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(54) Title: MODULAR FLOATING STRUCTURE FOR PHOTOVOLTAIC ARRAY

(57) Abstract: The invention relates to a floating modular structure for a solar energy conversion installation arranged on water surfaces and made up of raft-like-elements which support photovoltaic panels and which also form a walkable flat surface.

Modular floating structure for photovoltaic array

Field of the Invention

The current invention is related to a modular floating structure for photovoltaic installations.

In particular, the invention relates to a system with a floating structure for a solar energy conversion installation which is arranged on water surfaces.

State of the art

Traditional photovoltaic systems are designed to be installed on the ground, for example agricultural grounds, or roofs and other fixed arrangements on flat or tilted surfaces.

Installation of these systems involves more than few disadvantages both environmental ones and safety ones, as in the case of laying on building roofs. In addition, more and more often the territories are bound by laws that keep into account the environmental impact as well as the preservation of the landscape, the land occupation for farming or for other types of exploitation, to avoid a continuous and not justified increase of the land value.

There exist, therefore, the need to exploit different areas from the ones used until now to arrange solar panel installations, i.e., sea, river, lake, lagoon surfaces, artificial basins and artificial basins connected to hydroelectric dams by installations based on photovoltaic floating systems.

US 2008/0029148 discloses a floating structure for the support of solar panels. In particular, it is described a structure which comprises rows of extended tubular elements that support photovoltaic panels

arranged with an appropriate slope in order to get the higher absorption of solar rays.

Anyway, structures of this type show some disadvantages, such as maintenance difficulties, due to uncomfortable passages between a row and the other of floating means, difficulties in assembling a particularly complicated structure such as the one that keeps the tubular floating elements in position, as well as difficulties to pass cables in a protected way, both in terms of safety and of duration.
Therefore, it was felt the need to put right a structure which could allow reducing the maintenance and production costs, in particular in terms of maintenance and assembly times, with a simplification of the construction.

Summary of the Invention

A modular floating structure for photovoltaic installations has now been made, which overcomes all the disadvantages mentioned above, and which is now the object of the present invention.

The modular floating structure for photovoltaic installations is characterized in that it comprises raft-like floating elements which can be inter-connected in such a way to obtain uniform floating surfaces able to hold the supporting structures of the photovoltaic panels and to form a continuous surface for the passage of the maintenance staff.

The supporting structures of the photovoltaic panels are provided for in such a way that the panels can be regulated in an optimal tilted position for the absorption of solar rays.

Moreover, the supporting structures are made in order to be hold in places provided for on the raft-like elements, or in between adjacent raft-like elements.

Also provided for are elastic means to anchor the raft-like elements or groups of raft-like elements to the bottom and to the bank of the bacin, which are able to keep the raft-like elements in position in spite of the movements of the waters below and of the stress due to strong winds in adverse atmospheric conditions, and to any possible external agent.

Also provided for are channel-type means which are placed on the raft-like floating means and which are able to allow wiring by means of traditional electric cables for solar applications.

Further features and purposes of the modular floating structure for photovoltaic installation according to the present invention will be evident from the following detailed description, with reference to preferred embodiments, with the understanding the variants can be made without going out of the protection scope as defined by the appended claims and by reference to the enclosed figures.

Brief description of the drawings

Figure 1 is a schematic perspective view of one element of the floating modular structure for photovoltaic installation of the invention;

Figure 2 is a schematic view of a preferred embodiment of the adjustable coupling joint between the photovoltaic panels and the supporting bars carried by the raft-like elements of the modular floating structure for photovoltaic installation of the invention;

Figure 3 is a schematic view by way of example of a profiled protection for the cables provided for in the modular floating structure for photovoltaic plant of the invention;

Figure 4 is a schematic view by way of example of an arrangement of the anchor guy ropes of the modular floating structure for photovoltaic plant of the invention;

Figure 5 is a schematic view of the arrangement of a number of elements of the modular floating structure for photovoltaic plant of the invention.

