



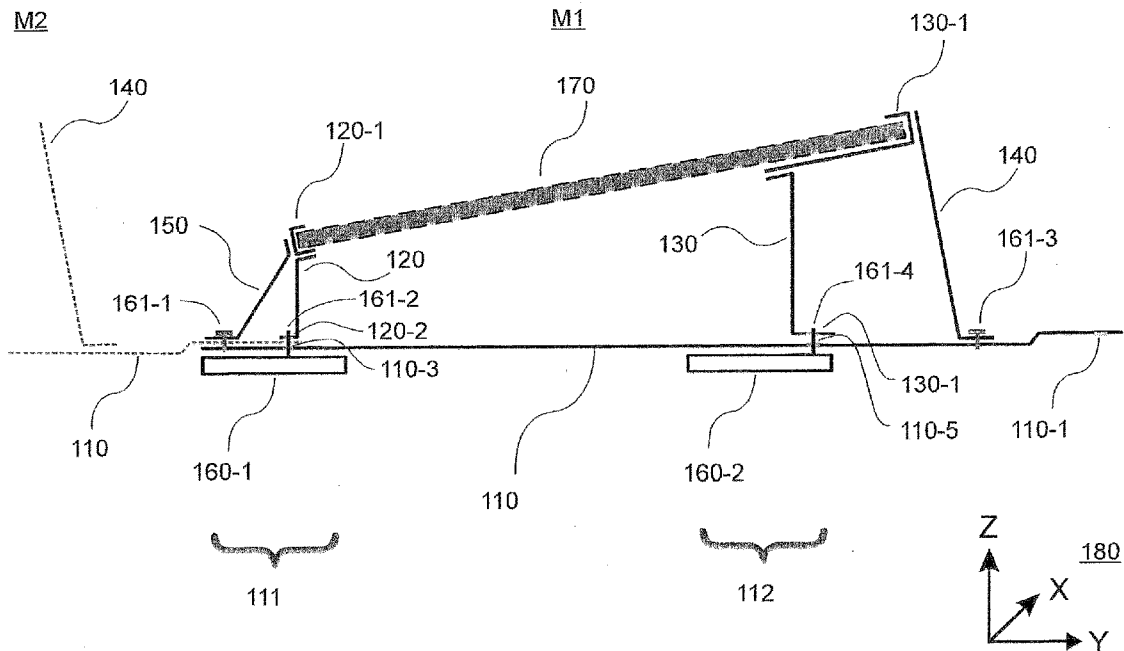
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(19) **United States**(12) **Patent Application Publication**
Kosslinger et al.(10) **Pub. No.: US 2011/0277400 A1**(43) **Pub. Date: Nov. 17, 2011**(54) **ROOF MOUNTING SYSTEM FOR SOLAR
MODULES**(75) Inventors: **Markus Kosslinger**, Friesenried
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Friesenried (DE)(21) Appl. No.: **13/126,255**(22) PCT Filed: **May 26, 2009**(86) PCT No.: **PCT/EP2009/003707**§ 371 (c)(1),
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E04D 13/18 (2006.01)(52) **U.S. Cl. 52/173.1**(57) **ABSTRACT**

The invention relates to a modular, self-supporting mounting system for mounting an arbitrary number of flat modules (170) on flat roofs, wherein the modular, self-supporting mounting system comprises at least one base element for mounting a single flat module (170), wherein the base element comprises the following: a first and second module strut (110) disposed in parallel next to each other; a first and second front module support (120) having a first length, wherein a first end of the first front module support (120) is attached to a first area (111) of the first module strut (110), and wherein a first end of the second front module support (120) is attached to a first area (111) of the second module strut (110); a first and a second rear module support (130) having a second length, wherein a first end of the first rear module support (130) is attached to a second area (112) of the first module strut (110), wherein a first end of the second rear module support (130) is attached to a second area (112) of the second module strut (110); wherein the first length is greater than the second length, and wherein the second ends of the first and second, front and rear module supports (120, 130) are provided for attaching the flat module (170), so that the flat module (170) forms a prescribed angle to the module struts (110), said angle being defined by the first and second length and greater than zero; a front cover (150) covering the space between the two front module supports (120);



