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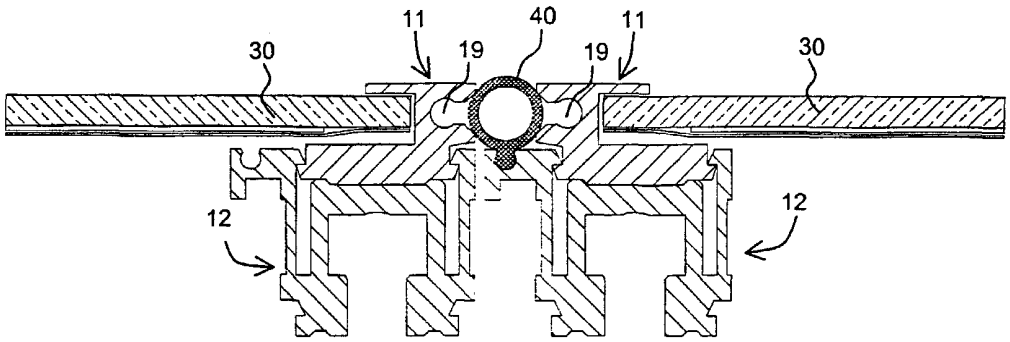
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(54) Title: FRAMING SYSTEM FOR FLAT PLATE PANELS



(57) Abstract: The invention concerns a framing system for photovoltaic modules, comprising a photovoltaic laminate and a frame surrounding the photovoltaic laminate on at least one of its edges. The frame comprises a first frame element (11) which is secured to the edge/s of the photovoltaic module (30) and a second frame element (12). The first frame element (11) comprises first integral attachment means and the second frame element (12) comprises second integral attachment means which attachment means allow the first frame element (11) and the second frame element (12) to be attached to each other in a snap-fit way. The invention also concerns a method for attaching a frame to a photovoltaic module (30) in which method the first frame element (11) being attached to at least one edge of the photovoltaic module (30), the second frame element (12) being attached to the first frame element (11) so that it extends essentially over the entire length of the first frame element (11) at the edge it is being secured to in a snap-fit way, and the framed photovoltaic module (30) being inserted into a mounting element (50) for the photovoltaic module (30).

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Framing system for flat plate panels

The invention relates to a framing system for photovoltaic modules, comprising a photovoltaic laminate and a frame surrounding the photovoltaic laminate on at least one of its edges.

The invention also relates to a method for attaching a frame to a photovoltaic module.

A photovoltaic module or a PV module consists of a photovoltaic laminate and a frame. PV laminate typically comprises a transparent front cover made of glass or plastic, an encapsulation layer, photovoltaic cells made of semiconductor material, a second encapsulation layer and a back protection layer made of glass, metal or plastic. The frame protects the edges of the PV laminate and in prior art PV modules also makes the structure of the PV module rigid. Shape of the PV modules is usually quadrangular, preferably rectangular.

It is known from the prior art that PV laminates are framed using a profile structure for protecting the laminate e.g. against wind loads and for providing a rigid structure e.g. for attachment to a roof, wall, or another mounting surface. Usually the PV module is attached to a separate mounting part, which is then attached to a roof or a wall of a building or to another structure. Mounting systems for frameless laminates are described in **EP 5025225** and **DE 4014200**. In **US 5571338** a frame structure consisting of several parts is represented. In **US 5740996** a multiple structure mounting system comprising a snap-fit attachment means for attaching the parts together is represented.

Typically the PV modules are framed with a profile, which surrounds the module on all four edges. The ends of the profile pieces are cut in each end into 45 degrees angle and the four pieces are then connected together with an edge piece or screws.

Profile pieces can also be cut straight and connected with screws together. In this case two types of profiles can be used and some machining is needed possibly in the end of the profiles. The function of the frame is to give edge protection to the PV glass laminate and also to give the necessary strength to the module to withstand transportation, handling and also the normal wind loads, storms and snow loads.

