

(19)



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11)

**EP 1 637 685 A2**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**22.03.2006 Bulletin 2006/12**

(51) Int Cl.:  
**E06B 3/20 (2006.01) E06B 3/58 (2006.01)**

(21) Application number: **05020079.9**

(22) Date of filing: **15.09.2005**

(84) Designated Contracting States:  
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR  
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI  
SK TR**  
Designated Extension States:  
**AL BA HR MK YU**

(30) Priority: **15.09.2004 DK 200401408**

(71) Applicant: **P.T.V. Holding ApS**  
**7500 Holstebro (DK)**

(72) Inventor: **Koldtoft, Kristian**  
**8310 Bedder (DK)**

(74) Representative: **Tellefsen, Jens J. et al**  
**Patrade A/S,**  
**Fredens Torv 3A**  
**8000 Aarhus C (DK)**

(54) **Window frame assembly**

(57) Window frame assembly made from profiles, where said assembly comprises a first outer frame adapted to be fastened to another building element and a second inner frame, which second frame is openable in relation to the first frame, and that said second frame com-

prises means for holding a window glass pane, for example double- or triple glazing window panes, where the panes are arranged in parallel at a certain distance, and that the distance is maintained by spacers, wherein the profiles are made from a composite material comprising fibres and a resin.

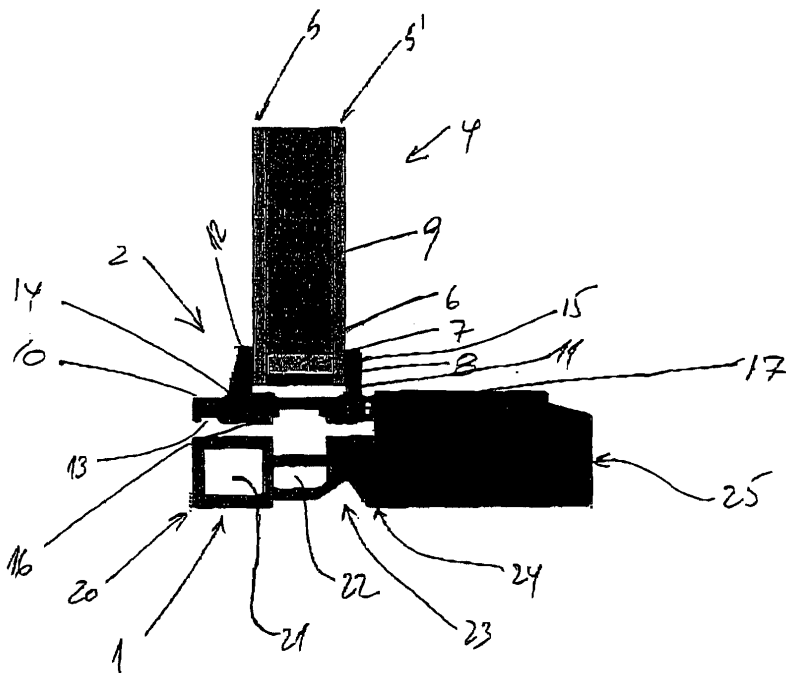


Fig 2

**EP 1 637 685 A2**

## Description

**[0001]** The present invention relates to a window frame assembly made from profiles. Window frame assemblies are well known in the art, for example made from wood, aluminium, plastic and the like. The assembly usually comprises an outer frame wherein means are provided for fastening the frame inside the opening provided in the building element, for example an outer wall. A second frame is provided inside the outer frame which second frame may be opened in relation to the first frame whereby it is possible to gain access to the outside or create ventilation through the openable window. Usually the first and second frames are connected by means of hinges and some type of handle device which usually also may function as a locking device such that the window may only be opened from one side.

**[0002]** A number of these types of products are on the market and come in a wide variety of materials, shapes and so forth.

**[0003]** One of the aspects which a number of these products try to improve and provide is improved insulation properties in that the cost of heating has increased dramatically and will probably keep rising in the future also. There is therefore a desire to be able to insulate houses better both with respect to the walls but especially with respect to window and door openings.