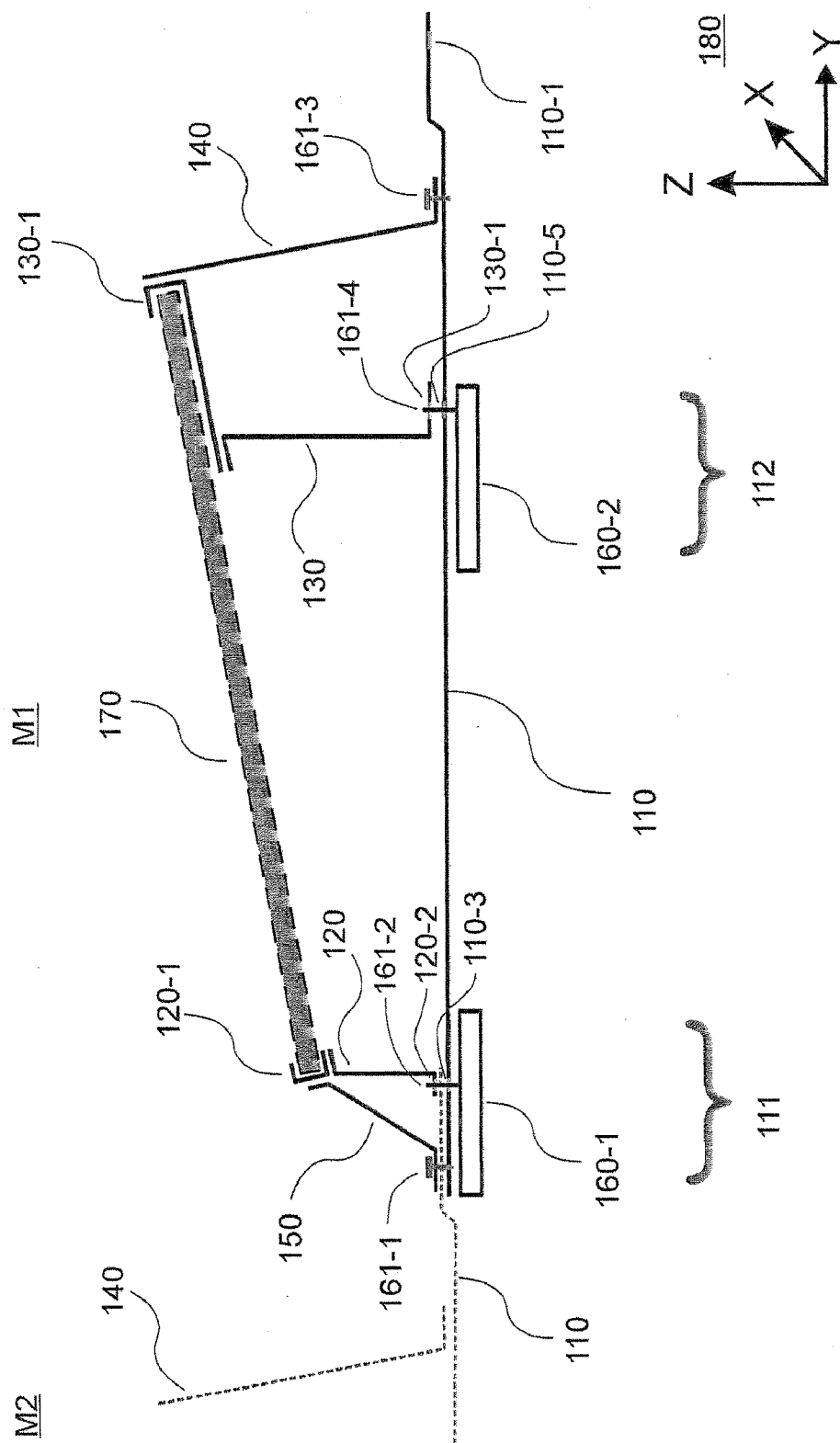


Fig. 1

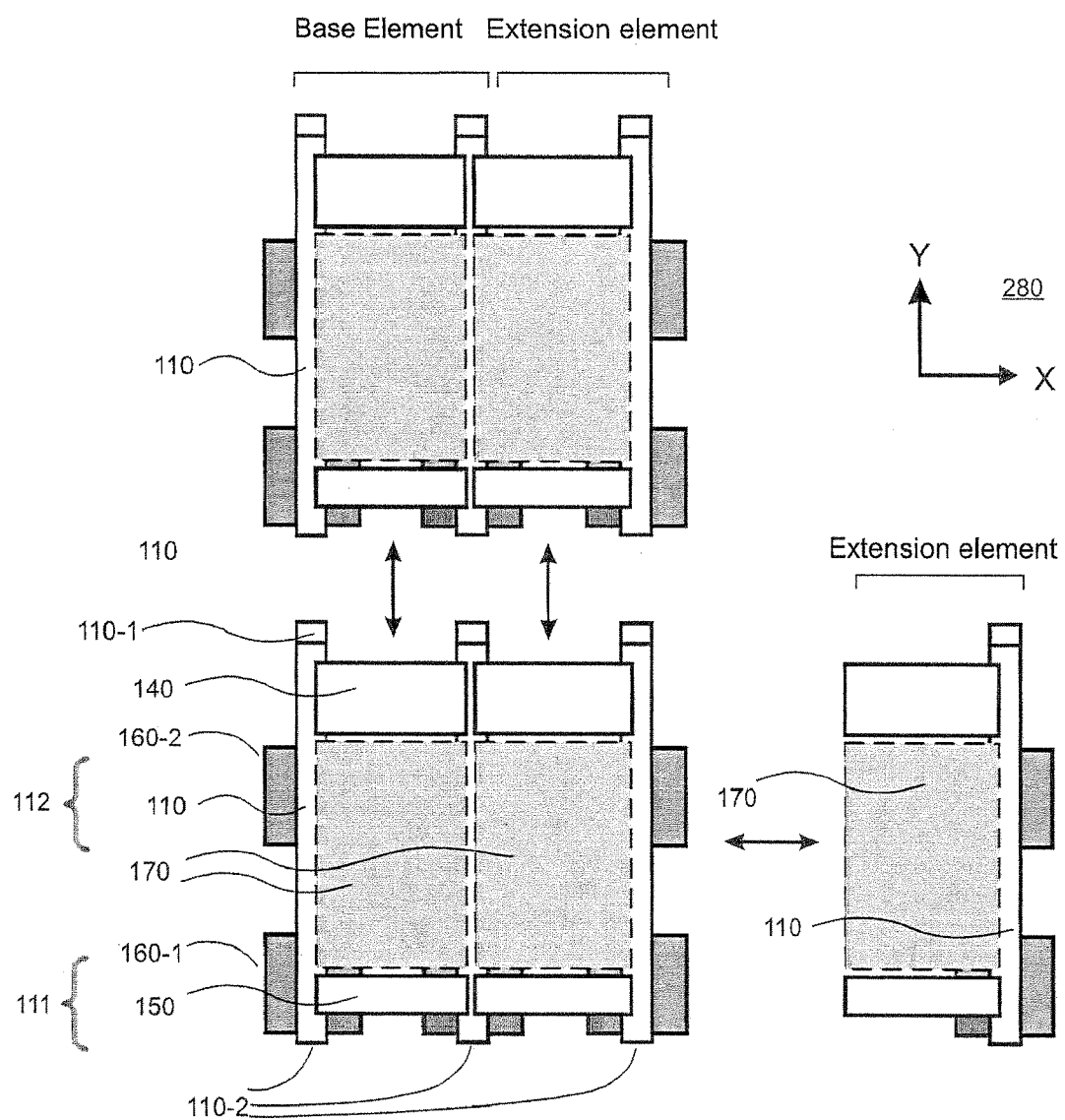


Fig. 2

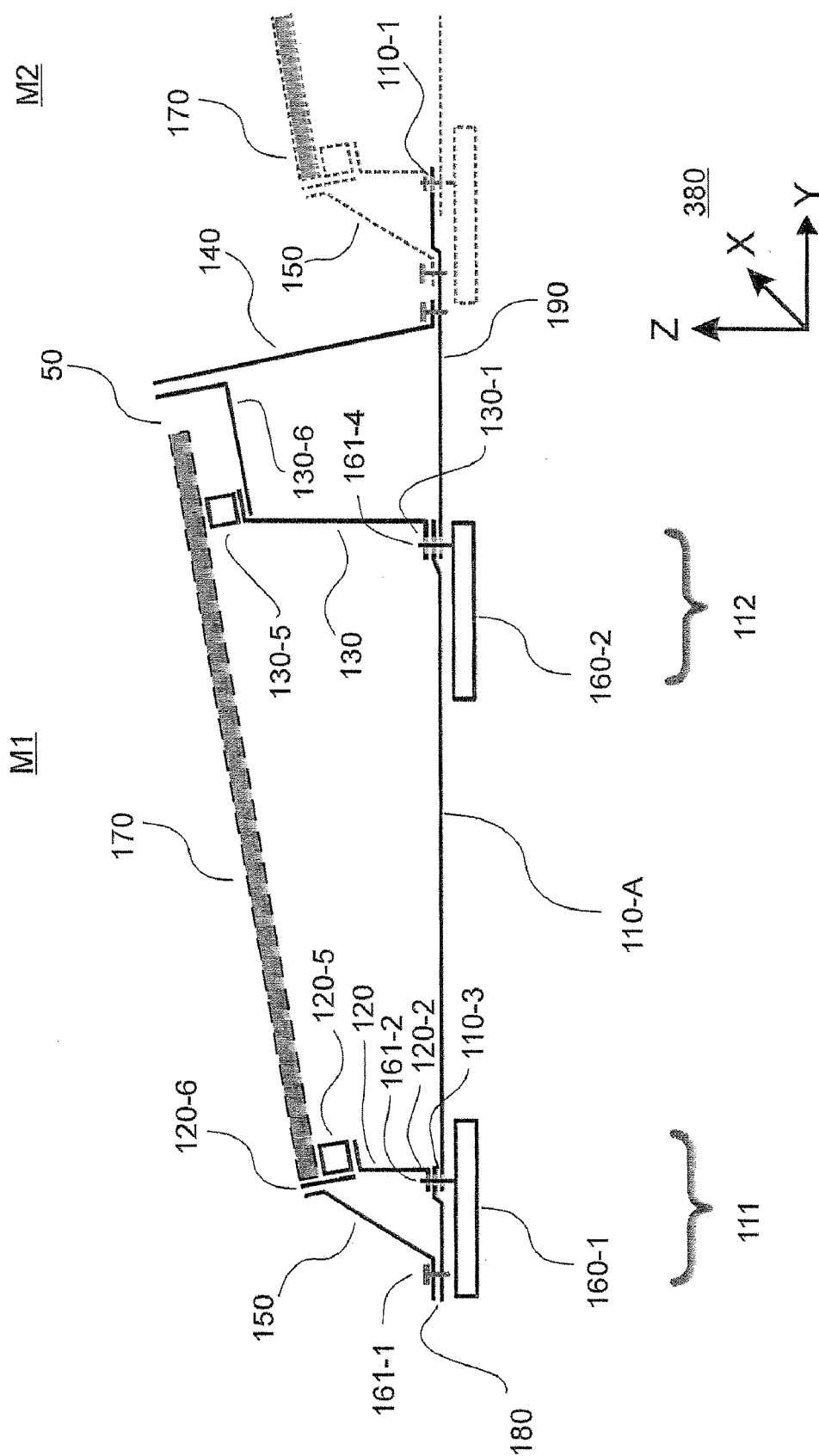


Fig. 3

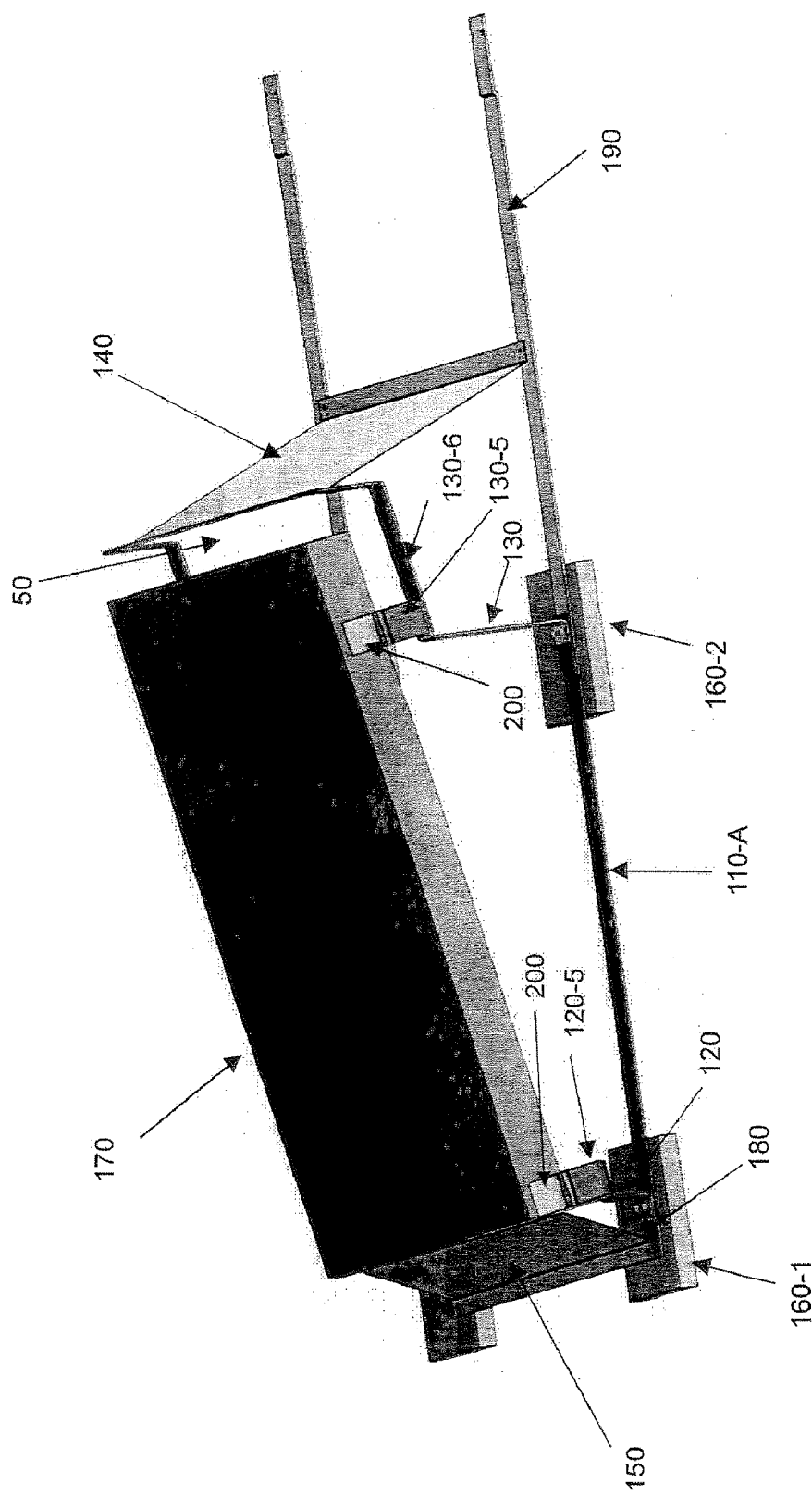


Fig. 4

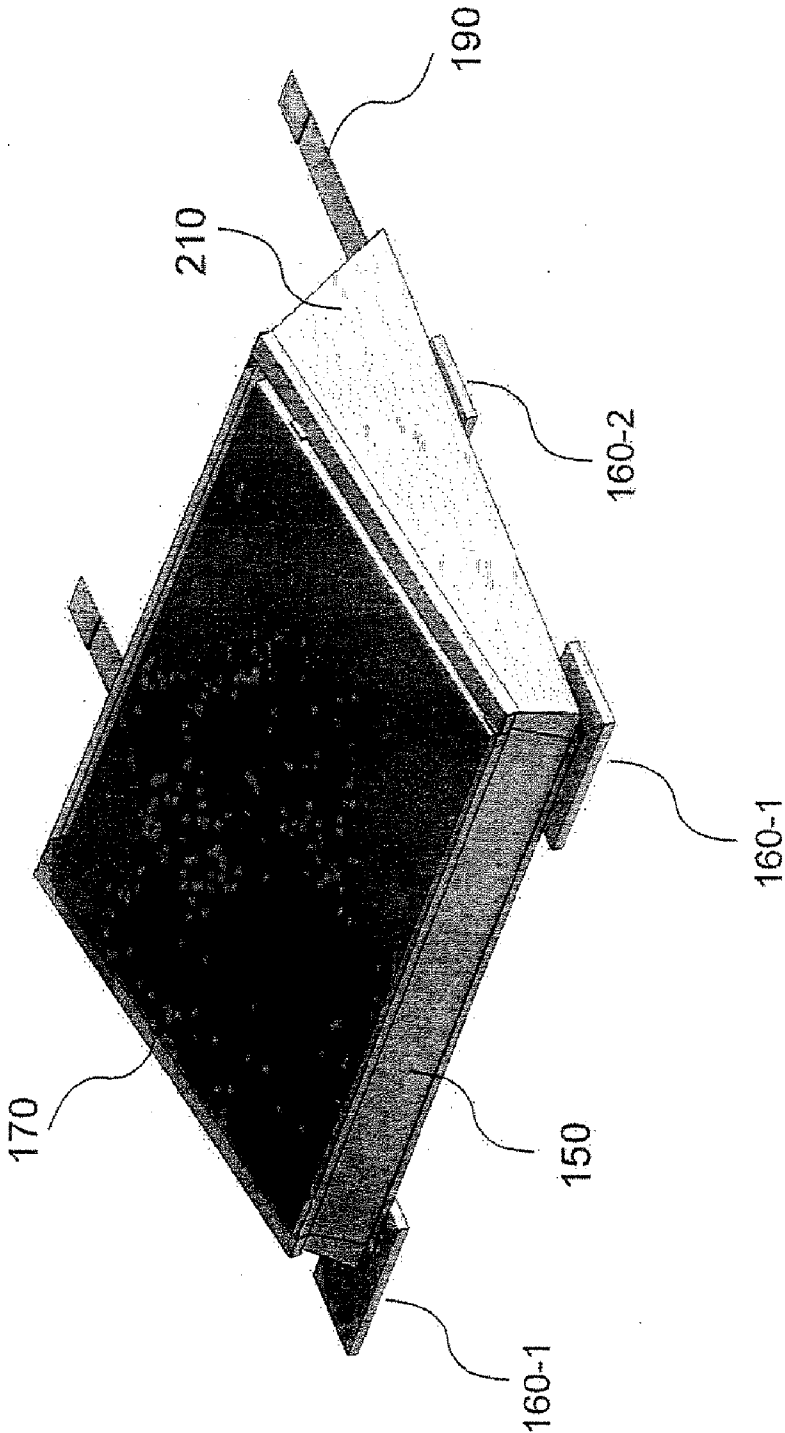


Fig. 5

ROOF MOUNTING SYSTEM FOR SOLAR MODULES

TECHNICAL FIELD

[0001] The invention relates to a flat roof attachment for solar modules and in particular for a modular, self-supporting mounting system for mounting an arbitrary number of flat solar modules on flat roofs.

PRIOR ART

[0002] For the generation of solar energy, large absorbing surfaces for absorbing solar radiation are required. Since roofs are mainly unutilized surfaces which cannot be used for other purposes, they are an ideal location for utilization of solar energy. Mountings for sloping roofs are widely used since the wind-stable attachment on a roof surface is easy to implement.

[0003] Since, however, there are also a large number of roof surfaces in particular in the industrial field, it is desired to also utilize flat roofs for generating solar energy.

[0004] The attachment of mountings for solar modules on sloping roofs without impairing the tightness of the roof is relatively simple due to the slope. With flat roofs, in contrast, there is the danger that the mounting of the modules might damage the roof cladding, thereby rendering the roof untight.

[0005] Such a roof attachment is known from document DE 10 2005 033 780 A1. In order to particularly secure the roof attachment against wind loads, the supporting frame is anchored to a corresponding sustainable sub-construction of the roof. The supports required at the supporting frame penetrate the roof cladding, thereby impairing its function as watertight roof element. In order to counteract this, extensive tightening measures have to be taken at the penetrated spots.

