(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 865 836 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.04.2015 Bulletin 2015/18

(51) Int Cl.:
E06B 3/02 *(2006.01)*

(21) Application number: **13189759.7**

(22) Date of filing: **22.10.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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

(57) An openable frameless door or window casement arrangement with multiple insulating glazing, comprising an externally located glass plate (2), an inwardly located glass plate (3) with an encompassing edge protection (6) opposite the externally located glass plate (2), a spacer (4) which is gas-tightly inserted generally along the edge between the inwardly located and externally located glass plates (2, 3) creating a plate interspace (7), a cured cordon of sealant (5) securing said panels together and a fixing arrangement (10) which along the edge encompasses the spacer (4) and is positioned between the glass plates (2, 3) for receiving a fitting, whereby actuating elements pass through the inwardly located glass plate (3) through openings and facilitate access to the fitting.

According to the invention, the fixing arrangement (10) is formed by a closed support profile (11) and an outwardly opening generally U-shaped profile (12), which arrangement (10) is closely fastened onto the cured sealant (5) between the glass plates (2, 3).

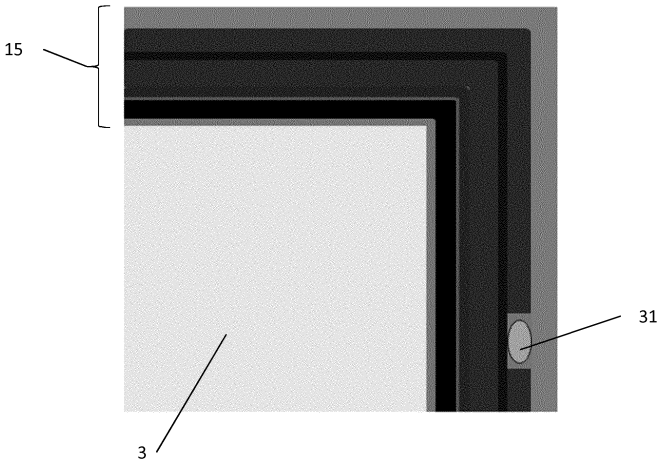

Figure 3

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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 stat-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, 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 turn and tilt 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 German Publication DE-

AS-1212274 discloses an arrangement in which the inwardly located glass plate possesses a peripherally extending edge projection relative to the exteriorly located glass plate, whereby there is contemplated a purely rotary fitting which is either glued thereon or clamped thereto, and essentially on the projection. However, this arrangement does not permit the utilization of a turning/tilting 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 disadvantages and discloses a frameless door or window casement arrangement with insulated glazing in which the U-shaped profile receiving the fittings, surrounds the spacer but is separated from it, and is either glued to the glass or embedded in the uncured sealing of the insulated glazing. Both of these configurations are likely to lead to high local stressing of the glass plates or of the sealant, which is undesired to have a stable and durable IGU. In addition, embedding the U-shape profile in uncured sealant is likely to lead to inaccurate positioning, or even to spacer displacement and butyl tear out (gas tight function of the spacer/sealing is not easily controlled), and is very unpractical from a process point of view (insertion of supporting profiles must be made mandatorily during the few hours following the injection of the sealant, when sealant has still sufficiently low viscosity). When gluing the U-shaped profile to glass, the structural durability of the assembly is directly depending on the quality and durability of the glue which can be rapidly impaired by weathering conditions. 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.

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 insulated glazing and a method for manufacturing such an openable frameless door or window casement arrangement which will fulfill the practical demands, from both mechanical and thermal points of view, and can be practically performed in a factory so as to more easily control the quality of the finished product and to provide an openable frameless door or window casement arrangement which is ready for installation in wall openings.

[0010] According to a first aspect of the invention, there is provided an openable frameless door or window casement arrangement with multiple insulating glazing, comprising an externally located glass plate, an inwardly located glass plate with an encompassing edge protection opposite the externally located glass plate, a spacer which is gas-tightly inserted generally along the edge between the inwardly located and externally located glass plates creating a plate interspace, a cured cordon of sealant securing said panels together and a fixing arrangement which along the edge encompasses the spacer and sealant, and is positioned between the glass plates for receiving a fitting, whereby actuating elements pass through the inwardly located glass plate through openings and facilitate access to the fitting. The fixing arrangement is formed by a closed support profile and an outwardly opening generally U-shaped profile, which arrangement is closely fastened onto the cured cordon of sealant between the glass plates.

[0011] A key particularity of the present concept, as compared to previously described solutions, is that there is no permanent nor strong bonding between the profile arrangement and the abutting glass sheets via the sealant or via any additional glue. The structural cohesion of the assembly is obtained by preventing the arrangement to move independently from the glazed unit:

- in the plane of the window casement: because profiles, especially the closed support profile, are mechanically fastened to form a mechanically continuous support which is in close and continuous contact with the external surface of the cured sealant of the glazed unit, what prevents any slack between the fixing arrangement and the sealant and therefore the glazing.

- in the direction perpendicular to the window casement: because the arrangement, in particular the closed support profile, is maintained between the in-

wardly and the externally located glass plates.

[0012] The structural way of working of such a configuration can be explained with the following example. When the window casement (glazed part) is opened so that the plan of the casement is vertical and perpendicular to the façade, even if the weight of the glazing directly applies on the bottom part of the arrangement, this load will be transferred, through the closed support profiles, to the whole periphery of the glazing, and therefore to the hardware which can support the opened casement.

[0013] A key advantage of the configuration disclosed in the present invention is that the loads are mainly transferred all around the glazing via the continuous structure formed by the closed support profile, and therefore with very limited local stressing of the abutting glass sheets or sealant (which is, by contrast, the case when profiles are glued to glass or embedded in uncured sealant).

[0014] Moreover, fastening the arrangement onto cured sealant, by contrast to embedding it in uncured sealant, permits to have sufficient and appropriate sealant strength to offer mechanical protection which allows to avoid, when profiles are inserted, any perturbation (i.e. displacement) of the spacer, that can occur if the arrangement or profiles are inserted in a sealant which is uncured, and that could lead to higher gas leakage or water penetration levels. Furthermore, the used of cured sealant permits to have a solid-state level which allows for a more accurate positioning of the profiles around the glazing. Fastening the arrangement on cured sealant is easily noticeable on the final product, as there is no penetration of the profiles inside the sealant, nor permanent bonding between profiles and sealant, or between profiles and glass sheets.