The disadvantage of these types of profile system is that in order to obtain strong enough structure with standard glass-tedlar PV modules the profile has to be thick enough, which adds depth to the module. In order to make the corner connection of the frame easily, the thickness of the profile has to be same on all edges or some machining is needed otherwise. This restricts the usability of the PV module in such mounting structures which are intended to be visually slim and flat. This feature is useful especially in BIPV applications (Building Integrated Photovoltaic), where PV modules are integrated in the building envelope. Another disadvantage of the prior art frame structure is that once the module has been framed the mounting options will be limited. Therefore it is expensive to add other features afterwards to the ready-made module. The module could be left without a frame in the manufacturing phase and framed when the usage of the module is known. This however is disadvantageous in the storage phase because frameless laminates need more care in storage and handling than framed PV modules.

The object of the present invention is to provide a novel framing system and method for photovoltaic laminates which solves the above mentioned problems.

It is a particular object of the present invention to provide a framing system for photovoltaic laminates in which the final rigidity of the frame is achieved by inserting another frame element.

It is a further particular object of the present invention to provide a framing system for photovoltaic laminates which has various mounting options.

It is a still further object of the present invention to provide a framing system for photovoltaic laminates which is easy to install.

In view of achieving the objectives stated above and those that will come out later, the system according to the invention is mainly characterized in that the frame comprises a first frame element secured to the edge/s of the photovoltaic module and a second frame element and that the first frame element comprises first integral attachment means and that the second frame element comprises second integral attachment means which first integral attachment means and second integral attachment means allow the first frame element and the second frame element be attached to each other in a snap-fit way.

The method according to the invention is mainly characterized in that it comprises the steps of:

- attaching the first frame element of the frame to at least one edge of the photovoltaic module,

- attaching the second frame element of the frame so that it extends essentially over the entire length of the first frame element at the edge it is being secured to in a snap-fit way, and

- inserting the photovoltaic module with the frame into a mounting element for the photovoltaic module.

According to the invention a PV laminate is framed at the manufacturing phase with a slim edge profile or a first frame element, which preferably surrounds the laminate in all four edges. The purpose of the first frame element is not to give the strength required at the final installation but only to protect the edges of the PV laminate from damage, moisture or contaminants. The strength is conferred by a second frame element, which is attached at the manufacturing or installation site by pressing it to

the backside of the first frame element essentially over its entire length. The second frame element is provided with flexible wings which fit to the corresponding counterparts in the edge profile. The edge profile and the second frame element are then attached to each other in a snap-fit way. A snap-fit assembly is an integral locking assembly between two parts where no other fastening means are needed. Parts to be secured to each other in a snap-fit way comprise locking means which provide the final attachment between the parts through their elastic deflection and recovery.

The second frame element makes the frame of the PV laminate strong and rigid and has other useful features as well. The second frame element is preferably provided with bolt grooves and sealing gasket grooves. The second frame element is preferably designed in such a way that several profile parts can be stacked on top of each other. This makes it possible to add more strength or thickness to the module if needed.

The flexible wings of the second profile are designed so that the slim profile frame and the second profile can be releasably detached from each other and changed to another type of a profile or a frame element if needed.

The framing system according to the invention makes it possible to choose which edges of the PV laminate are supplied with a strengthening profile and which are not, depending on the installation requirements. The required strength in the chosen edges is thus achieved with the second frame element.

The framing system according to the invention is very advantageous when mounting the PV module e.g. in a BIPV application as shown in Fig. 5. In Fig. 5 the module is slid into a horizontal mounting profile. The advantage of the use of the slim edge profile is that the horizontal profile of the mounting system can also be of smaller size. This reduces costs and keeps the distance of the module small from the mounting surface. Forces on the mounting screws or other attachment means secured

to the mounting surface decrease and therefore smaller screws can be used. However, the slim frame does not give high enough wind load resistance and the required strength is achieved by attaching the second profile on the backside of the long edges of the PV module. The additional depth of the module caused by the strengthening part of the frame does not increase the total mounting structure depth because it fits in the space behind the PV module needed for the mounting profile. According to the invention the module does not have to be supported on all four edges by the mounting support system. The mounting method according to the invention makes the installation and maintenance fast and easy. The module can be easily removed by lifting it up, tilting it and taking it out, without touching the other modules.

In the following, the invention will be described in detail with reference to the figures in the accompanying drawing, the invention being, however, by no means strictly confined to the details of said embodiments or variations.

Figure 1A is a cross-section illustration of a first frame element and a second frame element of the framing system according to the invention.