**[0004]** In order to create good insulation, it is necessary to attain a very low U-value which is a measure for the amount of energy transmitted through a member per square meter Kelvin ( $\text{W/m}^2\text{K}$ ). For typical so-called low energy windowpanes, the value U is around 1 or 1.1 to  $1.3 \text{ W/m}^2\text{K}$ . It is therefore widely regarded that the glass part of the window assembly has substantially attained the same insulating properties as what is obtainable for other constructional elements of a house. On the other hand, the frame assembly in which the glass is fitted, usually gives rise to an increased U-value such that the overall average for window openings will be higher than the value for the glass itself. This in turn implies that the insulating properties of a window assembly are less than the glass itself which in turn means that the frame gives rise to a lower insulation than what could be desired.

**[0005]** Another aspect in some regions of the world is to decrease the amount of sunlight coming in through the windows, especially when there are large exterior areas of the building covered by glass. The incoming sunlight also transmits a lot of heat into the interior of the building such that it is necessary to ventilate or use air condition in order to make the interior of such a building comfortable. It is also used to provide an exterior film which is heat reflective.

**[0006]** On the other hand, for other buildings where the relative glass area of the entire façade area of the building is less, it may be desirable to allow as much sunlight as possible through the window openings in order to use the energy provided by the sunlight for heating such that the passive heating of the sunlight may be uti-

lised instead of providing heating from other sources. This aspect is called the energy balance ( $E_{\text{ref}}$ ) and is for traditional type windows, using a traditional wooden frame construction, aluminium or plastic constructions with two or three layers of glass separated by either a vacuum or an argon-filled space in the range of -50 to  $-200 \text{ kWh/m}^2$ . With this property, it is true that the lower the value, i.e. minus -200 is very low, the less energy will be transmitted through the window. For the purposes where the window openings of the building façade only constitute a minor part of the entire area, it is desirable to have as high an  $E_{\text{ref}}$  as possible.

**[0007]** It is therefore an object of the present invention to provide a window frame assembly where the entire construction aims at providing as high an  $E_{\text{ref}}$  as possible and at the same time provide good insulating properties

**[0008]** The present invention addresses this by providing a window frame assembly where said assembly comprises a first outer frame adapted to be fastened to another building element and a second inner frame, which second frame is openable in relation to the first frame, and that said second frame comprises means for holding a window glass pane, for example double- or triple glazing window panes, where the panes are arranged in parallel at a certain distance, and that the distance is maintained by spacers, wherein the profiles are made from a composite material comprising fibres and a resin.

**[0009]** The use of composite material comprising fibres and resin makes it possible to make very shallow and thin profiles due to the high strength of the material. Furthermore, the material is substantially flexible such that the brittleness usually associated with high strength materials is, due to the composite material comprising resin and fibres transformed into a high strength material with a very ductile characteristic such that very shallow and thin profiles may be used for making the frames of the window frame assembly which at the same time fulfils the requirements to strength both for openable and non-openable window assemblies.

**[0010]** The composite material used within the present invention has very low heat conductivity capabilities which in particular when the material is shaped into relatively thin profiles, provides for very good insulation.

**[0011]** Furthermore, the composite material only exhibits minimal creep. PVC which is also used in manufacturing window frames will when exposed to the environment exhibit a relatively large degree of creep. Enough such that normally it is necessary to reinforce the PVC panels with steel brackets in order to counter this problem.

**[0012]** By using a strong composite material, a substantially larger effective area of the window opening is used for the glass panes of the window and thereby for letting in the energy and passive heating from the sunlight. Furthermore, as the U-value of the glass may be selected very low as explained above, the entire U-value of the complete window frame assembly including the glass may be maintained at a very low value substantially

close to 1 W/m<sup>2</sup>/K.

**[0013]** In this context, it is also contemplated that the composite profiles may be combined with timber profiles. This is particularly interesting on the side of the window frame which is to face the interior of the building in that for aesthetic reasons, it may be more desirable with a wood finish, and wood not exposed to the outside environment has a minimal maintenance requirement. At the same time, it is a relatively cheap material which exhibits good strength and insulating properties.