[0015] As a third advantage of this configuration, the process to manufacture an openable frameless door or window casement arrangement is improved. Indeed, fastening the arrangement on the cured sealant enables to have separated (in time, and in space) production steps meaning that the production of the insulating glazing Unit (IGU) and fastening of the profiles can be separated; which render the whole process more flexible or less constraining.

[0016] It is understood that the fixing arrangement which is formed by a closed support profile and an outwardly opening generally U-shaped profile, which arrangement is closely fastened onto the cured cordon of sealant could be formed by a single piece which is independent of the spacer. The use of a single piece forming the fixing arrangement facilitates the manufacturing of the openable frameless door or window casement arrangement accordingly to the invention.

[0017] According to a second aspect of the invention, there is provided an openable frameless door or window casement arrangement wherein the closed support profile of the arrangement is positioned inside and closely of the periphery of the externally located glass plate.

[0018] The closed support profile is inserted on its entire height between the glass plates so that its outer surface is as close as possible from the periphery of the externally located glass plate, because such a positioning enables to minimize the distance covered by opaque components on the periphery of the glazing, and therefore maximizes the natural light illumination of the building interior through the window, while still allowing the closed profile to fulfill its mechanical support function (as it is entirely inserted between the glass plates).

[0019] The closed support profile is chosen among generally and commercially available hollow profiles with close, typically square or rectangular, section. For structural reinforcement or thermal insulation, the closed profile of hollow section could be filled with a specific reinforcement or insulating material.

[0020] According to another aspect of the invention, there is provided an openable frameless door or window casement arrangement wherein the outwardly generally opening U-shaped profile of the fixing arrangement is positioned in the space defined between peripheries of the said externally located glass plate and the said inwardly located glass plate.

[0021] The load transferring and supporting function is already fulfilled by the closed support profile. Therefore the outwardly opened U-shaped profile, which is tightly connected to it and has no supporting function, is not necessarily positioned inside the periphery of the externally located glass plate. On the contrary, it is preferable to position it outside the periphery of the externally located glass plate, again, in order to minimize the light obstruction. In addition, it is preferable to position the U-shaped profile inside the periphery of the internally located glass plate, so as to protect and hide it (and in particular the hardware which is fixed to it) from people located in the interior of the building.

[0022] Preferably, the U-shaped profile may comprise, in cross-section, two leg portions joined by a bridging portion, the free ends of the leg portions lying not beyond the level of the edge of the externally located glass plate.

[0023] According to a further aspect of the invention, there is provided an openable frameless door or window casement arrangement comprising a cured cordon of sealant which has a generally flat surface suitable for creating good surface contact with closed support profile.

[0024] Ensuring a flat surface of the cured cordon of sealant and therefore a good surface contact between the closed support profile and the cured sealant is of high importance in the concept, because the closed profile is not glued or fixed to the adjacent glass surfaces nor embedded in the glazing sealant. Ensuring a good surface contact between the cured sealant of the glazing and the closed profile consists in other words in vanishing the possible movements and displacements between the closed profile and the sealant of the glazing, and it ensures that the glazing and closed support profiles (and all the components fixed to it) cannot move independently from each other. Indeed, any slack between the sealant and the profiles would cause a slack between the glazed

part and the fixed frame. So the close fastening avoids shifts that would render the opening and closure of the window more difficult (larger handle forces needed), and also avoids local damaging of the cured sealant due to repeatedly and locally applied forces.

[0025] The sealant material is selected from silicone, polyurethane or polysulfide adhesive materials. Preferably, the adhesive material is selected from silicone adhesive materials, because silicone materials are much less sensitive to light, and globally more stable than other cited materials. More preferably, it is a silicone adhesive material with high elastic modulus in tension and compression (E > 2,5 Mpa) and high hardness (H (shore A) > 55). Such a material reduces the deformation of the glass during heating/cooling cycles, and therefore, reduces possible stresses on the profile arrangement.

[0026] Accordingly to the invention, the cordon of resin must be cured, or at least sufficiently cured, before the integration of the profile arrangement, so that there is no permanent penetration of the arrangement in the sealant, nor permanent bonding between them. The advantages of such a configuration have already been emphasized in above paragraphs.

[0027] From a technical point of view, it is easy to make the difference with CA 2260070, where profiles are embedded in uncured sealant. Embedding means that the sealant has sufficiently low viscosity to be deformed and immerse partially or totally the profile. In the present invention, we consider that tack-free time is the minimum duration before integration of profile arrangement. Tack free time is the period from the start of cure to a point when the material is sufficiently robust to resist damage by contact or touch or setting dirt. After this period, the sealant is not fully cured, but it has reached a sufficient modulus and hardness to prevent the profile arrangement to penetrate inside the sealant. For a silicone for instance, tack-free time is about 3 to 4 hours. After this period, the product has reached a hardness Shore A of about 20 to 30.

[0028] Not mandatory, but preferred, is the integration of the profile arrangement between the tack free time and the time when the sealant has developed its full hardness. For a silicone, almost full hardness (~40 to 63 Shore A depending on the Silicone type) and full curing (~ 95%) are obtained after 24 to 48 hours.

[0029] Preferably, the closed support profile is formed by strongly connected parts forming continuous framing structure.

[0030] It is fundamental for the closed support profile to be made of strongly connected members, forming a continuous framing structure. As already emphasized in above paragraphs, such a fastening makes the whole cohesion of the assembly, by preventing the profiles (and the integrated fittings) to move independently of the glazing. The continuity of the closed support profile means that any dynamic or static load applied locally or on limited portion of the closed profile is transferred and distributed on the complete profile structure. There are at least two advantages consequent to this:

- stresses are locally reduced, because the same total load is distributed and applies on a larger total surface;
- as soon as the closed profile is tightly fastened onto the glazing, any load applied to the glazing or casement when it is opened (own weight for instance) is directly and completely transferred to the fixed frame via the hardware components which are positioned regularly along the glazing periphery.

[0031] Pursuant to a further aspect of the present invention, the closed support profile is made of material with high tensile strength capacity, low deformation, low thermal expansion.