[0006] Further, flat roof attachments with supporting frames are known which are solely attached on the roof cladding in a frictionally engaged manner, i.e. which make due without anchoring elements penetrating the roof cladding. The stabilization against wind loads at this supporting frames is due to a high dead weight. In this respect, the frame parts themselves can be particularly heavy as well, as can be seen from document DE 203 12 641 U1. In other cases, the supporting frame is provided with receiving devices, like troughs in order to apply a superimposed load with bulk material. Such a possibility is described in document DE 203 11 967 U1.

[0007] Solar modules of known roof attachments can be arranged without taking the aerodynamic situation any further into account, provided that the modules in the lateral area are arranged in a protruding manner and both their upper surfaces and their lower surfaces are exposed to wind. This requires a particularly high dead weight of the roof attachment in order to render said roof attachment insensitive to wind. This, in turn, has an adverse effect on the statics of the building.

[0008] Another solution for a flat roof attachment for mounting of solar modules is described in document WO 2008/022719 A1. This document describes a flat roof attachment comprising a supporting frame for a plurality of solar modules that are disposed in parallel. The flat roof attachment can solely be mounted on the roof cladding in a frictionally engaged manner but it is in part laterally open and therefore insensitive to wind. The supporting frame further impairs the flow of water on the roof and thus the drainage of the roof surface. Moreover, the flat roof attachment of document WO 2008/022719 cannot be mounted on roofs with gravel or granular bulk material since irregularities can hardly be

