the second spacer (21), and is positioned between the second (2) and third (3) glass plates in an identical way as the first profile (10) between the first (1) and second (2) glass plate.

12. Openable frameless door or window casement arrangement (100) according to anyone of preceding claims, **characterized in that** the two spacers of the triple glazing have the same size and are positioned at the same level inside the IGU.

13. Openable frameless door or window casement arrangement (100) according to claims 1 to 8, **characterized in that** the insulating glass unit is a double glazing.

14. Openable frameless door or window casement arrangement according to anyone of preceding claims, **characterized in that** at least one of the spacers (11, 21) is a warm-edge spacer.

15. Openable frameless door or window casement arrangement (100) according to anyone of preceding claims, **characterized in that** at least one of the glass plate (1, 2, 3) is a safety glass chosen among tempered glass or laminated glass.

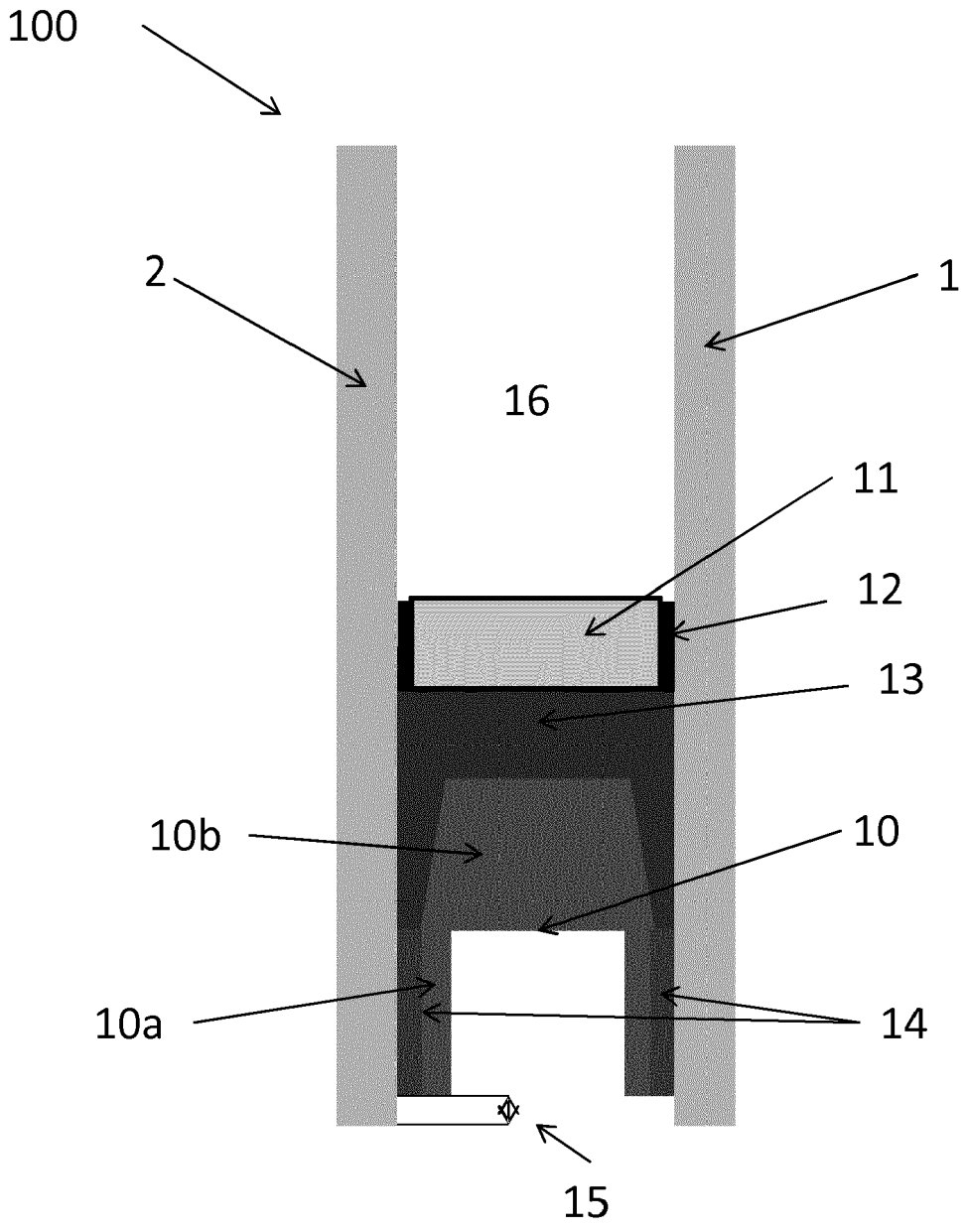

Figure 1

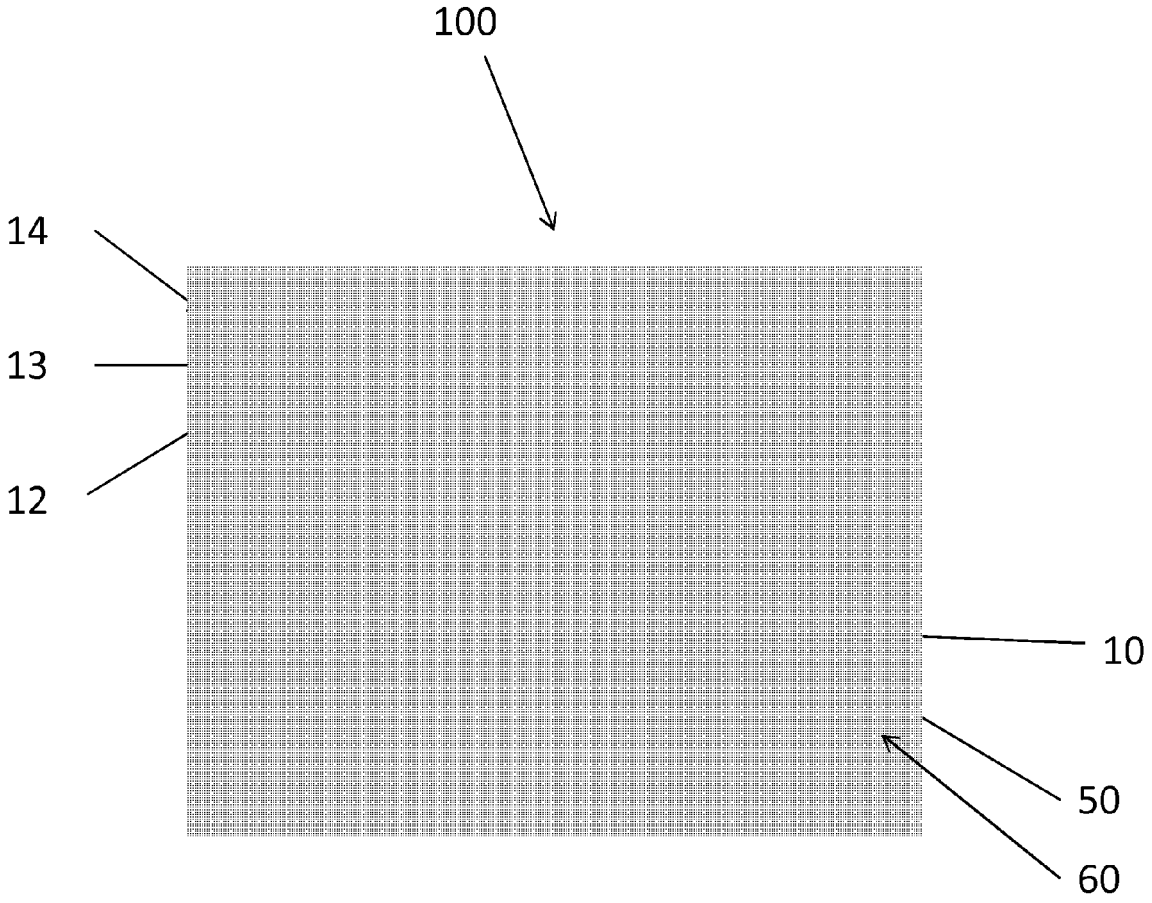

Fig. 2

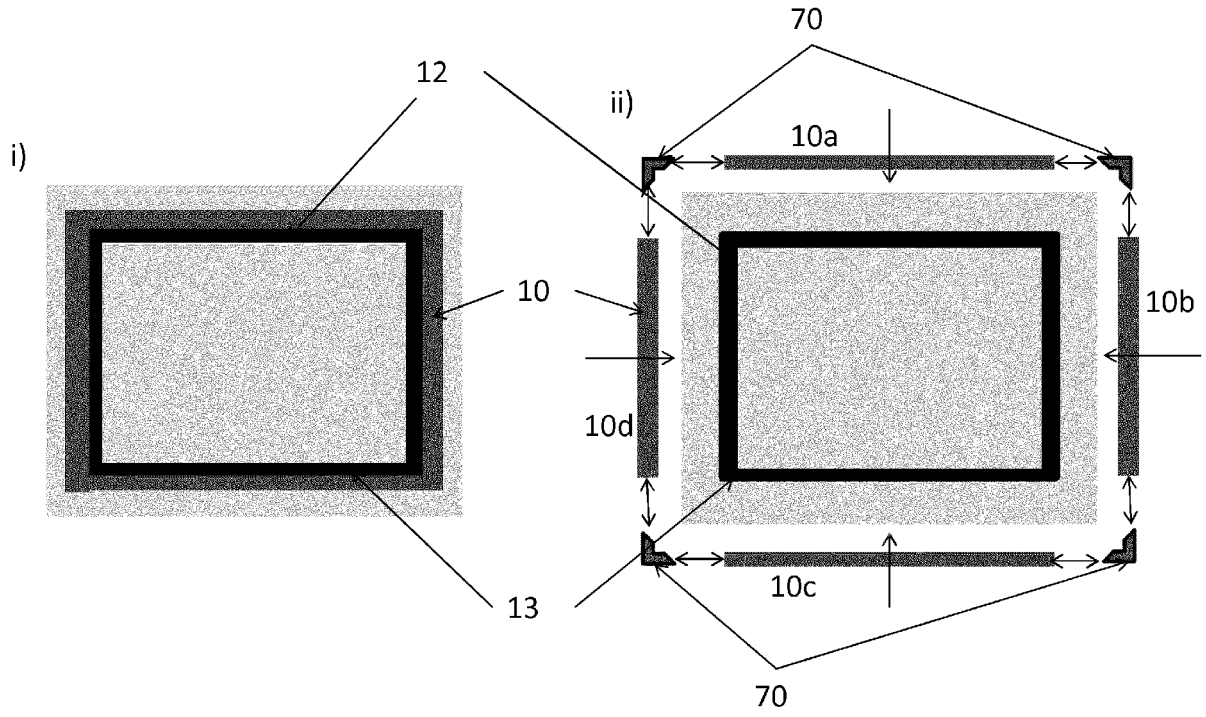

Fig. 3

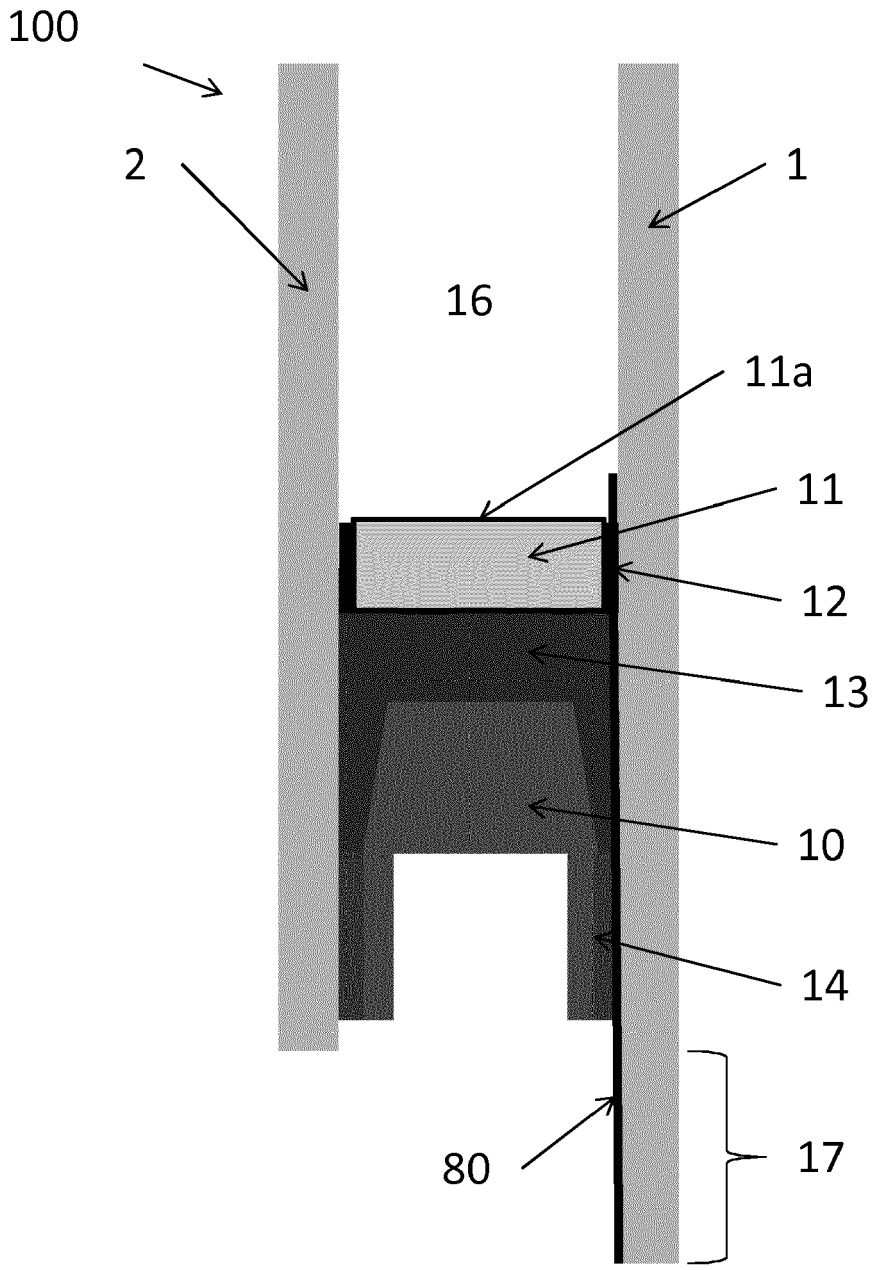

Fig. 4

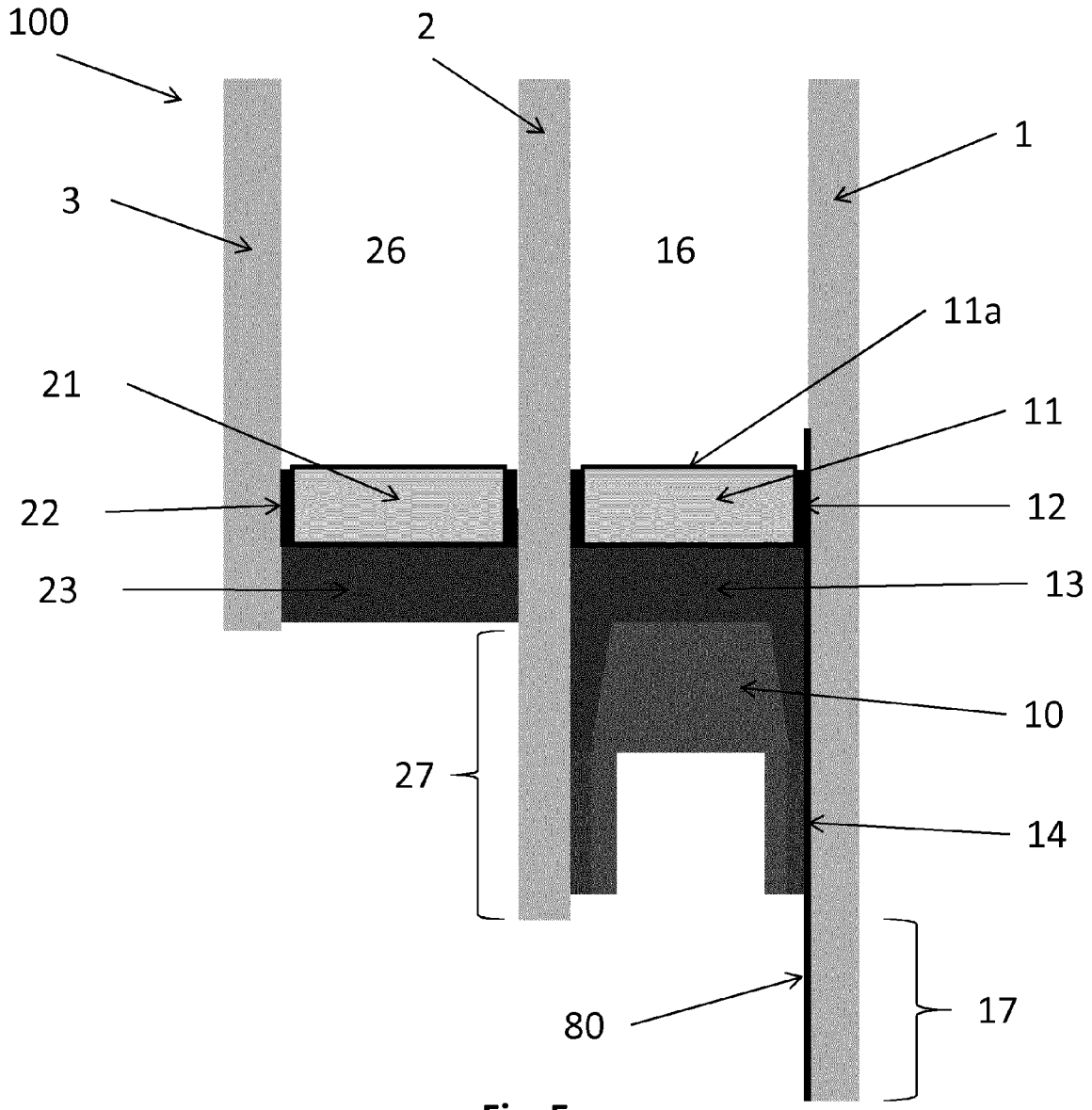