Detailed description of the preferred embodiments

With reference to Figure 1, a preferred embodiment of the modular floating structure for photovoltaic installation according to the present invention comprises a plurality of raft-like floating elements **1** inter-connected by connecting means, e.g., with a flange or tubular or the like **2**, coaxial or transversal, protruding outwards equipped with a pass-through hole **2a** for the insertion of a pin or a bolt **2b** that can be inserted in the holes of two flanking raft-like elements.

Tubular elements are an integral part of the structure of the rafts, and they are placed on both sides of the floating means. The tubular elements of two flanking floating means are arranged so that they are coaxial and allow the insertion of blocking elements which guarantee a firm hold against the oscillating movements of the structure.

Alternatively, systems can provided for, which allow connecting a number of floating means, like longitudinal plastic bands, i.e., high-density polyethylene, or metallic, closed in a ring, which wrap two or more raft-like elements.

Flanged or tubular seats **102** placed on at least one side of the floating raft-like element **1** present holes **102a** for the insertion of at least one supporting bar **3** for the traditional solar panel **5**, not described in detail. Advantageously, said holes **102a** show an internal diameter slightly larger than the external one of the bars, to determine a friction pairing such that any unwanted vertically directed of the bar itself is avoided.

On the contrary, the bar can be moved vertically inside the holes to set the height of one side of the solar panel **5**, being blocking means provided for in such a case.

Preferably, a second bar **4** is provided for, which can be drown in the raft-like element **1** or inserted in an appropriate seat provided for on such element **1,** to form the second supporting element of the solar panel **5**, which can be both fixed and mobile.

To the aim of reducing the weight of supporting structure of solar panels **5**, bars **3** and **4** are preferably made of HDPE, and they are hollow, this way allowing electric wires to be passed inside, and they are conveniently threaded at both ends to be connected at the lower extremity with said floating raft-like elements **1** and with said blocking means, and to be connected at their upper extremity with coupling joint means 6 for the tilting of same panels.

The connection between the solar panel **5** and their relative supporting bars **3** and **4** is obtained by means of at least one coupling joint **6** interposed between the bars themselves and at least one supporting structure **7** fixed to the solar panel **5**.

The at least one supporting structure 7 is preferably made of sections in anodized aluminium coupled with link-up plates **11** connected to the coupling joints **6**.

With reference to Figure 2, it is shown a detail of a preferred embodiment of the coupling joint **6** for the slope adjustment of each solar panel **5**. This coupling joint **6** is provided with a rotation pin **8** with indentations, grooves, ways or similar means able to avoid the mutual rotation between the ear-shaped elements **9** of the link-up plates **11** fixed to the support **7** of each solar panel **5** and the ear-shaped elements **10** fixed to the connecting bars **3** and **4** to the raft-like elements **1**. Preferably, the coupling joints **6** placed onto respective

bars **3** and **4**, are oriented in opposite directions to fix sections and to block transversal movements caused by the slope of the same.

The coupling joints **6** can be of every known type, for example friction joint, grooved joint or the like, as long as they are able allow a tilted orientation of the solar panels **5**, ensuring at the same time the stability of the achieved position.

Preferably, coupling joints **6** are made of such materials as galvanized iron or steel, which is resistant to water, sea water, bad weather, acids and solar light.

With reference to Figure 3, by way of example a type of section which can be used for a supporting structure 7 is shown.

The regulation of the height of the rear supporting bar **3** allows arranging solar panels **5** with the most convenient tilt, which is able to guarantee maximal performances of the solar energy captation.

It is also provided that at least the height of the rear supporting bar **3** could be adjustable even in at a distance through actuators linked to programming means, in order to optimize the sun incidence angle throughout the year, seasonal variations notwithstanding.

With reference to Figure 1 also shown is the preferred arrangement of one tubular seat **12** provided for on the raft-like means **1** to house the solar application cables 12a, able to make an electric wiring that allows sending on shore all the cables and link them to a structure which contains the components of the power electronics, in order to guarantee safety and ease of the maintenance operations.