**[0014]** In a further advantageous embodiment of the invention, the extent of the frame in the plane of the window of the first and second frames is between 40 mm and 55 mm, more preferred between 43 mm and 48 mm and most preferred between 44 mm and 47 mm. By utilising the strong composite material including fibres and resin, it is possible to make very shallow and thin profiles. In the range of an entire frame assembly, ranging from 44 to 47 mm in respectively bottom, top and side profiles, only an area corresponding to substantially half of traditional frame constructions is needed. Furthermore, for frame constructions made from aluminium, it is necessary to design the profiles such that the thermal bridge created by the very high heat conductivity of aluminium is broken. If this is not broken, the energy balance between the outside and the inside will be severely effected in that the aluminium frame will tend to conduct substantial amounts of energy out through the profile. By designing these types of profiles such that the thermal bridge is disconnected, usually rather cumbersome profiles, i.e. profiles taking up a substantial amount of the available area of the window opening are provided. Furthermore, manufacturing such profiles incurs the extra costs of usually assembling two or more, different profiles around a core of high insulating material in order to disconnect the thermal bridge. The present invention, however, due to the composite material and the construction of the very shallow and thin profiles alleviates this as the composite material comprising the fibres and resin has very poor thermal conductive characteristics such that very good insulation properties are also provided by these profiles.

**[0015]** In a further advantageous embodiment of the invention, the energy balance  $E_{ref}$  for a window frame assembly comprising a window glass pane of the double glazing type having two parallel 4 mm float glass panes separated by 20 mm argon filled space, where said window glass pane is sealed, is higher than -35 kWh/m<sup>2</sup> and more preferred higher than -25 kWh/m<sup>2</sup> and most preferred higher than -20 kWh/m<sup>2</sup>. The described glass construction comprising two parallel panes of glass each having a thickness of 4 mm float glass separated by a 20 mm argon filled space is a traditional construction of so-called low energy window panes where the equivalent U-value is approximately 1.18 W/m<sup>2</sup>/K. The variation in the energy balance  $E_{ref}$  is affected by the choice of seal which is used to separate the glass pane and at the same time keep the distance between the two parallel glass panes of the window glazing.

**[0016]** When an aluminium construction such as for example sold under the trade name Bendtec is used, the  $E_{ref}$  for a window constructed according to the features of the present invention is approximately -30 kWh/m<sup>2</sup> whereas when a stainless steel seal is used, the  $E_{ref}$  is approximately equally to -23 kWh/m<sup>2</sup>, and the best results are achieved when the seal is a combined plastic and steel/metal foil seal such that a plastic member is introduced between the panes in order to keep the distance, and a steel/metal foil/tape is used in order to hermetically close the space between the two window panes. With this construction,  $E_{ref}$  is approximately -17 kWh/m<sup>2</sup>.

**[0017]** Traditional values according to the report "Heat loss of windows" (Vinduers varmetab) published by Thomas Kampmann, November 2001 by Rådvad Centeret, the  $E_{ref}$ -values for traditional constructions comparable to the constructions of the present invention, i.e. with the same type of window panes, when wood is used for the frame construction is in the interval depending on the design and type of wood from -65 to -200 kWh/m<sup>2</sup> and for traditional plastic profiles used for the window frame assembly even with three layers of glass, the best  $E_{ref}$ -values measured are approximately -50 kWh/m<sup>2</sup>.

**[0018]** The construction according to the present invention achieves an  $E_{ref} \approx +3$  kWh/m<sup>2</sup> with a glass pane having 3 layers separated by krypton gas ( $U=0.58$  8 W/m<sup>2</sup>k) whereas a standard double glazing ( $U=1.15$  W/m<sup>2</sup>k) would result in an  $E_{ref} \approx -18$  kWh/m<sup>2</sup>. Both values listed for a 1230x1480 mm window. The corresponding overall U-value for a construction according to the present invention is approximately 0.8 W/m<sup>2</sup>k. The window construction fulfils the requirements listed in Germany regarding insulation and light for a so-called "Passivhaus".

**[0019]** It is therefore evident that there is a substantial and much improved effect by utilising the inventive window frame assembly according to the present invention in comparison to other window frame assemblies.