Figure 1B and 1C are cross-section illustrations showing the first frame element connected to the second frame element which is connected to another second frame element of the framing system.

Figure 2 is a cross-section illustration of the framing system according to the invention showing two PV modules installed next to each other.

Figure 3 is a cross-section illustration of a PV module attached to a mounting element.

Figure 4 is a side view of the PV module installation showing the second part of the framing system supporting the vertical side of the PV module.

Figure 5 shows an example of mounting PV modules to a wall.

Figure 1A shows the cross-section of the slim profile of the first frame element 11 and the second frame element 12 of the framing system 10 according to the invention. The first frame element 11 is preferably a partial U-shaped piece comprising a groove 13, into which a PV laminate is mounted, and attachment lugs $14a_1$ and $14a_2$ for a snap-fit attachment to the second frame element 12. A PV laminate is preferably framed on all of its sides by the first frame elements 11. However, if needed, some of the edges can be left without framing.

The second frame element 12 is a profile structure which comprises a body section 120 which extends to flexible wings $15a_1$, $15a_2$. The flexible wings $15a_1$, $15a_2$ have snap-fit attachment means $16a_1$ and $16a_2$, respectively, acting as counterparts for the attachment lugs $14a_1$ and $14a_2$ of the first frame element 11. The body section 120 is provided with lugs $140a_1$ and $140a_2$ acting as counterparts for attachment means$16a_1$ and $16a_2$ thus enabling a snap-fit attachment between two second frame elements 12 stacked on each other. The body section 120 is preferably U-shaped serving as a bolt base for an optional bolt installation of the PV module.

The snap-fit attachment lugs $14a_1$ and $14a_2$ are preferably symmetrical as well as the snap-fit attachment means$16a_1$ and $16a_2$ so that two second parts can be attached to each other in a way shown in Fig. 1B or 1C. The second frame element 12 has preferably an extension 150 which is provided with a groove 17 suitable e.g. for attaching a sealing gasket to make the PV module installation leakproof. The extension 150 can be attached to the wings $15a_1$ and/or $15a_2$ and/or to the body section 120.

The second frame element 12 is made of a homogeneous material such as aluminium or a non-homogeneous material such as fiberglass. The second frame element 12 can also be made of two or more different materials e.g. so that the flexible wings

$15a_1$, $15a_2$ are of a less rigid material than the other structures of the second frame element 12. Flexible wings $15a_1$, $15a_2$ are in any case integral parts of the second frame element 12.

Figure 2 shows a cross-section C-C marked in Fig. 5 of the framing system according to the invention. Fig. 2 shows two PV modules 30 installed next to each other. In this embodiment first frame elements 11 of the PV modules 30 are separated from each other by a sealing gasket 40 which prevents the structures behind the modules from moisture or dirt. The sealing gasket 40 is attached into a groove 17 in the second frame element 12 of the framing system 10. The first frame element 11 also has groove 19 in this embodiment for an optional sealing gasket installation. Groove 19 may have other functions as well like serving as a base for screw heads.

Figure 3 shows another preferable embodiment of the framing system according to the invention. In Fig. 3 shown is a cross-section A-A marked in Fig. 5 illustrating a PV module 30 attached to a mounting element 50. The first frame element 11 is supported by a mounting element 50 at two of its ends. The second frame element 12 is not needed in those edges of the PV module 30 that are against the mounting element 50, which in this case gives the strength needed for those edges.

Figure 4 shows a side view B marked in Fig. 5 of the PV module installation. Fig. 4 shows the second part 12 of the framing system 10 supporting the side of the PV module 30. The second frame element 12 comprises one uniform profile piece which is preferably installed at the vertical side of the PV module 30 and it covers essentially the total length of the PV module 30. However, the second frame element 12 can be slightly shorter than the first frame element 11 due to the space needed by the mounting element 50 at the ends of the first frame element 11 as shown in Fig. 4. This does not essentially effect the strength of the structure. The vertical side of the PV module 30 can be either the long or the short side of the module depending on the way the module is to be mounted.

Figure 5 shows an example of PV modules mounted to a wall 62. The mounting system comprises horizontal mounting profiles 60 attached to vertical support bars 61 or to the wall 62. The PV modules 30 provided with the framing profile 10 according to the invention is slid into grooves in the mounting profiles 60. An air gap 63 is formed between the PV modules 30 and the wall 62.