evened out. Since the solar modules on the supporting frame are mounted in that an edge of the solar module almost rests on the roof surface, it is difficult for snow loads to slip down in winter, which has an adverse effect on the efficiency of the solar module. Further, the flat roof attachment of document WO 2008/022719 cannot be used as universal self-supporting solar module carrier since solely solar modules of a certain type (size, mounting) can be used and mounted in order to render the flat roof attachment structurally stable. The size of the flat roof attachment cannot be adjusted individually to a certain number of solar modules, either, so that individual modules can be mounted subsequently.

[0009] Thus, the object of the invention is to overcome the above disadvantages, at least in part. It is in particular an object of the invention to provide a modular self-supporting mounting system for mounting an arbitrary number of plane solar modules of an arbitrary type on flat roofs which makes due without an anchoring at the roof construction.

SUMMARY OF THE INVENTION

[0010] This object is solved by a modular self-supporting mounting system for mounting of flat solar modules of an arbitrary type on flat roofs according to the features of claim 1 by means of assembly of base elements according to claim 14 and extension elements according to claim 15.

[0011] In this respect, the term “self-supporting” means that the mounting system can be set up in a stable manner without a plane module having to be mounted as a stabilizing element. Here, the term “modular” means that the mounting system can be designed for an arbitrary number of plane modules and can also be expanded later on.