**[0020]** In this context, it should be noted that all values refer to the combination of frames and glass panes.

**[0021]** The surprising effect of achieving a positive  $E_{ref}$  of approximately +3 indicates that for window sections constructed according to the inventive principles according to the invention, a possible contribution to the energy balance of a building is achieved. The testing, modelling and calculating were carried out by the Danish Technical University in accordance with Danish and European Building Code. The results achieved surpass previously tested constructions and the thresholds for insulating values set in the above mentioned code.

**[0022]** In order to further optimise the overall economy, the profiles are made by a pultrusion or an extrusion process. This facilitates a fairly economic way of mass producing the profiles which thereafter may be further processed into window frame assemblies.

**[0023]** In a still further advantageous embodiment of the invention, the fibres may be chosen among glass

fibres, carbon fibres, plastic fibres, preferably polypropylene or polyvinylchloride based fibres, either only one type of fibres or a mix of more types of fibres. The fibre materials whether they are glass, carbon or plastic fibres, provide extra ductility to the matrix where the strength-giving component is the resin. In this manner, a high strength material having a high ductility may be achieved which is suitable for producing the inventive window frame assembly according to the invention. The combination of high strength and high ductility makes it feasible to produce very shallow profiles which due to the fibre enforcement have a high strength and high ductility.

**[0024]** For some special purposes, it might be advantageous to mix different types of fibres in that for example carbon fibres are extremely strong in comparison to plastic fibres whereas plastic fibres may provide for better thermal expansion and contraction properties than the carbon fibres. Therefore, for some purposes, a mix of different fibre materials and fibres having different lengths may advantageously be used in the matrix.

**[0025]** The choice of materials within this invention also foresees that the frames may be readily treated with water based paints. This makes it possible to alter the appearance of the frames as desired for example in connection with the rest of the house being painted. Tests indicate that painting the inorganic surface in this manner may provide effective protection for up to 10 years or more. In comparison, wooden frames must be treated every 3-5 years.

**[0026]** Also in order to provide a strong but yet also economically interesting solution, the invention in a further advantageous embodiment provides for a frame construction where the second frame means for holding the window glass panes, is in the shape of two assembled sub-profiles, where a first sub-profile is of generally L-shape, such that one leg of the L optionally comprises a drip nose, and the other leg of the L comprises an integrated seal, adapted to seal against the glass, and a tongue or groove arranged outside the area where the glass is in contact with the L, and that the second sub-profile also is of generally L-shape, where one leg of the L extends a distance substantially corresponding to the thickness of the window pane and that a groove or tongue is arranged at the tip of the leg, for engagement with the corresponding tongue or groove arranged in the first sub-profile, and that the other leg on one side of the leg is adapted to be brought into contact with the window glass, and on the opposite is provided with a groove in which groove a seal may be arranged. In this manner, the second frame may very easily and very accurately be arranged around, the periphery of the window glass such that a very firm connection between the glass and the frame may be achieved and at the same time standardised frame profiles may be utilised such that by changing for example the first sub-profile, different presentations of the entire window frame assembly may be achieved at a very low cost.

**[0027]** The first outer frame provides the entire window frame assembly with its integrity and therefore needs to be made substantially stronger than the second frame. For this purpose, the first outer frame comprises a profile having at least one hollow substantially rectangular section, and that on the side of the profile which in use will be facing away from the second frame, one or more indentations are arranged, and that means may be provided on the side of the profile which in use is on the interior side of the window frame assembly, where said means are suitable for fastening an interior window frame or sill made from for example wood. As is true for most constructions, the strength of the material is provided substantially by the outer regions of the material. Therefore, the advantageous profiles according to the present invention may be produced with a hollow interior which does not affect the overall strength of the construction but on the other hand provides improved insulating properties and a light weight construction which during the fitting of the windows in the buildings provides further advantages.

**[0028]** The types of buildings where it is usually desirable to improve the passive energy influx from the sun are typically older houses and especially during renovation of the older house, it is advantageous to replace existing old-fashioned windows with the inventive window frame assembly according to the present invention. As the construction may be overall lighter, and that this type of work usually takes place from a scaffold, the overall handling of the windows by the personnel carrying out the work may be eased. Furthermore, as the window frame assemblies are made from composite materials which may be moulded or extruded into substantially any shape in that the integrity and interior strength of the materials are very high, traditional window designs may be contemplated with the present invention such that similar frame designs, only slimmer may be made according to traditional designs such that both the advantages of lighter overall windows and higher energy balance may be achieved.