[0032] The choice of the material for closed support profile is of high importance because of the mechanical function fulfilled by the profile. A high tensile strength allows the profile to sustain loads applied to it, without breaking or being damaged. A low deformability avoids the creation of slacks between the profile and the glazing 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.

[0033] The closed support profile is typically made of a reinforced plastic like PEEK, PP, PU, PA,... or a metal like thin wall stainless steel, aluminum,...

[0034] Pursuant to a further aspect of the invention, the closed support profile is separated from the outwardly opening U-shaped profile by a tight gasket.

[0035] The utilization of tight gaskets in window products is a highly recommended step to ensure the product to fulfill sufficient water tightness and air permeability performances. The insertion of the gasket between the closed profile and the outwardly opening U shaped profile is key as it allows to have a smooth contact between both profiles, and because it is a barrier to humidity preventing (or at least reducing the amount of) water to reach the closed support profile and to infiltrate between the closed support profile and the sealant.

[0036] Such a positioning is also very practical in terms of fabrication process as it enables to fasten the gasket very easily to the rest of the structure, by fastening the profiles together with the gasket being held in between.

[0037] Tightness gasket is suitably made of a durable and elastic material, such as a natural or synthetic rubber.

[0038] Pursuant to a further aspect of the present invention, a joint is positioned between the closed support profile and the outwardly opening U-shaped profile (12) and extends at least to the edge of the externally located glass plate.

[0039] In addition with its water barrier function, the gasket can also be used to protect the edge of the externally located glass plate, which can be a key safety or

comfort parameter for the window casement perception.

[0040] Pursuant to a further aspect of the invention, the closed support profile and the outwardly opening U-shaped profile, are bonded together by at least one mean adapted to ensure durable structural connection. The said mean could be for example an adhesive joint, a screw, a glue, a welding joint....

[0041] Connection of the closed support profile to the outwardly opening U shaped profile needs to be structurally strong to ensure that both profiles cannot move independently from each other, and that loads applied to one are automatically and on their whole connection length transferred to the other. The durability of the connection is of importance as well, knowing the weathering conditions that could stress the connection such as resistance to water, high temperatures, thermal cycles,...

[0042] Preferably, the mean adapted to ensure durable structural connection is a self-tapping screw (material without corrosion problem).

[0043] The advantages of the self-tapping screw are:

- easy and low cost fastening process
- mechanically strong
- durable.

[0044] Pursuant to a further aspect of the invention, the openable frameless door or window casement arrangement is **characterized in that** the inwardly located glass plate is heat-strengthened or toughened.

[0045] The inwardly located glass plate has no peripheral protection, by contrast with a classical double framed window, and is more likely to be subjected to contacts and shocks linked to human activities inside the building. For safety reasons, it is therefore of interest that the inwardly located glass plate is heat-treated to have enhanced resistance to mechanical and thermal shocks. It can be heat-strengthened (according to EN 1863-2: 2004), thermally toughened (according to EN 12150-2: 2000), thermally toughened and heat soaked (according to EN 14179-2: 2005). But only in cases of heat toughening, the glass may be considered as a safety glass, as breakage then leads to the formation of small (and not sharp) pieces. It is useful to mention that the aforementioned heat strengthening processes are compatible with silk-printing or enameling processes, which would be needed in the present concept, if the encompassing edge protection should be rendered opaque to hide the profile arrangement and the integrated hardware; and they are also compatible with drilling processes needed to make openings to give access to hardware from the interior of the building.

[0046] Preferably, the inwardly located glass plate will be edge-grinded before heat-treatment. 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.

[0047] Advantageously, the inwardly located glass plate will have a low-e coating on the side facing the interior of the glazed unit, for thermal insulation improvement.

[0048] According to one aspect of the invention, the multiple glazing is a double or a triple glazing.

[0049] In another embodiment, the multiple glazing is a triple glazing which has thermally insulating material placed at the periphery of the case arrangement creating thermal break at its peripheral zone and is located between externally located glass plate and middle glass plate.

[0050] Integrating a profile arrangement on the periphery of the glazed unit has for impact to reduce the linear thermal resistance, known as the Psi-value (Ψg), of the glazing. This is due to heat conduction through the profiles. Heat conduction can be reduced by the use of polymeric or composite profiles instead of metallic profiles; but in any case, the impact will not be negligible. This is the reason why it is of interest to introduce on the periphery of the glazing thermally insulating compounds. To reduce the heat flux, these compounds must be placed in series with the profiles. This is very difficult to achieve with a double glazed unit, and, by contrast, quite straightforward for a triple glazed unit for which a free space is available between the mid located and the externally located glass panes, directly in series with the profile arrangement inserted between the inwardly and the mid located glass plates.

[0051] The thermally insulating compound may be chosen amongst very diverse materials, including polyurethane foam, polystyrene, glass or stone wool,...; which will be preferably chosen to be chemically compatible with the sealant of the glazing.

[0052] In the triple glazing version, the gasket fastened between closed and opened U shape profile extends to the edge of the externally located glass plate as it is claimed in claim 12. This also enables to reduce the risk of water penetration from the exterior, and protect the thermally insulating material which is placed between the middle and the external pane.

[0053] According to a further aspect of the invention, there is provided a method of manufacturing an openable frameless door or window casement arrangement comprising the steps of:

(i) providing at least one externally located glass plate, an inwardly located glass plate with an encompassing edge protection;

(ii) enameling or silk-printing the edge region of at least the inwardly located glass plate with an encompassing edge protection;

(iii) heat treating at least the inwardly located glass plate with an encompassing edge protection for burning the enameling;

(iv) associating, inserting, assembling and gluing of the outwardly and inwardly located glass plates and

the spacer for insulated glazing in manner known per se;

(v) filling in of cordon of sealant for the insulated glazing in a manner per se;

(vi) curing the cordon of sealant until reaching the tack-free time and elastic/hardness conditions thereof;

(vii) inserting the closed profile and fastening it closely around the cured sealant in the space between the outwardly and inwardly glass plates;

(viii) inserting, for triple glazed units, a thermally insulating material around the spacer and the sealant separating the mid and the outwardly located glass plates;

(ix) and fastening the outwardly opening generally U-shaped profile to the closed support profile, and, if present, a tightness gasket between the closed and the opening U-shaped profile.