[0012] According to one aspect of the present invention, a modular self-supporting mounting system for mounting plane modules of an arbitrary type on flat roofs is provided, wherein the modular self-supporting mounting system comprises at least one base element for mounting an individual plane module, the base element comprising the following: a first and a second module rail, disposed in parallel alongside to each other; a first and a second front module support having a first length, wherein a first end of the first front module support is attached to a first area of the first module rail, and wherein the first end of the second front module support is attached to a first area of the second module rail; a first and a second rear module support having a second length, wherein a first end of the first rear module support is attached to a second area of the first module rail, and wherein a first end of the second rear module support is attached to a second area of the second module rail; wherein the first length is greater than the second length, and wherein the second ends of the first and second front and rear module supports are adapted for mounting the plane module so that the plane module forms a prescribed angle to the module rails, said angle being defined by the first and second length and being greater than zero; a front cover covering the space between the two front module supports; and a rear cover covering the space between the two rear module supports, wherein the base element comprises an attaching device for mounting at least one of a further base element and an extension element of the modular, self-supporting mounting system.

[0013] This arrangement leads to a modular mounting system which can be set up in a stable manner independently of the plane module and which makes due without anchorage to the roof surface. This arrangement further allows the mounting of an arbitrary number of plane modules, i.e. of modules from various manufacturers having any size, thickness, mounting points, framed and unframed modules. The mixture of various modules in one set-up is also possible. The self-

supporting construction allows for a facilitated assembly of the mounting system. As regards the exchange of damaged modules, one is not tied down to one specific type either. Further, the front cover and the rear cover provide for a streamlined design, wherein the wind pushes the system against the roof surface, thereby requiring less ballast for weighing down the system which has an adverse effect on the statics. Hence, the system allows for a low-ballast construction of the roof without anchoring in the roof. The system further allows for a mounting of the plane modules inclined towards the roof so that an edge of the plane module, which is closer to the roof surface, may comprise a prescribed distance to the roof surface, e.g. 20 cm. This allows for a better slipping down of the snow in winter, impairing the function of the plane module to a lesser extent.

[0014] One embodiment thereof provides a mounting system, wherein each module rail is mounted on at least two supporting devices being able to keep the module rail at a prescribed distance from a roof surface.

[0015] Due to the supporting device, the flow of water is not impaired in any direction and water accumulating on the roof after strong rain or when snow is melting can freely flow away. The assembly system for flat roofs according to the present invention is in particular suited for areas with high precipitation (snow and rain) since the flow of water is not impaired.

[0016] This is achieved by the open-bottom construction only resting on the roof by means of the relatively small surfaces of the supporting device.

[0017] In an further embodiment thereof, the modular self-supporting mounting system is designed so that a gap is situated between the plane module and the rear cover, said gap being greater than the prescribed distance between the module rail and the roof surface.

[0018] The gap serves as a defined venting gap for the drying of the roof surface below the solar module and for the discharge of accumulated heat.

[0019] In a further embodiment thereof, the supporting devices are provided with screws, the module rail being fitted onto said screws and screwed together with the supporting device.

[0020] The screws facilitate the assembly of the mounting systems. Further, the screws can also be used as connecting elements for attaching base elements and extension elements, facilitating the assembly and extension to a considerable extent.

[0021] In a further embodiment, the modular self-supporting mounting system further comprises an extension element, wherein the extension element comprises the following: a third module rail, disposed in parallel alongside to the base element; a third front module support having the first length, the first end of which is attached to a first area of the third module rail; a third rear module support having the second length, the first end of which is attached to a second area of the third module rail, wherein the second ends of the third front and rear module supports together with the second ends of a front and a rear module support of at least one of a neighboring base element and an extension element are adapted for mounting a second plane module so that the second plane module forms the prescribed angle to the module rails; a second front cover covering the space between the third front module support and a neighboring base element or extension element; a second rear cover covering the space between the third rear module support and the neighboring base element or extension element.

[0022] The extension element uses the same structural elements as the base element, but in a lower number, thereby facilitating the manufacture and rendering it more cost-effective.

[0023] In one embodiment, the attaching device for mounting a further base element or extension element of the modular self-supporting mounting system is formed by a connecting device between said two module rails so that a rear end area of the first, second or third module rail can be connected to a rear end area of a further module rail.

[0024] In doing so, more module rails which can be, e.g., part of various base or extension elements can be connected with each other in longitudinal direction. The connecting device can be, e.g., realized by means of holes in the module rails so that the module rails can be assembled by means of the screws or supporting devices.

[0025] In a further embodiment of the modular self-supporting mounting system, the attaching device for mounting a further extension element of the modular self-supporting system is formed by means of a device attached to the front and rear module supports to which neighboring plane modules, neighboring front covers and neighboring rear covers can be attached.

[0026] Thus, the extension elements can be attached to the mounting system "laterally" with respect to the module rail (in contrast to the aforementioned "longitudinal direction").

[0027] In a further embodiment of the modular self-supporting mounting system, the front module supports and the rear module supports comprise devices for attaching the plane modules.

[0028] In this respect, arbitrary types of module attachments can be used.

[0029] In one embodiment thereof, the devices for attaching plane modules can be adjusted to various module sizes and types.

[0030] Thus, from a technical point of view, it is possible to replace manufacturer-specific module attachments.

[0031] In another embodiment of the modular, self-supporting mounting system, the devices for attaching the plane modules each comprise the following: a profile rail attached to a second end of the module support on which the plane module (170) can rest; and a module clamp attached to the profile rail.

[0032] This embodiment allows for the use of a profile rail serving as a rest for the plane module on the one hand and allowing for universal attachment of module clamps on the other hand. For security reasons, plane modules like e.g. photovoltaic modules may often be solely mounted with type-specific supporting devices (module clamps). These supporting devices (module clamps) can be attached to the profile rails in a simple and technically correct manner. Thus, a low-cost, universal mounting system is provided.

[0033] In a further embodiment of the modular, self-supporting mounting system, m base elements and $(n-1) \times m$ extension elements are disposed and connected to a $m \times n$ matrix array, wherein m and n are a natural number greater than or equal 1.

[0034] The mounting system allows for the set-up of module fields of arbitrary size on flat roofs, solely limited by the roof surface. In this respect, it is also possible to combine several matrix arrays of different sizes. For example, it is possible to attach a 1×2 array to a 6×4 array. Thus, the surface of any type of roof shape can be utilized.

[0035] In a further embodiment, the self-supporting mounting system further comprises $2 \times m$ lateral covers for the $m \times n$

matrix array, wherein each lateral cover covers the space between a front cover and a rear cover in order to form an all around closed assembly.

[0036] This measure causes the flat roof attachment including the solar modules to form a completely closed roof structure which is open on the bottom side, laterally to the roof cladding.

[0037] This increases the earlier mentioned aerodynamic effect. Therefore, the wind coming from any direction is blowing above the roof structure. This generates both pressing forces and suction forces below the roof structure. Together with the frictional forces due to the resting surfaces of the whole assembly frame, the roof attachment is secured against displacing, tilting over or lifting off. The aerodynamic effect taken advantage of is in particular increased by the closed roof structure.