**[0029]** Prototypes of the present window frame assembly has indicated that the overlap of the sub-profiles of the second frame profile may advantageously be maintained such that the legs of the L of the two sub-profiles adapted for engagement with the window glass, overlap the glass by 2 mm to 20 mm, more preferred 4 mm to 15 mm and most preferred 5 mm to 10 mm, and that the entire length of the overlapping legs of the L is from 10 mm to 40 mm, more preferred between 15 mm and 30 mm and most preferred between 18 mm to 25 mm. Therefore, in comparison to traditional window frame assemblies, the size of the inventive frame assemblies according to the invention is substantially reduced due to the use of the composite materials.

**[0030]** A further advantage with the present invention is the possibility to combine the composite profiles with timber/wood members.

**[0031]** Architects have a desire to create buildings with

larger and larger glass facades, and often without visible supports or support structures. The large, often 6x6 m or 6x15 m facade sections are due to building code requirements and lack of internal strength in the window panels and/or frames supported by steel structures. Although the steel structures are optimised, they often create aesthetic undesirable details. With the present invention, large facade sections of the type mentioned above may be created as independent self-carrying structures. This is done by maintaining the outer profiles made from a composite material and connecting these profiles with horizontal and vertical timber members, having a relatively slim cross section and thereby a relatively high moment of inertia in one direction. The slim profile does not affect the overall  $E_{ref}$  factor, and the architect therefore enjoys the large glass facade without interference from a steel construction, and at the same time, the window frame sections are strong enough to address the constructional requirements.

**[0032]** Depending on the process according to which the profiles are manufactured when the profiles are extruded or pultruded, other features may be added to the frames. Antennas may for example be embedded such that coreless control of the opening/closing of the windows may be facilitated or security systems may be embedded in the frames.

**[0033]** Also the material may be given special characteristics. For example, it is possible to add fire dampening agents to the material such that the overall frame construction may be fire rated in a higher protection class.

**[0034]** The invention will now be explained with reference to the accompanying drawing wherein

fig. 1 illustrates a traditional window construction, and  
fig. 2 illustrates a cross-section through an example of a window frame assembly.

**[0035]** In fig. 1, a traditional type "dannebrog" window is illustrated. This window design is widespread, especially in the Danish four to five storey apartment blocks built from approximately 1920 through 1960s and 1970s. The window comprises a window frame construction comprising a first outer frame 1 and a second inner frame 2. The inner frame is openable in relation to the outer frame 1 such that ventilation i.e. fresh air may be conveyed through the window. Means for opening the openable sections of the window are provided by the handles 3. Due to the very shallow construction of the window frame assembly according to the invention in the illustrated example, the second frame profile is so shallow that it is not possible to arrange the opening mechanism 3 on the frame which is usually the way in which this is done. For this purposes, the handles 3 may be attached to the glass itself according to the principle of the applicant's co-pending Danish utility model BA 2004 00197 which hereby is incorporated by reference.

**[0036]** A further advantage achieved for this particular design of window is the fact that the middle section sep-

arating the four openable sections of the window may be made substantially slimmer than the traditional constructions such that even better  $E_{ref}$ -values may be achieved than what is possible with traditional constructions of this type and such that the  $E_{ref}$ -values may be substantially higher than mentioned above when comparing the inventive window frame assembly with the traditional window frame assemblies.

**[0037]** Turning to fig. 2, a cross-section through a window frame assembly according to the present invention is illustrated. The window frame assembly comprises a first outer frame 1 and a second inner frame 2. In the second frame 2, a double glazing glass pane 4 is arranged. The glazing is made up of two sheets of float glass 5,5' arranged in parallel which are separated by a space element 6. The space element may advantageously as explained above be chosen as a plastic member 7 which is sealed off with a seal/metal foil 8 whereby the best  $E_{ref}$ -values are obtained. In the space between the two glass sheets 5, 5', a space 9 is provided. This space may advantageously be filled with an inert gas such as for example argon. The second frame 2 is made up of two sub-profiles 10,11. Both sub-profiles are of a generally L-shaped configuration. On the first sub profile 10, a groove 12 is provided in which a seal may be arranged for sealingly engaging the glass sheet 5. At the other leg of the L, when the sub-profile 10 is adapted for use in the lower part of the window, a drip nose 13 may be arranged. Additionally, a second groove 14 is provided which groove is adapted to receive a tongue 15 arranged in the second sub-profile 11.