[0054] The advantage of such a construction is that the stepped IGU can be manufactured on a classical automatic IGU production line, and that the introduction of profiles can be made in a second, separate step. Thus, there is no constraint on maximum time to be respected between production of IGU and integration of profiles. Once the profiles are integrated, fittings can be fixed all around the glazing, and the resulting assembly is then ready to be installed in a fixed frame.

[0055] 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 illustrates schematically a plan view of such an openable frameless window casement arrangement seen from the interior of the building, where only closed support profile and connections between closed support profile members are depicted;

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, where all described components are depicted, and seen from the interior of the building.

Figure 4 shows a partial cross-section of an openable frameless window casement arrangement with triple insulating glazing according to a first embodiment of the invention.

[0056] ***Figure 1*** illustrates an inventive openable frameless window casement arrangement 1, which is constructed in accordance with the principle of an insulated glazing. Accordingly, it is provided with an outwardly or externally located glass plate 2, an inwardly located glass plate 3 and a spacer 4.

[0057] The spacer 4 is typically of commercially usual constructional type and consists of a hollow profile element, formed of metal and/or plastics, of rectangular (or close from rectangular) cross-section, in the inner space of which there can be received a moisture- absorbent material, whereby the inner space stands in connection with the plate interspace 7 through small perforated holes . Alternatively, the spacer 4 is a flexible cordon which is typically made of a polymeric foam, such as a silicone foam.

[0058] As is usual with insulated glazing, the spacer 4 is inserted between the glass plates 2 and 3 by means of butyl or silicone adhesive strips 16 at a certain, generally small, distance from the outer edges of the latter. Thereby, formed is an encompassing surrounding edge joint, such as is usual for insulated glazing, which is provided with a cordon of sealant 5. Thus, the interspace 7 between the glass plates 2 and 3 is sealed with respect to the exterior in a gas and moisture-sealed type manner. The plate interspace 7, as is known per se, can be filled with a gas or (partially) evacuated.

[0059] The sealant material 5 is typically selected from silicone, polyurethane or polysulfide adhesive materials. Preferably, the adhesive material is selected from silicone adhesive materials, because silicone materials are much less sensitive to light, and globally more stable than other cited materials. More preferably, it is a silicone adhesive material with high elastic modulus in tension and compression (E > 2,5 Mpa) and high hardness (H (shore A) > 55). Such a material reduces the deformation of the glass during heating/cooling cycles, and therefore, reduces possible stresses on the profile arrangement.

[0060] Accordingly to the invention, the cordon of sealant must be cured, or at least sufficiently cured, before the integration of the fixing arrangement 10, so that there is no permanent penetration of the arrangement in the sealant, nor permanent bonding between them.

[0061] Preferably, the cured cordon of sealant 5 has a generally flat outer surface suitable for creating good surface contact with closed support profile 11. The advantages of such a configuration have already been emphasized in above paragraphs.

[0062] Pursuant to the first embodiment of the invention, the closed support profile 11 of the fixing arrangement 10, which is separated from the spacer 4, is inserted between the outwardly and inwardly located glass plates 2,3 and positioned closely to, and in contact with the outer surface of the cordon of sealant 5. The closed support profile 11 may have different shaped sections (I profile, Omega profile, rectangular or square closed profile,...). Preferably, it consists of a hollow profile element of rectangular or tubular cross section.

[0063] Preferably, the closed support profile 11 is made of a material with high tensile strength capacity, low deformability, and low thermal expansion. For example, the closed support profile 11 is made of a material chosen among reinforced plastics such as the PolyEtherEtherKetone (PEEK), Polypropylene (PP), Polyurethane (PU), Polyamide (PA)... or metals like thin wall stainless steel, aluminum alloy... or composite materials made of plastics and metallic parts.

[0064] As depicted on ***Figure 2,*** the closed support profile 11 is formed by strongly connected parts or members forming continuous framing structure. Figure 2 represents a connection which is a classical fastening with corner pieces. But it is understood that any other kind of connection, which is compatible with the IGU assembly, may be envisioned for the purpose of the invention: soldering, brazing, adhesive bonding,... It is fundamental for the closed support profile 11 to be made of strongly connected members 21, forming a continuous framing structure. As already emphasized in above paragraphs, such a fastening makes the whole cohesion of the assembly, by preventing the profiles (and the integrated fittings) to move independently of the glazing.

[0065] As depicted on ***Figure 1,*** and according to the invention, the fixing arrangement is completed with an outwardly opening generally U-shaped profile for the receipt of a fitting, especially a turning/tilting fitting of a usual type of construction.

[0066] The inwardly located glass plate 3 possesses a surrounding edge projection 6 opposite to the externally located glass plate 2, which serves, first, for protecting and hiding the profile arrangement and the window hardware/fitting from people located inside the building, and secondly, to offer a continuous contact surface between the glazed casement and the fixed frame.

[0067] According to another aspect of the invention, the closed support profile 11 and the outwardly opening U-shaped profile 12, are bonded together by at least one mean 14 adapted to ensure durable structural connection between the said closed support profile 11 and the outwardly opening U-shaped profile 12. Preferably, the closed support profile 11 and the outwardly opening U-shaped profile 12 are bonded together by a welded/soldered/brazed joint and/or by an adhesive joint and/or by screws. More preferably, the closed support profile 11 and the outwardly opening U-shaped profile 12 are bonded together by self-tapping screws which have no corrosion problem.

[0068] According to another aspect of the invention, the closed support profile 11 and the outwardly opening generally U-shaped profile 12 are separated from each other by a tight gasket 13. The tight gasket 13 is positioned between the closed support profile 11 and the outwardly opening U-shaped profile 12, so as to prevent water to infiltrate and accumulate around closed support profile 11, in particular between the cured cordon of sealant 5 and the closed support profile 11, and extends to at least to the edge of the externally located glass plate 2 to protect the edge of the externally located glass plate, which can be a key safety factor for people who could enter into contact with the opened window casement.