In Figure 4 a preferred embodiment of the anchorage of the structure is shown, which is performed by elements including ballast means **13** linked to the structure with guy ropes **13a**, on which elastic means **14** are interposed which are able to absorb the forces generated by wave

movements and thus to guarantee a steady position of the raft-like elements **1** even in case of water movements, as well as of movements due to strong winds or/and to adverse atmospheric conditions.

The raft-like elements **1** can be of any type and of such dimension as to make one walkable surface which constitutes the support for the solar panels and, at the same time, a gangway for the maintenance staff, as exemplified in Figure 5.

With the arrangement of at least one section **7**, at least a hollow supporting bar **3** and one tubular element **12**, cables **12a** are all contained in the above mentioned elements, that is, they are not exposed to the outside and thus they are not exposed to external atmospheric agents but they are well protected and guided.

The supporting bars **3** and **4** of the solar panels are fixed to the raft-like elements **1** by known means and the connections are all provided for in resistant materials for every kind of external agent and also sea water.

Further, it is clear that, through the modular floating solar system of the present invention, also the quality of the water basins is improved, since their direct exposition to the sun is avoided, thus decreasing the evaporation, also obtaining a reduction in the proliferation of algae as a consequence of a lower exposition to the solar radiation.

CLAIMS

1. A modular floating structure for photovoltaic installation comprising at least one solar panel (5), at least one supporting means (3,4) for said installation connected to floating means (1), characterized in that said floating means are raft-like elements (1) and are provided with connecting means (2, 2a, 2b) to at least a second raft-like element (1).

2. The structure according to Claim 1, characterized in that said connecting means (2, 2a, 2b) are flanges or tubular elements which can be blocked and linked to each other in a releasable way.

3. A structure according to claim 1, wherein said floating raft-like means are linked to each other by longitudinal bands closed in a ring around at least two raft-like elements.

4. The structure according to Claim 1, characterized in that said raft-like floating means are connected to each other by means of tubular elements which are integral parts of the structure of the raft-like elements and are placed on both sides of the floaters, being the tubular elements of two flanking floating means being coaxially placed for the insertion of blocking elements.

5. The structure according to Claim 1, characterized in that said raft-like floating means (1) are able to form a walkable flat surface.

6. The structure according to Claim 1, characterized in that said supporting means (3, 4) are made of upright bars of different heights, and are preferably hollow.

7. The structure according to Claim 6, characterized in that said bars (3, 4) are adjustable in height, independently from each other.

8. The structure according to Claim 7, characterized in that said bars (3, 4) comprise blocking means.

9. The structure according to Claim 6, characterized in that said bars (3, 4) are connected to actuator means which can be remotely controlled by programmable means thereof.

10. The structure according to Claim 6, characterized in that at least one supporting means (3, 4) is connected to the respective solar panel by at least a coupling joint (6), preferably connected to at least one supporting structure (7) fixed onto the solar panel (5).

11. The structure according to Claim 9, characterized in that said coupling joints are provided with a rotation pin (8) with indentations, grooves, keyways or similar means able to avoid mutual rotation between the connected elements.

12. The structure according to Claim 1, characterized in that said floating means are provided with anchorage installations, the latter being preferably provided with guy ropes (13a), ballasts (13) and elastic shock adsorber means (14) interposed between them.

13. The structure according to Claim 1, characterized in that said raft-like floating means (1) are provided with at least one tubular element (12) to house electric cables.