**[0038]** The second sub-profile 11 is also of a generally L-shaped configuration such that one leg 15 of the L is adapted to overlap and engage the window glass 5' and the second leg 16 of the L substantially spans the distance between the two glass sheets 5,5' plus seals provided on either side between the L-shaped sections of the first and the second profiles 10,11. The second leg portion 16 of the second sub-profile 11 is provided with a tongue for engagement with the corresponding groove in the first sub-profile. In this manner, the two sub-profiles may be assembled in order to constitute the second inner frame in the window frame assembly.

**[0039]** The second sub-profile 11 may furthermore be provided with a groove 17 facing away from the plane of the window glass in which groove 17 a resilient seal may be arranged for closing the gap between the second inner frame and the first outer frame.

**[0040]** The first outer frame 1 comprises a first outer part which is of a substantially rectangular shape 20 surrounding a hollow interior space 21 which provides insulating properties. A further substantially rectangular hollow space 22 is provided in order to provide the necessary stiffness and size of the first outer frame in order to accommodate the second inner frame. An indentation 23 is provided along the outer edge of the first frame 1. This indentation 23 is provided in order to be able to insert a resilient flexible seal between the window frame assem-

bly and the building component into which the window to be arranged.

**[0041]** In this embodiment, the first frame is furthermore provided with means 24 for fitting an interior sill 25 in this example for example a wood sill such that from the interior, a traditional wooden appearance may be provided.

**[0042]** Although one specific example of the construction of the inventive window frame assembly has been explained in detail, the scope of the invention is only limited by the appended claims. In this connection, it should be noted that the composite material may be given any colour and that fillers or other materials may be introduced into the composite matrix in order to provide improved temperature ability or insulating properties.

## Claims

1. Window frame assembly made from profiles, where said assembly comprises a first outer frame adapted to be fastened to another building element and a second inner frame, which second frame is openable in relation to the first frame, and that said second frame comprises means for holding a window glass pane, for example double- or triple glazing window panes, where the panes are arranged in parallel at a certain distance, and that the distance is maintained by spacers, wherein the profiles are made from a composite material comprising fibres and a resin and that the energy balance  $E_{ref}$  for a window frame assembly comprising a window glass pane of the double glazing type having two parallel 4 mm float glass panes separated by 20 mm argon filled space, where said window glass pane is sealed, is higher than -35 kWh/m<sup>2</sup> and more preferred higher than -25 kWh/m<sup>2</sup> and most preferred higher than -20 kWh/m<sup>2</sup>.
2. Window frame assembly according to claim 1 **characterised in that** the extend of the frame in the plane of the window of the first and second frames is between 40 mm and 55 mm, more preferred between 43 mm, and 48 mm and most preferred between 44 mm and 47 mm.
3. Window frame assembly according to claim 1 or 2 **characterised in that** the profiles are made by a pultrusion or an extrusion process.
4. Window frame assembly according to claim 1, 2 or 3 **characterised in that** the fibres may be chosen among glass fibres, carbon fibres, plastic fibres, preferably polypropylene or polyvinylchloride based fibres, either only one type of fibres or a mix of more types of fibres.
5. Window frame assembly according to claim 1 or 2

**characterised in that** the resin is a polyester or epoxy based material, and that optionally fillers may be introduced in the material matrix.