[0038] This means that this embodiment allows for a reduction in ballast by exploiting aerodynamic forces.

[0039] Further, the stack effect for ventilating below the modules is considerably increased.

[0040] In a further embodiment, the plane modules are photovoltaic modules and/or solar modules.

[0041] The mounting system even allows for a mixture of module types.

[0042] According to a second aspect of the present invention, a base element for a modular, self-supporting mounting system is provided for mounting of plane modules of an arbitrary type on flat roofs, comprising: a first and a second module rail disposed in parallel alongside to each other; two front module supports having a first length, the respective first end of which is each attached to a first area of the first and second module rail, respectively; two rear module supports having a second length, the respective first end of which is each attached to a second area of the first and second module rail, respectively; wherein the first length is greater than the second length, and wherein the second ends of the module supports are adapted for mounting the plane module so that the plane module can form a prescribed angle to the module rails, said angle being defined by the first and second length and being greater than zero; a front cover covering the space between the two front module supports; and a rear cover covering the space between the two rear module supports; and wherein the base element comprises an attaching device for mounting at least one of a further base element and an extension element of the modular, self-supporting mounting system.

[0043] According to a third aspect of the present invention, an extension element for a modular self-supporting mounting system for mounting of plane modules of an arbitrary type to flat roofs is provided, which comprises the following: a module rail; a front module support having a first length, the first end of which is attached to a first area of the module rail; a rear module support having a second length, the first end of which is attached to a second area of the module rail, wherein the first length is greater than the second length, and wherein the second ends of the module supports are adapted for mounting the plane module so that the plane module forms a prescribed angle to the module rails, said angle being defined by the first and second length and greater than zero; a front cover, which can cover the space between the front module support (120) and a neighboring element; and a rear cover, which can cover the space between the rear module support and a neighboring element; wherein the extension element comprises an attach-

ing device for mounting a further extension element of the modular, self-supporting mounting system.

SHORT DESCRIPTION OF THE DRAWINGS

[0044] Further advantageous embodiments can be seen from the detailed description, wherein the accompanying drawings are referred to, in which:

[0045] FIG. 1 shows a schematic cross-section of the mounting system according to a first embodiment of the present invention;

[0046] FIG. 2 schematically shows how the base elements and extension elements of the mounting system according to the present invention are assembled;

[0047] FIG. 3 shows a schematic cross-section of the mounting system according to a second embodiment of the present invention, wherein different elements of the first embodiment are modified by way of example;

[0048] FIG. 4 schematically shows a perspective reproduction of the embodiment of FIG. 3; and

[0049] FIG. 5 shows the perspective reproduction of FIG. 4 including the lateral cover.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0050] In the following description, FIGS. 1 to 5 are referred to, in which the same reference numerals describe equal elements.

[0051] FIG. 1 shows the fundamental structural elements of the invention. In detail, FIG. 1, showing a cross-section of the mounting system according to the present invention, comprises a module rail 110 positioned on two supporting devices 160-1 and 160-2, a front module support 120, a rear module support 130, a front cover 150 and a rear cover 140. For attaching a plane module 170 to the front module support 120 and the rear module support 130, respectively, the module supports 120 and 130 are provided with attaching devices 120-1 and 130-1.

[0052] Even though the attaching devices 120-1 and 130-1 are illustrated in FIG. 1 such that they comprise the plane module of the coordinate system 180 in Y-direction, the attaching device is not limited to this. Further examples are explained in more detail in connection with FIG. 3.

[0053] In view of the present invention, the term “plane module” means that the surface dimensions are not considerably greater than the thickness dimension, wherein the cross-section of the surfaces is normally rectangular, but this is not mandatory. Here, solar modules, in particular photovoltaic modules (PV modules), solar collectors, electrothermic solar modules, hydrothermic solar modules and aerothermic solar modules are used.

[0054] The mounting system, however, can also be used for attaching any kind of flat objects, e.g. for shadowing purposes. The plane module 170 is shown with dashed lines since it is not a part of the mounting system and not required for stabilizing the mounting system either.

[0055] Due to the simple and inexpensive processing, the above-mentioned elements are preferably made of curved, weather-proof, treated metal sheet, but other materials can also be used, e.g. plastic molded parts.

[0056] The front module support 120 is shorter than the rear module support so that a mounted module forms an angle in the area of about 5° to about 25°, preferably from about 10° to 15° and most preferred of about 10° relative to the module rail 110. Further, the front module support is arranged in that the lower end of the solar module lies more than 10 cm, prefer-

ably in the area from 20 cm to 40 cm above the roof surface, in order to facilitate the slipping down of snow.

[0057] Due to the supporting devices 160-1 and 160-2, which can e.g. be a supporting plate comprising a supporting surface of about 5% to 20%, preferably of about 10% of the solar module surface, the defined distance to the roof surface is obtained. Thus, the mounting system according to the present invention can be assembled both on a foil roof and on a gravel-covered roof. Due to the provision of the supporting plates 160-1 and 160-2, the unimpeded drainage of the flat roof is secured.

[0058] The rear cover 140 is attached so that a defined venting gap is formed between the rear cover 140 and the edge at the upper end of the solar module 170 (not shown in FIG. 1, in FIG. 3 with reference numeral 50). The defined venting gap secures the drying of the roof surface below the solar module and the discharge of accumulated heat. Due to the dimensioning of the venting gap (see no. 50 in FIG. 3) and the defined distance from the flat roof mounting system to the roof surface due to the utilization of the supporting plate 160-1 and 160-2, the stack-effect occurring in this respect is exploited.

[0059] The supporting plate 160-1 and 160-2 is provided with screws 161-2 and 161-4 to which the module rail 110 can be screwed on via bores 110-3 and 110-5 made therein in defined areas 111 and 112. A first end of the front cover 150 and the rear cover 140, respectively, can be attached to the module rail 110 with a screw 161-1 and 161-3, respectively. A second end of the front cover 150 and the rear cover 140, respectively, is attached to the front module support 120 and the rear module support 130, respectively. As an alternative, the first end of the front cover 150 and the rear cover 140, respectively, can be screwed on with the module rail 110 each via an additional screw (not shown) in the gusset 160-1 and 160-2, respectively.

[0060] It shall be noted that the inclination direction of the plane module 170 provides an orientation for the terms "front" and "rear". All terms used in connection with the word "front", like e.g. "front cover", "front module support" or "front side" mean a disposition on the side where the plane module 170 is closer to the roof surface. All terms used in connection with the word "rear", like e.g. "rear cover", "rear module support" or "rear side" mean a disposition on the side where the plane module is further from the roof surface than it is on the front side.