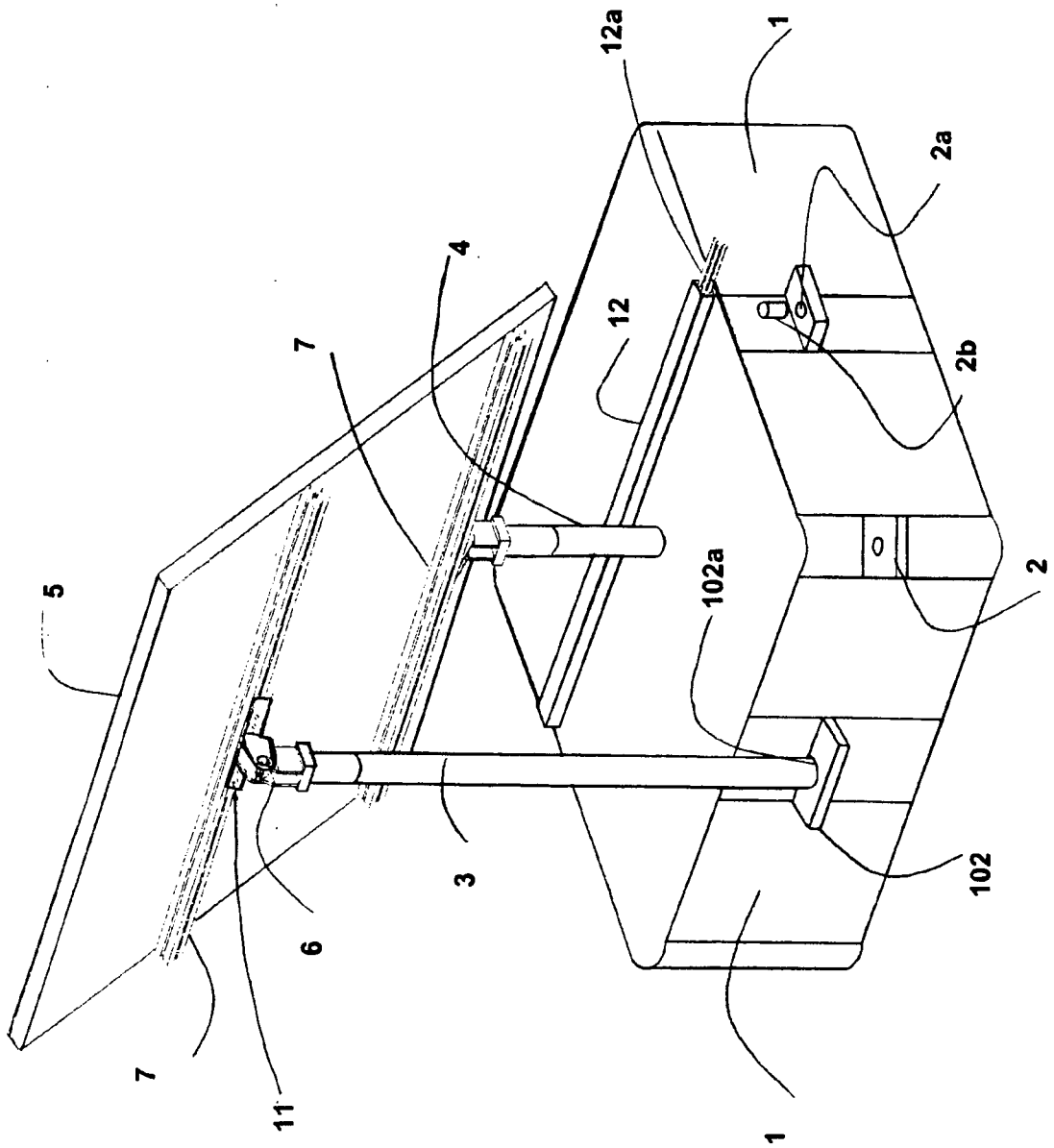

Fig. 1