[0069] In the embodiment illustrated in ***Figure 1,*** the inwardly located glass plate 3 possesses an enameling 15 which extends around the edge facing towards the plate interspace 7, the width is so dimensioned, as represented, that the spacer 4 and the fixing arrangement 10, as well as the cordon of sealant 5 therebetween are covered. It was found that such type of covering, such as the enameling, in its edge region can be produced extremely precisely, which is not afforded for the positioning of the silicon or butyl strips, so that there can be achieved an aesthetically clean closure. Furthermore, this enameling 15 renders the glass in this region opaque and/or colored in a particular manner. This enameling is a special glass technological treatment which requires a heat etching procedure. Heretofore this was only known with artistic work. However, it turned out that notwithstanding the enameling 15 there is achieved a very good adhesive base for the silicon or, respectively, butyl strips , and also for the cordon of sealant, so that gas tight and liquid tight closure is achieved for the plate interspace 7.

[0070] In the same way, the edge of the externally located glass plate 2 is preferably enameled or printed for hiding the spacer and sealant behind. This covering is made in the very same way as for the externally located glass plate, prior to the assembly.

[0071] ***Figure 3*** schematically illustrates the inwardly located glass plate 3 seen from the interior. This figure provides indications with regard to the dimensioning of the projection of the inwardly located glass plate 3. This projection is to be dimensioned so that the fixing arrangement and the elements of the fitting which project away from the plate interspace 7 will not be disruptive, especially will not be visible in the closed condition of the casement arrangement.

[0072] Figure 3 also illustrates how the inwardly located glass plate is drilled to allow for the passage of actuating elements, i.e. handles (which are not represented here), for the actuation of the window fitting/hardware. For a sake of simplicity, only one bore hole 31, 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 31, 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.

[0073] As the window fitting essentially lies in the free space of the outwardly opening generally U-shaped profile 12, bore hole(s) are drilled in the inwardly located glass plate 3 at the same level as the U-shaped profile lies between the two glass plates, so that the access of actuating elements to fitting is straightforward.

[0074] According to another aspect of the invention, the inwardly located glass plate is heat-treated after drilling, edge grinding and enameling processes, which allows this glass pane to sustain larger thermal and mechanical shocks.

[0075] The advantages of such an openable frameless door or window casement arrangement 1 with insulated glazing are apparent. Besides all advantages of an insulated glazing there is achieved an extremely high light through-flow. Furthermore, it is easy to take care of the arrangement. In contrast with a usual framed window, there is no presence of any corners or edges, which facilitates cleaning. Furthermore, it is possible to have a free color selection, especially for an enamelling. The servicing is unchanged with regard to usual framed windows, inasmuch as identical turning/tilting fittings can be employed. Architecturally viewed, for large building surfaces, the position of fixedly installed glass plates and of casement arrangements which can be opened, can be suitably selected, since the frames are eliminated and also for shutter frames there are no additional requirements to be considered.

[0076] ***Figure 4*** shows a partial cross-section of an openable frameless window casement arrangement with triple insulating glazing, which is again constructed in accordance with the principle of an insulated glazing. Accordingly, it is provided with an outwardly or externally located glass plate, a mid located glass plate 41, an inwardly located glass plate 3 and a spacer.

[0077] Inwardly located glass plate and mid located glass plate 41, 3, of the triple insulating glass casement are assembled in the same way as the double glazed structure presented on ***Figure 1*****:** encompassing edge protection 6 on inwardly located glass plate 3; separation of glass plates with a spacer 4, butyl strips 16, and a cordon of sealant 5, making a gas and liquid tight closure for the plate interspace 7; and closely fastened onto the cured cordon of sealant 5, a fixing arrangement 10 for the receipt of the window hardware, made of a closed support profile 11 and an outwardly opening generally U-shaped profile 12, both profiles being separated by a tightness gasket 13, suitably fabricated in a rubber material. The advantages and technical outcome of such a configuration have already been reviewed in preceding pictures.

[0078] The assembly comprises of a third, externally located, glass plate which is affixed to the mid-located glass plate, and separated from it with a similar spacer, butyl strips and sealant combination. The resulting interspace is in this way tightly closed. Preferably, the externally located glass plate edge is at the same level as the mid located glass plate edge 41, as depicted on ***Figure 4***.

[0079] Between externally located glass plate and mid located glass plate 2, 41, a thermally insulating material 42 is added to induce a break in the thermal fluxes that could occur on the periphery of the window casement through the profile arrangement 10 placed between the inwardly located and the mid located glass plates 3, 41. For reasons exposed above, the thermal break preferably lies in series with the profile arrangement to reduce significantly the thermal flux in this portion of the casement.

[0080] The thermally insulating material 42, typically a foam material, is protected from humidity by the tightness gasket 13 fastened in the profile arrangement 10, and which extends at least to the edge of the externally located glass plate 2. The protrusion formed at the edge of the externally located glass plate and which completely and continuously surrounds it, may enters into contact with the fixed frame, once the casement is introduced in it, to form a tightness barrier for the window.

[0081] It is of common knowledge that physical separation of the air barrier and water barrier has a beneficial impact on tightness properties of the window. The space formed between the two barriers and the fixed frame (when the casement is closed) ensures a correct drainage of the water through the fixed frame, what prevents water leakage at the periphery of the window.

[0082] In regards with this, the openable frameless window casement arrangement with triple insulating glazing, as depicted on Figure 4, is constructed in such a way that air and water barriers are physically separated.

[0083] In summary, the advantages of the triple glazed frameless casement are:

- better thermal insulation: smaller U value of the glazing and smaller peripheral linear thermal transmittance (Ψg) due to the insertion of a thermal break material in series with the profile arrangement 10.
- an additional space that can be used to separate physically the central tightness joint (water tightness joint used to protect metallic hardware from corrosion) and the externally located joint (air tightness joint). Physical separation of water and air barriers is highly recommended for a window to reach required tightness performances.
- three glass panes which allow for the integration of more functionalities (low-e coating, solar control,...).

[0084] 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 4. However, it is understood that such casement arrangements have logically to be combined with a fixed/mating frame, by means of fittings, to be a complete window product as introduced in the present document.

[0085] 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. In the closed position, there is:

- a first continuous contact with the mating frame on the internal surface of the encompassing edge protection of the inwardly located glass plate;
- a second and preferably a third sealed contact between the tightness gasket of the window casement and the mating frame. As already emphasized, a physical separation between the external air barrier seal and the central water barrier seal is highly preferred to ensure correct tightness performances of the window.