[0061] In order to consecutively connect several elements of the mounting system (base elements and extension elements) in longitudinal direction, i.e. in the inclination direction of the plane module 170, a rear end of the module rail 110 comprises a fold having a hole 110-1. In order to connect two module dispositions M1 and M2, the screw 161-2 of the front supporting plate 160-1 can be used in order to screw a front end of the module rail 110 of the module disposition M1 to the rear end of a neighboring module rail 110 of a neighboring module disposition M2 through the hole 110-1 in the fold of the neighboring module rail 110, as shown in FIG. 1. In FIG. 1, the neighboring module rail 110 of the neighboring module disposition M2 is drawn in dashed lines.

[0062] By connecting the neighboring module rail 110 with the front supporting plate 160-1, one obtains a very stable connection of the consecutively arranged base and extension elements. A somewhat simpler way of connecting the module rails 110 with one another is to use the screw 161-1 for mounting the front cover 150 to the module rail 110 (not shown).

[0063] FIG. 2 shows a top view as to how base modules and extension modules can be assembled to form an array. The

coordinate system 280 is a projection of the coordinate system of FIG. 1 for a better orientation.

[0064] FIG. 2 shows that the flat roof mounting system according to the present invention can be arbitrarily expanded and enlarged due to its construction. In doing so, one can flexibly arrange an arbitrary number of solar modules next to each other (in x direction) or consecutively (in y direction). The flat roof mounting system can be set-up completely and can be assembled with solar modules in subsequent working steps. In this respect, the lacking solar modules can be replaced by blind covers. The flat roof mounting system can be prefabricated in a partially mounted manner and can be completed on the roof surface later on.

[0065] FIG. 3 shows a schematic cross-section of the mounting system according to the present invention, wherein different elements of FIG. 3 are modified by way of example. It shall be highlighted that the modifications in FIG. 3 can be applied to the embodiment in FIG. 1 individually or in total.

[0066] FIG. 3 illustrates in particular modifications of the module supports 120 and 130 of FIG. 1. Said modifications facilitate the mounting of the system and thereby reduce the expenditure of time required for the mounting and reparation.

[0067] In FIG. 3, the front module support 120 further comprises a profile rail 120-5, a module gusset 120-6 and a module attachment (not shown). The rear module support 130 further comprises a profile rail 130-5, a holder 130-6 for the rear cover 140 and a module attachment (not shown).

[0068] The module supports 120 and 130 serve as profile supports 120 and 130, the first end of which is attached to the module rail 110. At a second end of the profile support 120 and 130, respectively, a profile rail 120-5 and 130-5, respectively, is attached. Further, the module attachment is attached to the profile rail 120-5 and 130-5, respectively (not shown in FIG. 3; identified with numerals 120-1 and 130-1 in FIG. 1; in FIG. 4 with numeral 200).

[0069] The holder 130-6 of the rear cover 140 is attached to the rear module support 130 (profile support) or, alternatively, to the rear profile rail 130-5. The holder 130-6 is disposed so that a venting gap 50 between the solar module 170 and the rear cover 140 remains free.

[0070] A module gusset 120-6 is attached to the profile rail 120-5. The front cover 150 can also be attached to said gusset.

[0071] On the one hand, the utilization of the profile rail 120-5 and 130-5, respectively, allows for the resting of a plane module 170. On the other hand, it allows for the universal attachment of module clamps. For security reasons, plane modules like e.g. photovoltaic modules may often solely be mounted with type-specific supporting devices (module clamps). These mandatory supporting devices (module clamps) can be attached to the profile rails in a simple and technically correct manner.

[0072] The attachment of a solar module can be implemented in different ways. The attachments do not necessarily have to be attached to the profile rail 120-5 and 130-5, respectively, but can also be attached directly to the front and rear module supports 120 and 130 in order to save material (see FIG. 1). The mounting via the profile rail 120-5 and 130-5, respectively, facilitates the mounting effort.

[0073] In FIG. 1, a mounting system was illustrated, which uses a U-shaped profile 130-1 (profile with U-shaped cross-section) at the rear profile support 130 and a U-shaped profile 120-1 at the front profile support 130, into which the solar module 170 can be inserted laterally. Using a hinged U-profile may facilitate the insertion and fixation of the solar module.

[0074] Alternatively, the solar module can be inserted and attached by means of screwing on a holder, using a screwable

attachment in a solar module receiving element attached to the front side of the profile support **120** and **120-5**, respectively, and to the rear side of the profile support **130** and **130-5**, respectively, in the form of an L-profile.

[0075] In another embodiment, the solar module can be attached to the sub-construction of the mounting system, e.g. the profile rail **120-5** and **130-5** by using appropriate solar module attachments **200** that are each adapted to the solar module **170** used in this respect.

[0076] In a further embodiment, the solar module can be attached by using standard aluminum profile rails having a U-profile with screws of the screw size M10 mm for attaching to the front side of the profile support and the rear side of the profile support as well as with a U-profile with screws of the screw size M8 mm for attaching the solar module by means of appropriate solar module attachments that are each adapted to the solar module used in this respect.

[0077] Further with reference to FIG. 3, the module rail **110** of a module disposition M1 can consist of a module rail base element **110-A** and a distance rail **190**. The front module support **150** and the rear module support **140** are attached to the module rail base element **110-A** in the same way as described in connection with FIG. 1. A rear end of the module rail base element **110-A** comprises a fold serving as connecting area with the distance rail **190**. The module rail base element **110-A** and the distance rail **190** can be connected via the screw **161-4** of the rear supporting device **160-2**. The rear cover is attached to the distance rail **190**. The distance rail **190** also comprises a fold having a bore **110-1** at its rear end, where a neighboring module rail base element **110-A** of a neighboring module disposition M2 (shown in dashed lines) can be attached, e.g. via the screw **161-2** of the front supporting device **160-1** as described in connection with FIG. 1. Thus, the front cover **140** (shown in dashed lines) of the neighboring module disposition M2 is attached to the distance rail **190** of the module arrangement M1.

[0078] If no further module disposition is situated in front of the module disposition M1, as shown in FIG. 3, the front cover **140** of the module disposition M1 has to be attached to a front sheet holder **180** with a screw **161-1**, e.g. via a sheet-metal screw. The front sheet holder **180** is connected to the module rail base element **110-A**, e.g. via a perforated fold at the front sheet holder **180** which is screwed with the screw **161-2** of the front supporting device **160-1**.

[0079] The embodiment of the module rail described in FIG. 3 is a particularly advantageous embodiment in view of the mounting effort. However, it shall also be further modified. For example, the module rail base element **110-A** can be extended forwards so that no front sheet holder **180** is required for the foremost (first) module disposition.

[0080] FIG. 4 shows a 3-D view of a base module according to FIG. 3. This view shows the module clamps **200** which can be attached to the profile rail **120-5** and **130-5**. Since the profile rails **120-5** and **130-5** universally allow for the mounting of the most varied holders, manufacturer-specific module clamps (holders) can also be used.

[0081] By utilizing solar module-specific module clamps which are required by many manufacturers of solar modules, all static and approval-relevant requirements for attaching can be met.