6. Window frame assembly according to any preceding claim **characterised in that** the second frame means for holding the window glass panes, is in the shape of two assembled sub-profiles, where a first sub-profile is of generally L-shape, such that one leg of the L optionally comprises a drip nose, and the other leg of the L comprises an integrated seal, adapted to seal against the glass, and a tongue or groove arranged outside the area where the glass is in contact with the L, and that the second sub-profile also is of generally L-shape, where one leg of the L extends a distance substantially corresponding to the thickness of the window pane and that a groove or tongue is arranged at the tip of the leg, for engagement with the corresponding tongue or groove arranged in the first sub-profile, and that the other leg on one side of the leg is adapted to be brought into contact with the window glass, and on the opposite is provided with a groove in which groove a seal may be arranged.
7. Window frame assembly according to any of claims 1 to 6 **characterised in that** the first outer frame comprises a profile having at least one hollow substantially rectangular section, and that on the side of the profile which in use will be facing away from the second frame, one or more indentations are arranged, and that means may be provided on the side of the profile which in use is on the interior side of the window frame assembly, where said means are suitable for fastening an interior window frame or sill made from for example wood.
8. Window frame assembly according to claim 6 **characterised in that** legs of the L of the two sub-profiles adapted for engagement with the window glass, overlap the glass by 2 mm to 20 mm, more preferred 4 mm to 15 mm and most preferred 5 mm to 10 mm, and that the entire length of the overlapping legs of the L is from 10 mm to 40 mm, more preferred between 15 mm and 30 mm and most preferred between 18 mm to 25 mm.
9. Window frame assembly according to claim 1 wherein the energy balance  $E_{ref}$  for a window frame assembly comprising a window glass pane of the triple glazing type having three parallel 4 mm float glass panes separated by a krypton filled space, where said window glass pane is sealed, is higher than -5 kWh/m<sup>2</sup> and more preferred higher than -3 kWh/m<sup>2</sup> and most preferred higher than -1 kWh/m<sup>2</sup>.