[0086] The mating frame is fixedly anchored in the building in a known manner which is not illustrated in detail.

Claims

1. An openable frameless door or window casement arrangement with multiple insulating glazing, comprising an externally located glass plate (2), an inwardly located glass plate (3) with an encompassing edge protection (6) opposite the externally located glass plate (2), a spacer (4) which is gas-tightly inserted generally along the edge between the inwardly located and externally located glass plates (2, 3) creating a plate interspace (7), a cured cordon of sealant (5) securing said panels together and a fixing arrangement (10) which along the edge encompasses the spacer (4) and is positioned between the glass plates (2, 3) for receiving a fitting, whereby actuating elements pass through the inwardly located glass plate (3) through openings and facilitate access to the fitting,
characterized in that the fixing arrangement (10) is formed by a closed support profile (11) and an outwardly opening generally U-shaped profile (12), which arrangement (10) is closely fastened onto the cured sealant (5) between the glass plates (2, 3).

2. An openable frameless door or window casement arrangement (1) according to claim 1, **characterized in that** the closed support profile (11) is positioned inside and closely of the periphery of the said externally located glass plate (2).

3. An openable frameless door or window casement arrangement (1) according to claim 1 **characterized in that** an outwardly generally opening U-shaped profile (12) is positioned in the space defined between peripheries of the said externally located glass plate (2) and the said inwardly located glass plate (3).

4. An openable frameless door or window casement arrangement (1) according to claim 1, **characterized in that** the cured cordon of sealant (5) has a generally flat surface suitable for creating good surface contact with closed support profile (11).

5. An openable frameless door or window casement arrangement (1) according to anyone of preceding claims, **characterized in that** the closed support profile (11) is formed by strongly connected parts forming continuous framing structure.

6. An openable frameless door or window casement arrangement (1) according to claim 5, **characterized in that** the closed support profile (11) is made of material with high tensile strength capacity, low deformation, low thermal expansion or metal.

7. An openable frameless door or window casement arrangement (1) according to anyone of preceding claims, **characterized in that** the closed support profile (11) is separated from the outwardly opening U-shaped profile (12) by a tight gasket (13).

8. An openable frameless door or window casement arrangement (1) according to claim 7, **characterized in that** a tight gasket (13) is positioned between the closed support profile (11) and the outwardly opening U-shaped profile (12) and extends to at least to the edge of the externally located glass plate (2).

9. An openable frameless door or window casement arrangement (1) according to anyone of preceding claims, **characterized in that** the closed support profile (11) and the outwardly opening U-shaped profile (12), are bonded together by at least one mean (14) adapted to ensure durable structural connection.

10. An openable frameless door or window casement arrangement (1) according to claim 9, **characterized in that** the mean (14) is a self-tapping screw.

11. An openable frameless door or window casement arrangement (1) according to anyone of preceding claims, **characterized in that** the inwardly located glass plate (3) is heat-strengthened or tempered.

12. An openable frameless door or window casement arrangement (1) according to anyone of preceding claims, **characterized in that** the multiple glazing is a double glazing.

13. An openable frameless door or window casement arrangement (1) according to claims 1 to 11, **characterized in that** the multiple glazing is a triple glazing.

14. An openable frameless door or window casement arrangement (1) according to claims 1 to 9, **characterized in that** the multiple glazing is a triple glazing which has thermally insulating material placed at the periphery of the case arrangement creating thermal break at its peripheral zone and is located between

externally located glass plate (2) and middle glass plate.

15. An method of manufacturing an openable frameless door or window casement arrangement (1) comprising the steps of:

a) Providing at least one externally located glass plate (2), an inwardly located glass plate (3) with an encompassing edge protection (6);
b) Enameling or silk-printing (15) the edge region of at least the inwardly located glass plate (3) with an encompassing edge protection (6);
c) Heat treating at least the inwardly located glass plate (2) with an encompassing edge protection (6) for burning the enameling or silk-printing;
d) Associating, inserting, assembling and gluing of the outwardly (2) and inwardly located glass plates (3) and the spacer (4) for insulated glazing;
e) Filling in of cordon of sealant (5) for the insulated glazing;
f) Curing the cordon of sealant (5) until reaching the tack-free time and elastic/hardness conditions thereof;
g) Inserting the closed profile (11) and fastening it closely around the cured sealant (5) in the space (7) between the outwardly (2) and inwardly (3) glass plates;
h) Inserting, for triple glazed units, a thermally insulating material around the spacer and the sealant separating the mid and the outwardly located glass plates;
i) And fastening the outwardly opening generally U-shaped profile (12) to the closed support profile (11).

16. A method of manufacturing an openable frameless door or window casement arrangement (1) according to claim 15, **characterized in** the multiple glazing is a triple glazing and **in that** a thermally insulating material is inserted around the spacer and the cordon of sealant (5) separating the mid and the outwardly located (2) glass plates.