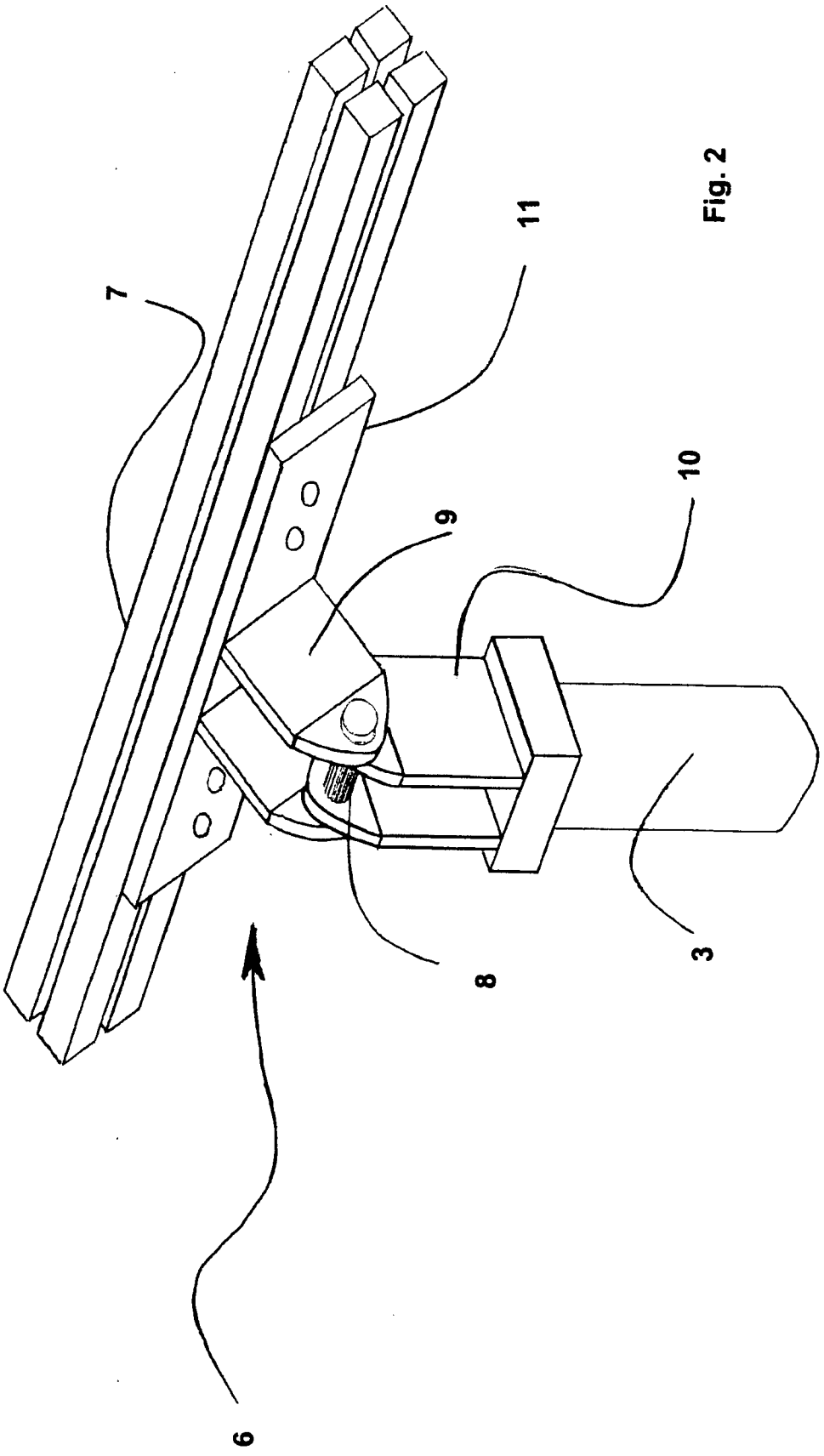

Fig. 2

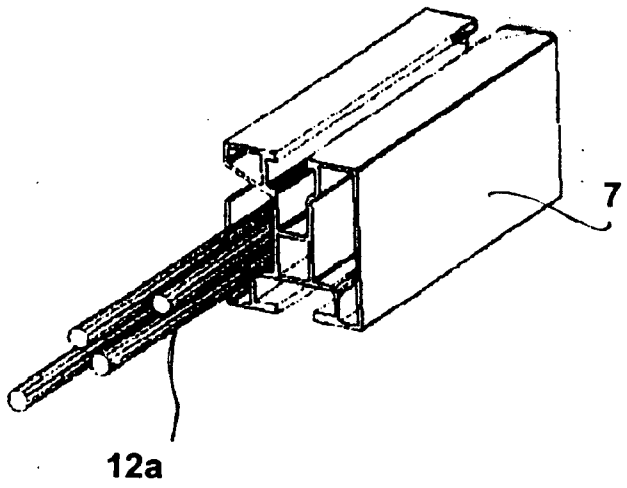