[0082] FIG. 5 shows the 3-D view of FIG. 4, which is provided with lateral covers **210**. Due to this, a completely closed body is formed, which is, however, open at the bottom, which enhances the above-described aerodynamic effects of the ballast-reduction.

[0083] Further modifications and variations of the present disclosure will be obvious to any expert who views this

description. Therefore, the description should be considered for illustration purposes, solely serving the expert as an aid for teaching the general principle of implementing the present invention, the scope of which is determined by the claims.

1. A modular, self-supporting mounting system for mounting of plane modules (**170**) of an arbitrary type on flat roofs, wherein the modular, self-supporting mounting system comprises at least one base element for mounting a single plane module (**170**), the base element comprising:

- a first and a second module rail (**110**), disposed in parallel alongside to each other;

- a first and a second front module support (**120**) having a first length, wherein a first end of the first front module support (**120**) is attached to a first area (**111**) of the first module rail (**110**), and wherein the first end of the second front module support (**120**) is attached to a first area (**111**) of the second module rail (**110**);

- a first and a second rear module support (**130**) having a second length, wherein a first end of the first rear module support (**130**) is attached to a second area (**112**) of the first module rail (**110**), and wherein a first end of the second rear module support (**130**) is attached to a second area (**112**) of the second module rail (**110**);

wherein the first length is greater than the second length, and wherein the second ends of the first and second front and rear module supports (**120**, **130**) are adapted for mounting the plane module (**170**) so that the plane module (**170**) forms a prescribed angle to the module rails (**110**), said angle being defined by the first and second length and being greater than zero;

- a front cover (**150**) covering the space between the two front module supports (**120**); and

- a rear cover (**140**) covering the space between the two rear module supports (**130**),

wherein the base element comprises an attaching device for mounting at least one of a further base element and an extension element of the modular, self-supporting mounting system.

2. The modular, self-supporting mounting system according to claim 1, wherein each module rail (**110**) is mounted on at least two supporting devices (**160-1**, **160-2**) being able to keep the module rail (**110**) at a prescribed distance from a roof surface.

3. The modular, self-supporting mounting system according to claim 2, which is configured so that a gap (**50**) is formed between the plane module (**170**) and the rear cover (**140**), said gap being greater than the prescribed distance between the module rail (**110**) and the roof surface.

4. The modular, self-supporting mounting system according to claim 2 or 3, wherein the supporting device (**160-1**, **160-2**) is provided with screws (**161-2**, **161-4**), and the module rail (**110**) being fitted onto said screws and screwed together with the supporting device (**160-1**, **160-2**).

5. The modular, self-supporting mounting system according to one of the claims 1 to 4, further comprising an extension element, wherein the extension element comprises the following:

- a third module rail (**110**), disposed in parallel alongside to the base element;

- a third front module support (**120**) having the first length, the first end of which is attached to a first area (**111**) of the third module rail (**110**);

a third rear module support (130) having the second length, the first end of which is attached to a second area (112) of the third module rail (110),

wherein the second ends of the third front and rear module supports (120, 130) together with the second ends of a front and a rear module support of at least one of a neighboring base element and an extension element are adapted for mounting a second plane module (170) so that the second plane module (170) forms the prescribed angle to the module rails (110);

a second front cover (150) covering the space between the third front module support (120) and a neighboring base element or extension element;

a second rear cover (140) covering the space between the third rear module support (130) and the neighboring base element or extension element.

6. The modular, self-supporting mounting system according to one of the claims 1 to 5, wherein the attaching device for mounting at least one of a further base element and an extension element of the modular, self-supporting system is formed by a connecting device between two module rails (110) so that a rear end part of at least one of the first, second and third module support (110) can be connected to a front end area (110-2) of a further module rail (110).

7. The modular, self-supporting mounting system according to one of the claims 1 to 6, wherein the attaching device for mounting a further extension element of the modular, self-supporting system is formed by a device at the front and rear module supports (120, 130) to which neighboring plane modules (170), neighboring front covers (150) and neighboring rear covers (160) can be attached.

8. The modular, self-supporting mounting system according to one of the claims 1 to 7, wherein the front module support (120) and the rear module support (130) comprise devices (120-1, 130-1, 120-5, 130-5, 200) for attaching the plane modules (170).

9. The modular, self-supporting mounting system according to claim 8, wherein the devices (120-1, 130-1, 120-5, 130-5, 200) for attaching the plane modules (170) can be adjusted to various module sizes and types.

10. The modular, self-supporting mounting system according to one of the claims 8 and 9, wherein the devices (120-5, 130-5, 200) for attaching the plane modules (170) each comprises the following:

a profile rail (120-5, 130-5) attached to a second end of the module support (120, 130) on which the plane module (170) can rest; and

a module clamp (200) attached to the profile rail (120-5, 130-5).

11. The modular, self-supporting mounting system according to one of the claims 1 to 10, wherein m base elements and (n-1)xm extension elements are arranged and connected so that they form an m×n matrix array, wherein m and n are a natural number greater than or equal 1.

12. The modular, self-supporting mounting system according to claim 11, further comprising 2xm lateral covers for the m×n matrix array, wherein each lateral cover covers the space between a front cover and a rear cover in order to form an all around closed assembly.

13. The modular, self-supporting mounting system according to one of the claims 1 to 12, wherein the plane modules (170) are at least one of photovoltaic modules and solar modules.

14. A base element for a modular, self-supporting mounting system for mounting of plane modules (170) of an arbitrary type on flat roofs, comprising:

a first and a second module rail (110) disposed in parallel alongside to each other;

two front module supports (120) having a first length, the respective first end of which is each attached to a first area (111) of the first and second module rail (110), respectively;

two rear module supports (130) having a second length, the respective first end of which is each attached to a second area (112) of the first and second module rail (110), respectively;

wherein the first length is greater than the second length, and wherein the second ends of the module supports (120, 130) are adapted for mounting the plane module (170) so that the plane module can form a prescribed angle to the module rails (110), said angle being defined by the first and second length and being greater than zero;

a front cover (150) covering the space between the two front module supports (120); and

a rear cover (140) covering the space between the two rear module supports (130); and

wherein the base element comprises an attaching device for mounting at least one of a further base element and an extension element of the modular, self-supporting mounting system.

15. An extension element for a modular, self-supporting mounting system for mounting of plane modules (170) of an arbitrary type on flat roofs, comprising:

a module rail (110);

a front module support (120) having a first length, the first end of which is attached to a first area (111) of the module rail (110);

a rear module support (130) having a second length, the first end of which is attached to a second area (112) of the module rail (110),

wherein the first length is greater than the second length, and wherein the second ends of the module supports (120, 130) are adapted for mounting the plane module (170) so that the plane module (170) forms a prescribed angle to the module rails (110), said angle being defined by the first and second length and greater than zero;

a front cover (150), which can cover the space between the front module support (120) and a neighboring element; and

a rear cover (140), which can cover the space between the rear module support (130) and a neighboring element;

wherein the extension element comprises an attaching device for mounting a further extension element of the modular, self-supporting mounting system.

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