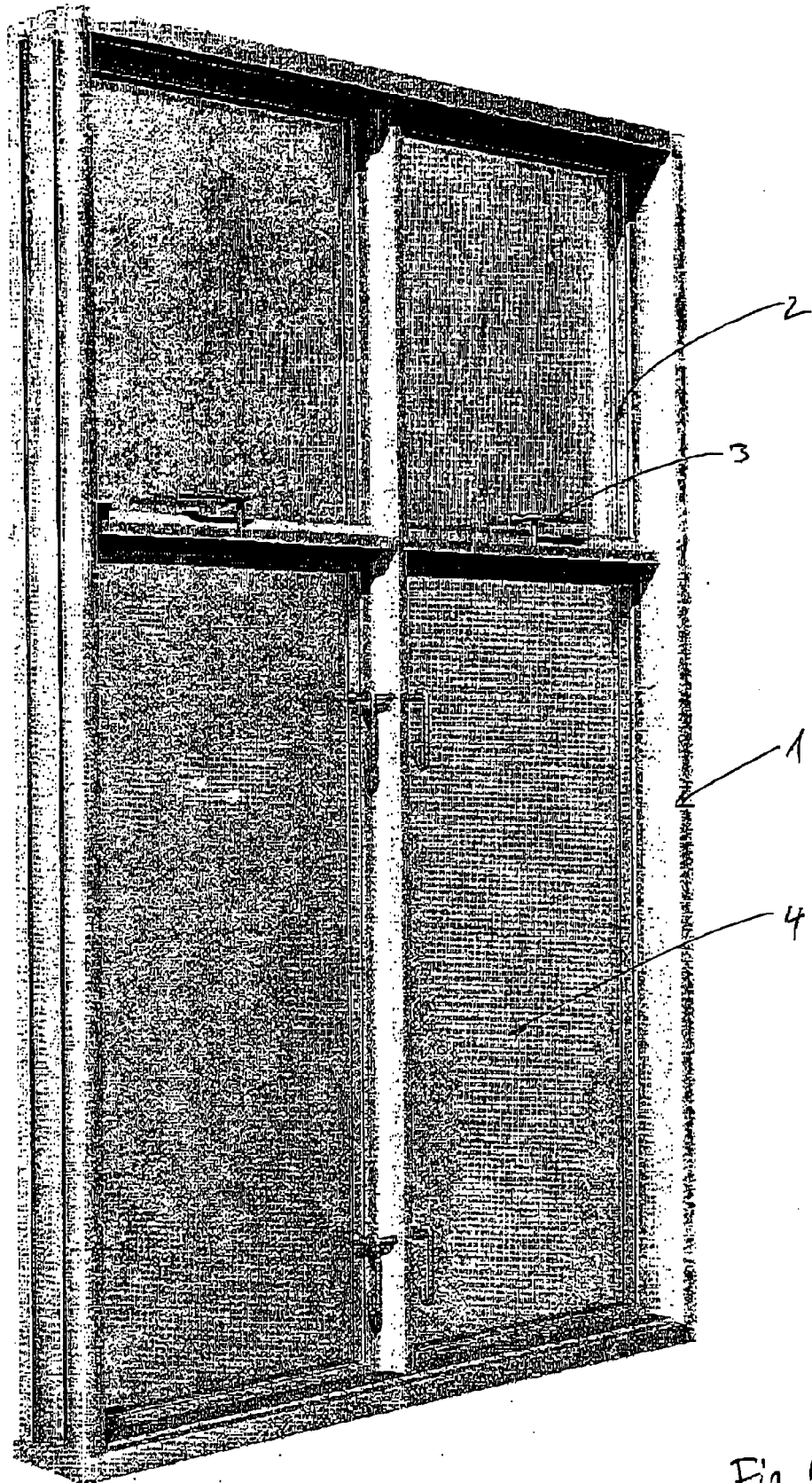


Fig 1

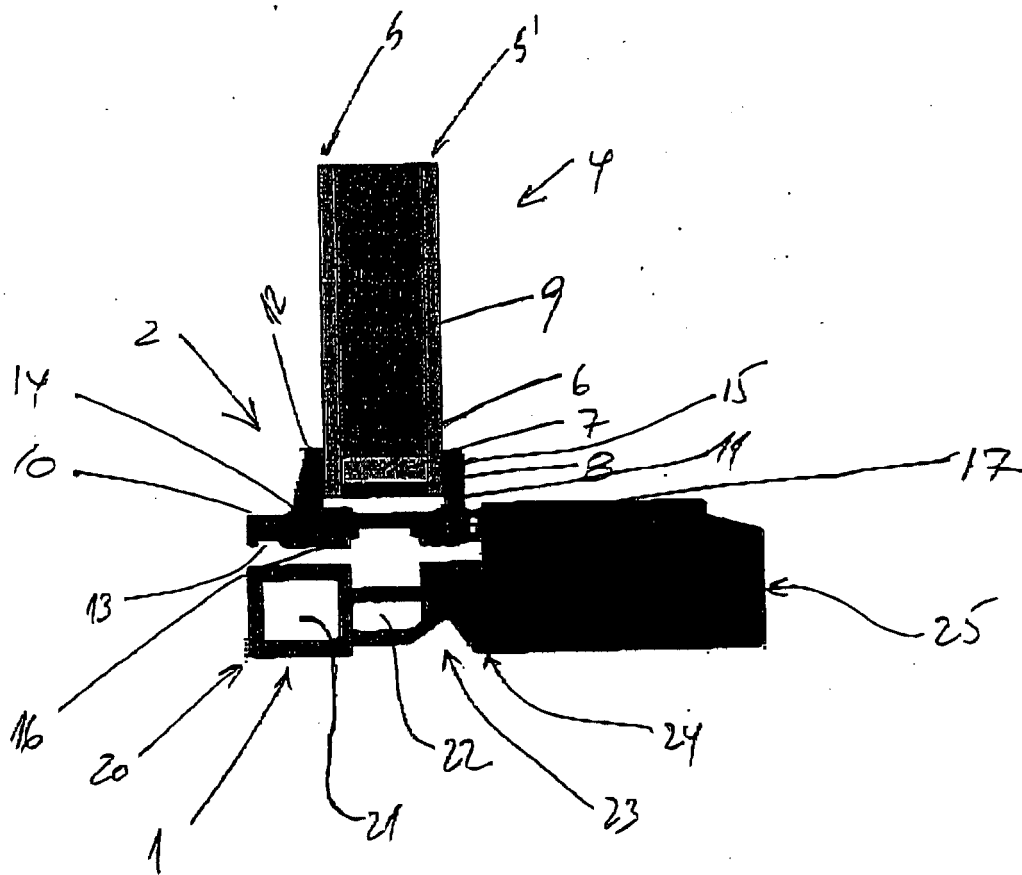


Fig 2