Fig. 3

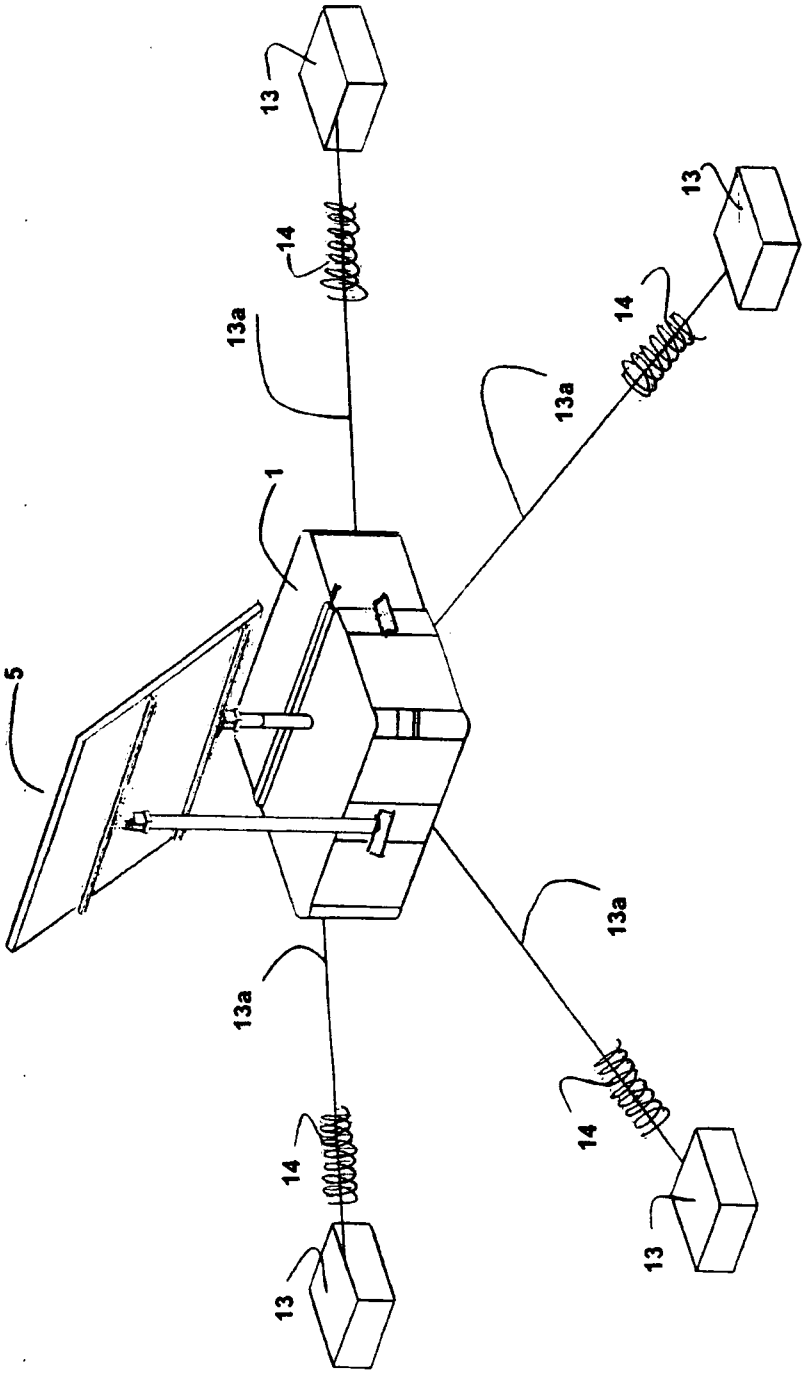