Fig. 5

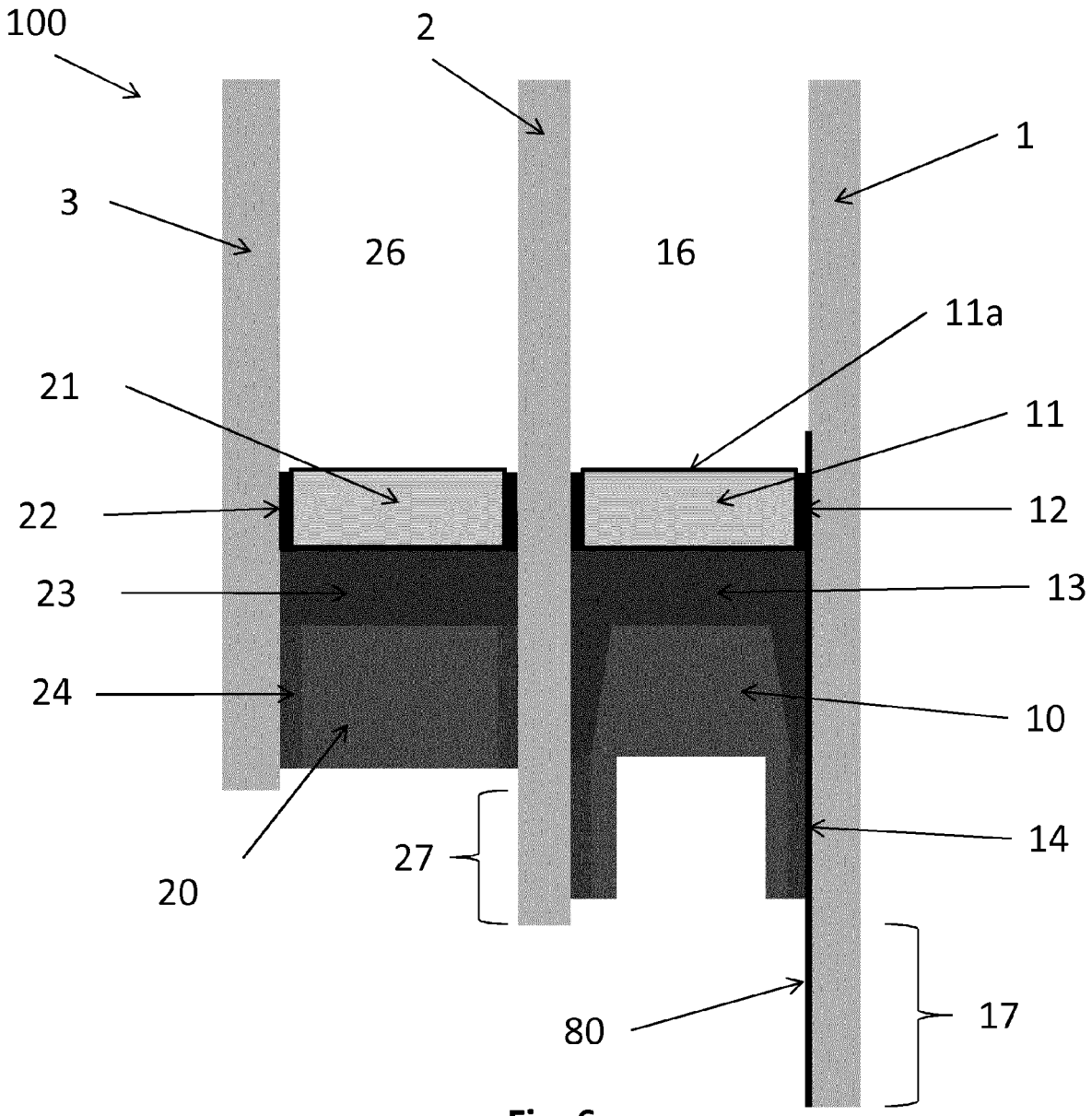

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 14 18 7018

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 March 2015	Verdonck, Benoit

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06-03-2015

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