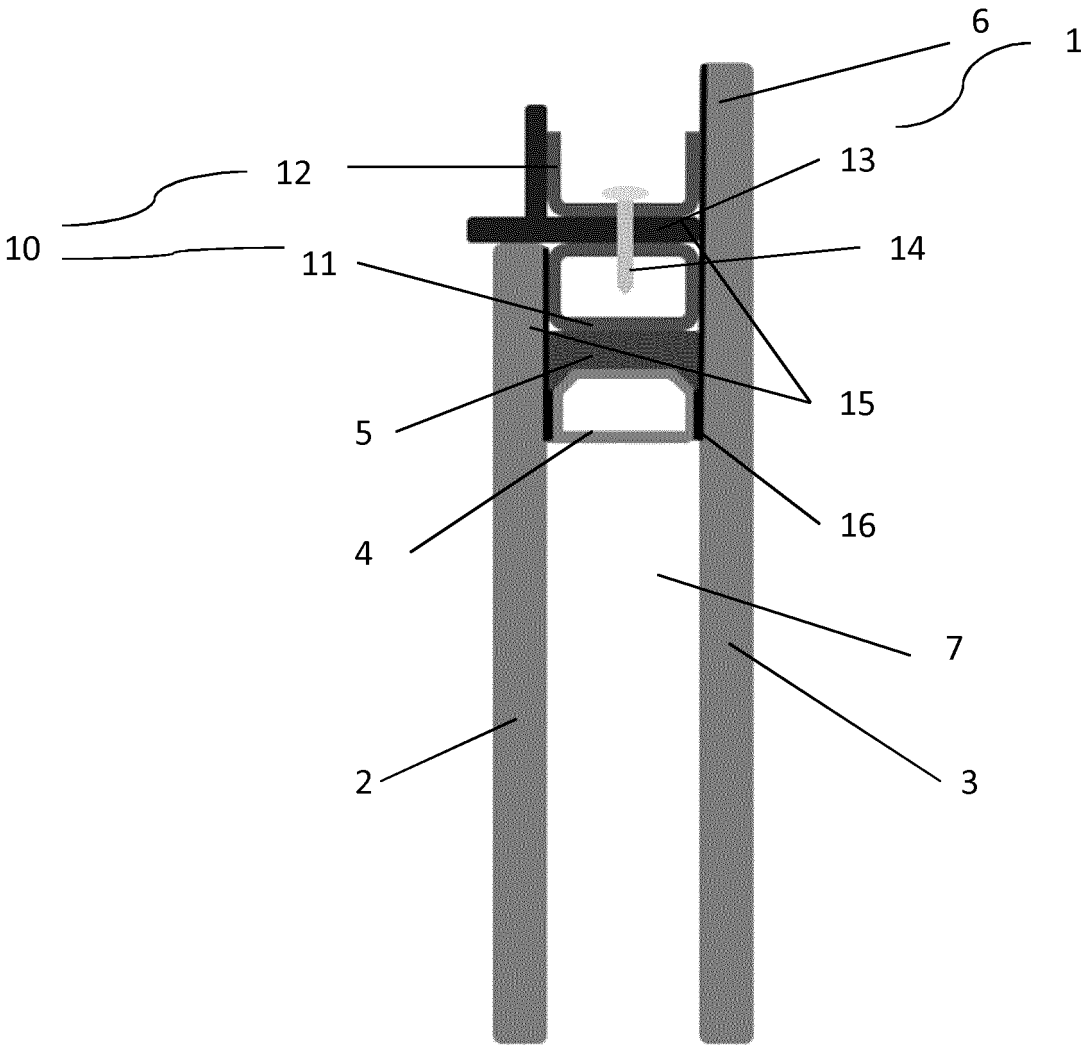

Figure 1

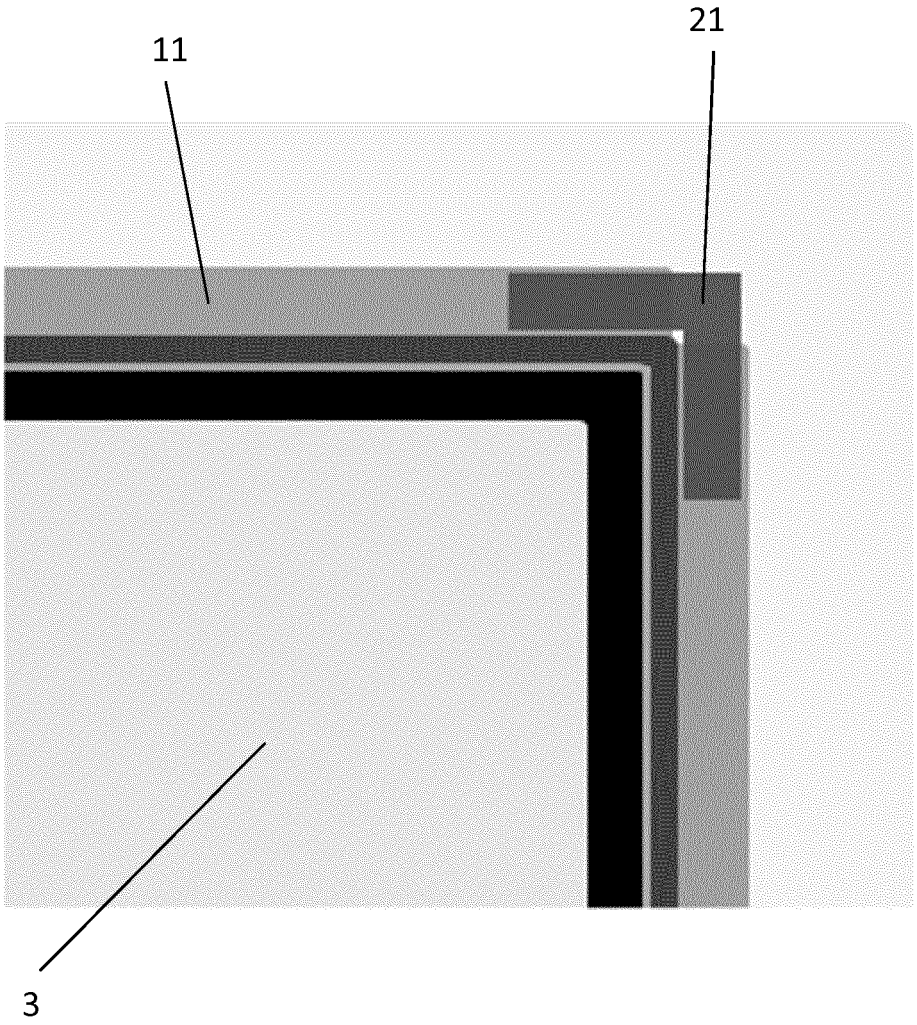

Figure 2

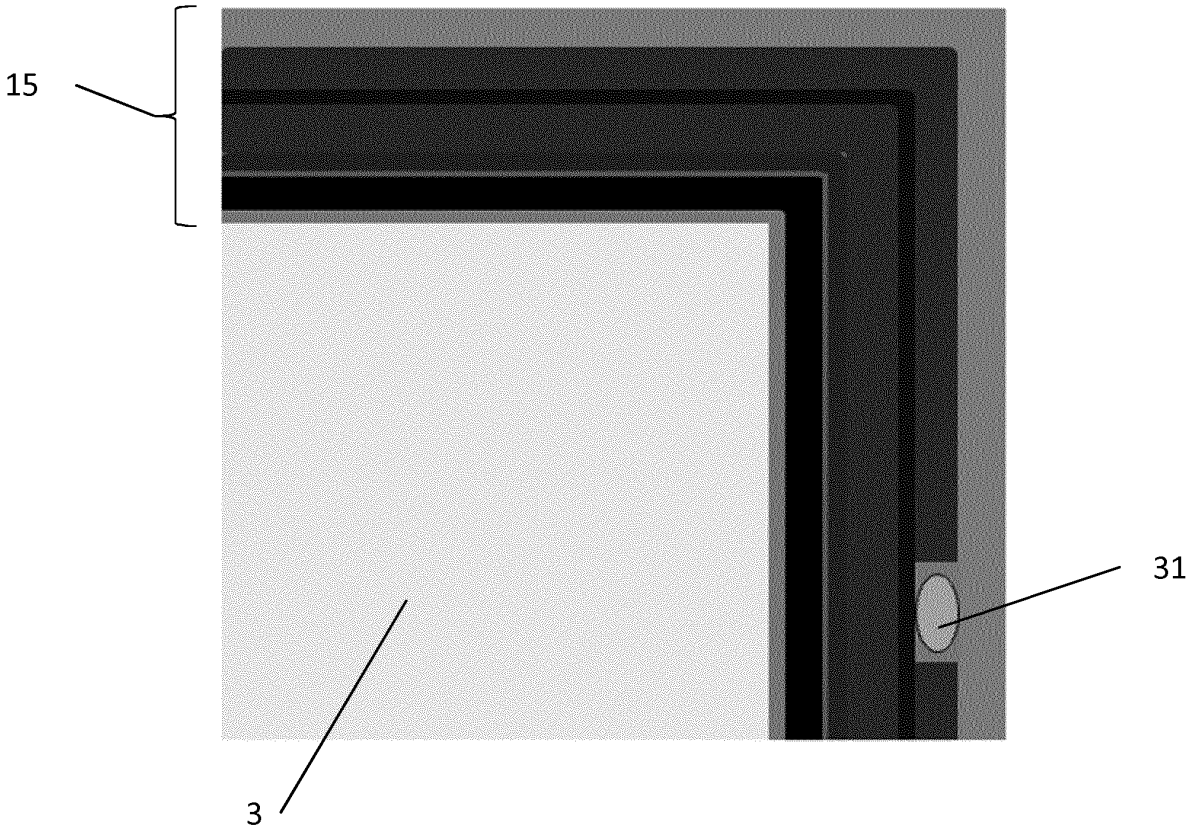

Figure 3

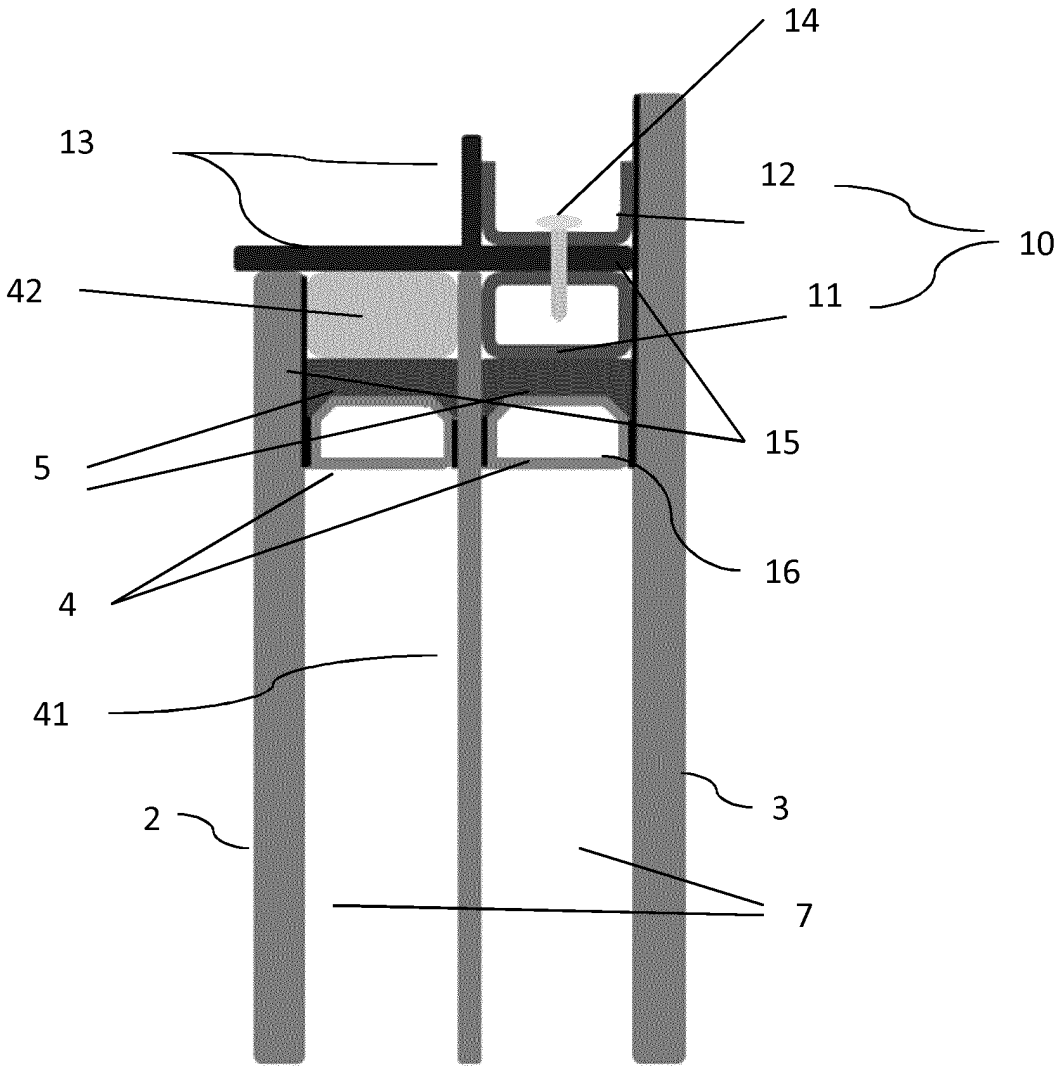

Figure 4

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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 9759

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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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	15 April 2014	Verdonck, Benoit

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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