In the following, the patent claims will be given, and various details of the invention may show variation within the scope of the inventive idea defined in the patent claims and differ from the details disclosed above for the sake of example only.

Patent claims

1. A framing system for photovoltaic modules, comprising a photovoltaic laminate and a frame surrounding the photovoltaic laminate on at least one of its edges, **characterized** in that the frame (10) comprises a first frame element (11) secured to the edge/s of the photovoltaic module (30) and a second frame element (12) and that the first frame element (11) comprises first integral attachment means and that the second frame element (12) comprises second integral attachment means which first integral attachment means and second integral attachment means allow the first frame element (11) and the second frame element (12) be attached to each other in a snap-fit way.

2. A framing system for photovoltaic modules according to claim 1, **characterized** in that the first frame element (11) and the second frame element (12) of the frame (10) of the photovoltaic module (30) are profile structures.

3. A framing system for photovoltaic modules according to claim 1 or 2, **characterized** in that the second frame element (12) of the frame (10) is extended essentially over the entire length of the first frame element (11) at the edge it is being secured to thus providing required strength to the frame (10).

4. A framing system for photovoltaic modules according to any of claims 1-3, **characterized** in that the first frame element (11) of the frame (10) of the photovoltaic module (30) comprises attachment lugs ($14a_1$, $14a_2$) for attaching the first frame element (11) in a snap-fit way to the second frame element (12) or to another profile or structure.

5. A framing system for photovoltaic modules according to any of claims 1-4, **characterized** in that said second frame element (12) comprises a body section (120), flexible wings ($15a_1$, $15a_2$) and attachment lugs ($140a_1$, $140a_2$).

6. A framing system for photovoltaic modules according to any of claims 1-5, **characterized** in that said second frame element (12) comprises attachment means ($16a_1$, $16a_2$) for attaching the second frame element (12) to the attachment lugs ($14a_1$, $14a_2$) of said first frame element (11) or to another second frame element (12) in a snap-fit way.

7. A framing system for photovoltaic modules according to any of claims 1-6, **characterized** in that the attachment lugs ($14a_1$, $14a_2$) of the first frame element (11) are releasably attached to the attachment means ($16a_1$, $16a_2$) of said second frame element (12).

8. A framing system for photovoltaic modules according to any of claims 1-7, **characterized** in that the thickness of the flexible wings ($15a_1$, $15a_2$) is structured in a way that they are flexible for the snap-fit attachment.

9. A framing system for photovoltaic modules according to any of claims 1-8, **characterized** in that the second frame element (12) comprises a groove (17) for attaching a sealing gasket (40) to make the PV module installation leakproof.

10. A framing system for photovoltaic modules according to any of claims 1-9, **characterized** in that the first frame element (11) comprises a groove (19) for attaching a sealing gasket (40).

11. A framing system for photovoltaic modules according to any of claims 1-10, **characterized** in that groove (17; 19) is arranged to serve as a base for screw heads.

12. A framing system for photovoltaic modules according to any of claims 1-11, **characterized** in that the body section (120) of the second frame element (12) is arranged to serve as a bolt base.

13. A framing system for photovoltaic modules according to any of claims 1-12, **characterized** in that the second frame element (12) is constructed of homogeneous material, such as aluminium.

14. A framing system for photovoltaic modules according to any of claims 1-13, **characterized** in that the second frame element (12) is constructed of non-homogeneous material, such as fiberglass.

15. A framing system for photovoltaic modules according to any of claims 1-14, **characterized** in that the second frame element (12) is constructed of two or more materials.

16. A method for attaching a frame to a photovoltaic module, **characterized** in that it comprises the steps of:

- attaching the first frame element (11) of the frame (10) to at least one edge of the photovoltaic module (30),

- attaching the second frame element (12) of the frame (10) so that it extends essentially over the entire length of the first frame element (11) at the edge it is being secured to in a snap-fit way, and

- inserting the photovoltaic module (30) with the frame (10) into a mounting element (50) for the photovoltaic module (30).