Fig. 4

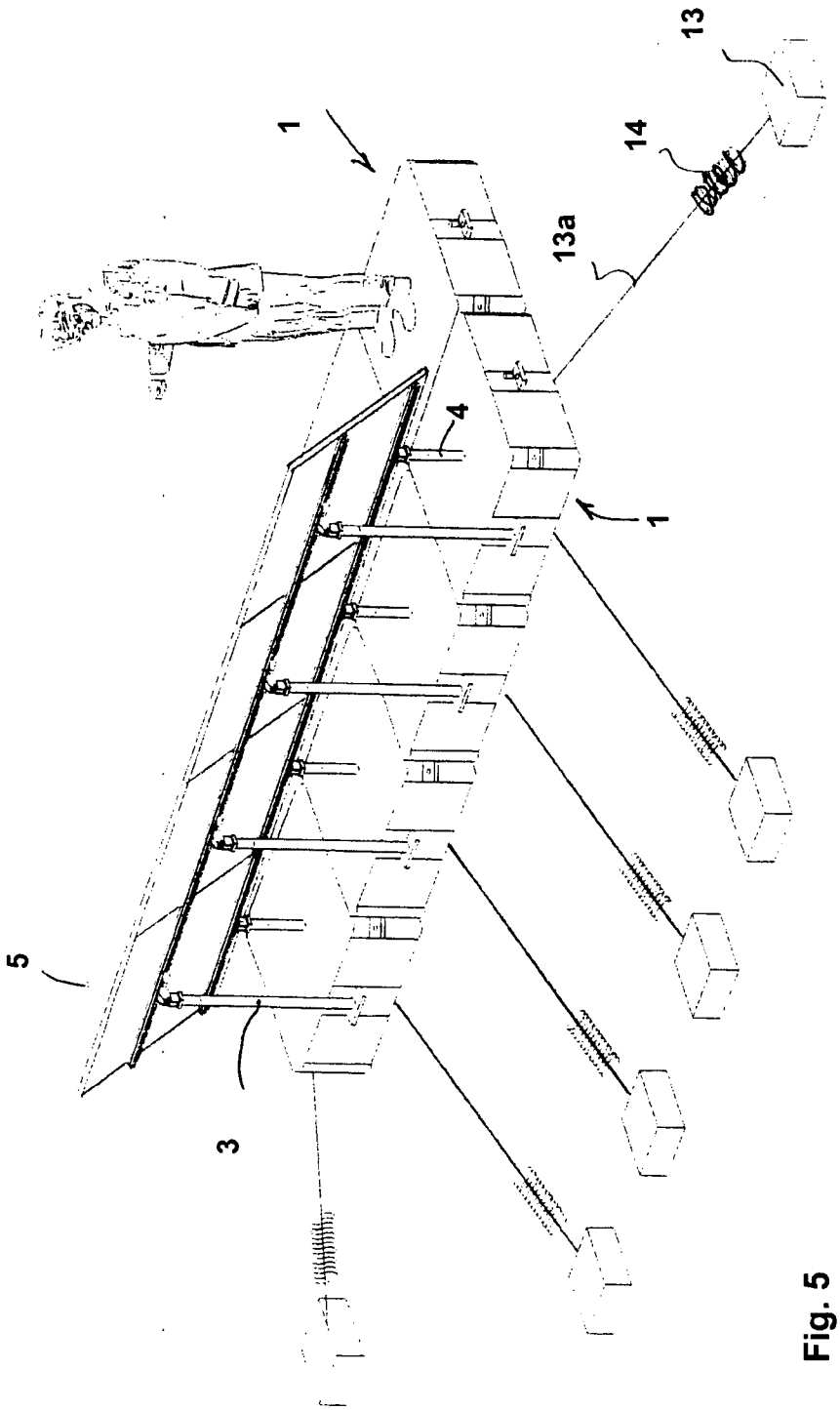

Fig. 5