17. A method according to claim 16, **characterized** in the first frame element (11) of the frame (10) being attached to the photovoltaic module (30) at the manufacturing plant of the photovoltaic modules.

18. A method according to claim 16 or 17, **characterized** in the second frame element (12) of the frame (10) being attached to the first frame element (11) of the frame (10) at the manufacturing plant of the photovoltaic modules.

19. A method according to claim 16 or 17, **characterized** in the second frame element (12) of the frame (10) being inserted to the first frame element (11) of the frame (10) of the photovoltaic module at the installation site.

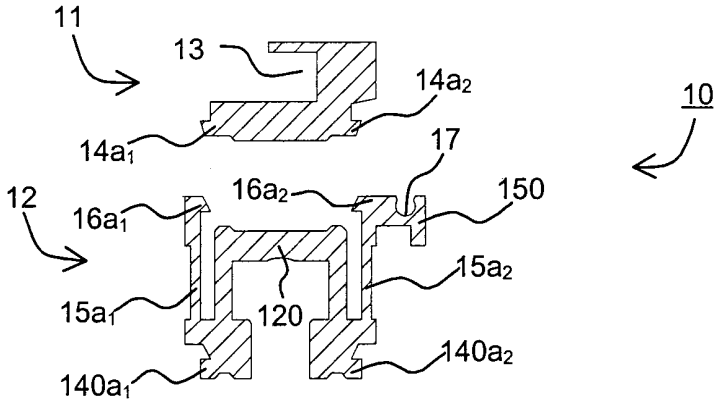


FIG. 1 A

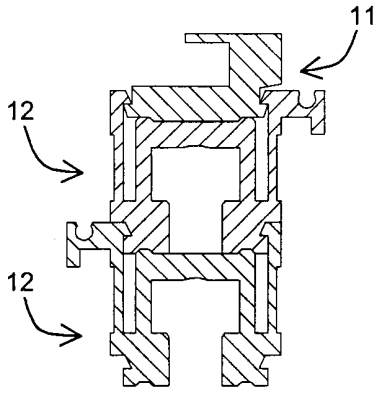


FIG. 1 B

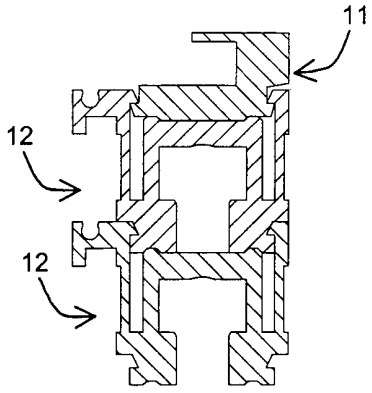


FIG. 1 C

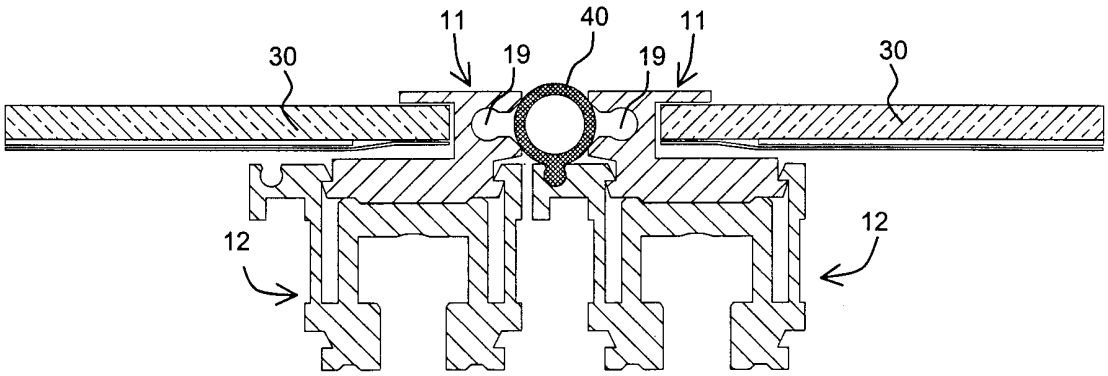


FIG. 2

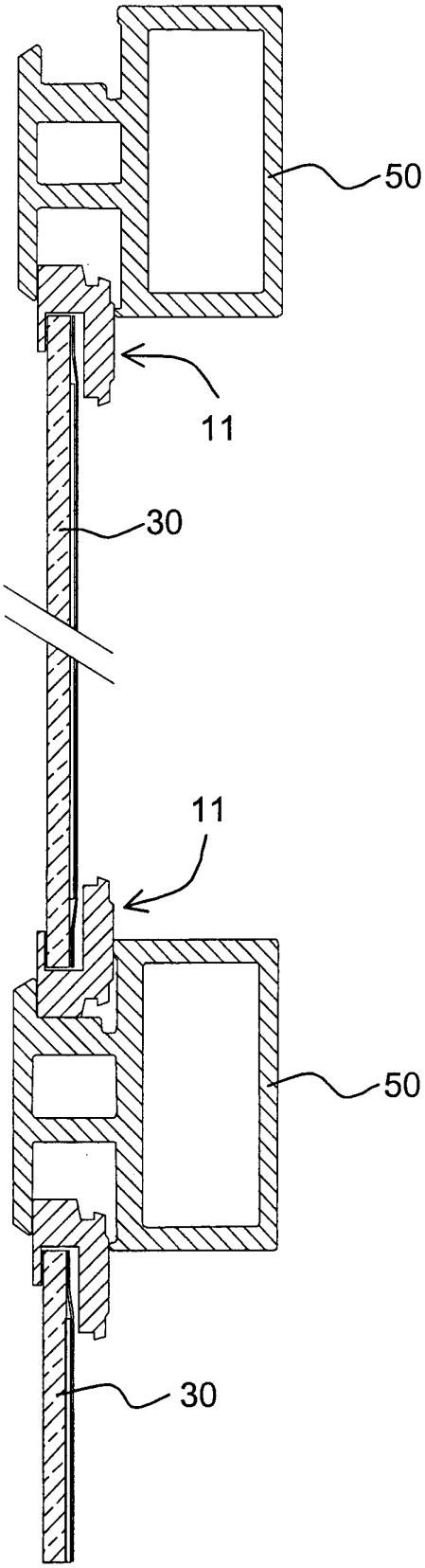


FIG. 3

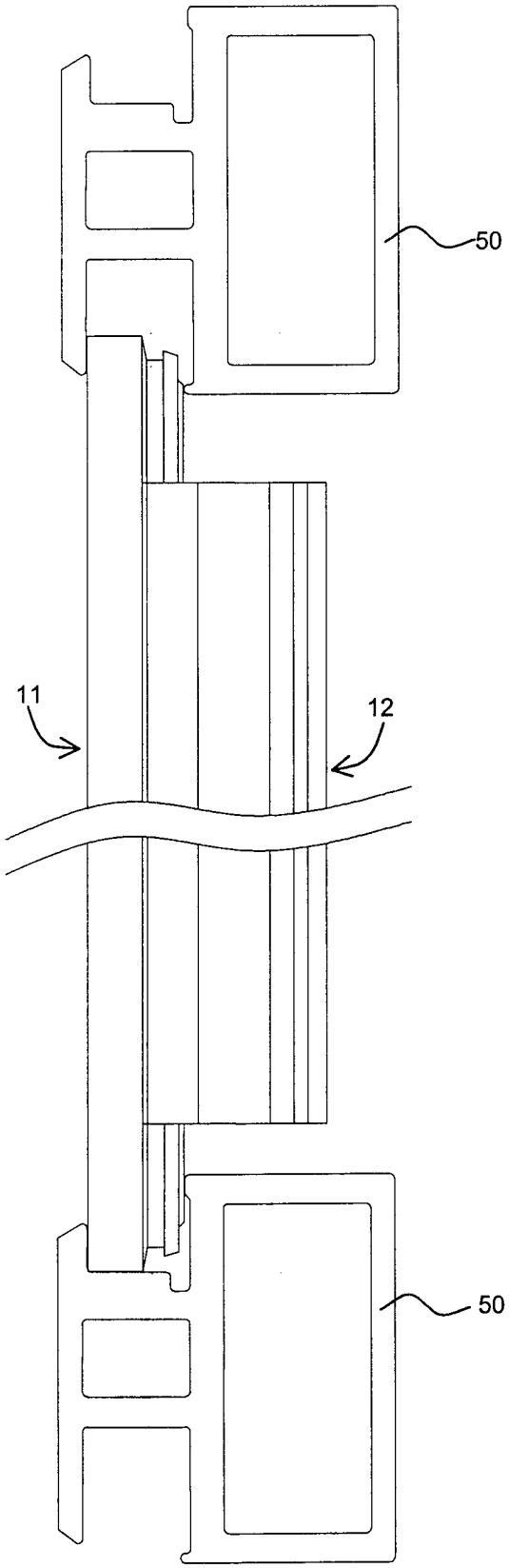


FIG. 4

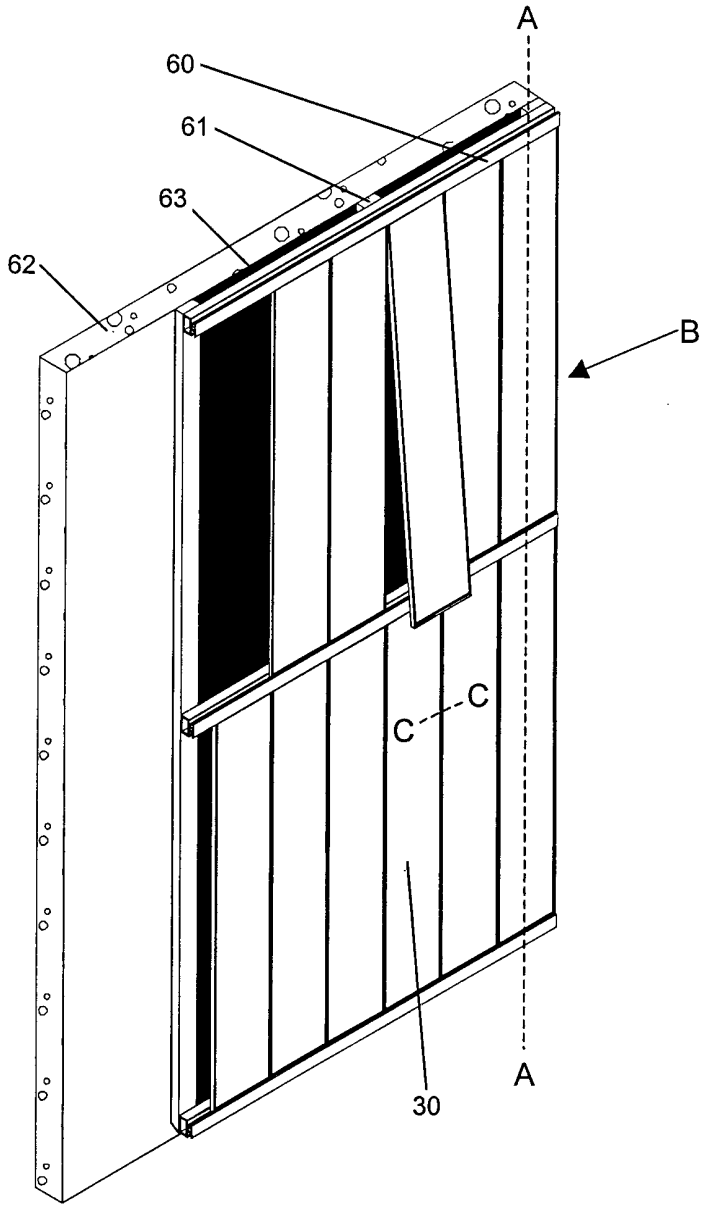


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00601

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H01L 31/042, F24J 2/52 // E04D 13/18
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H01L, F24J, E04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0905795 A2 (MATSUSHITA ELECTRIC WORKS, LTD.), 31 March 1999 (31.03.99), figures 5,6,10,11	1-19
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X	WO 9917063 A1 (WISMETH, W.), 8 April 1999 (08.04.99), figures 1-3	1-4,6,7, 12-19
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A	US 5571338 A (N. KADONOME ET AL), 5 November 1996 (05.11.96), figures 19-21	1-19
	--	
A	US 5740996 A (G. GENSCHOREK), 21 April 1998 (21.04.98), figure 3	1-19
	--	

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 October 2000	10 -10- 2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Jan-Axel Ylivainio / MRo Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/FI 00/00601

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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