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(54) **PHOTOVOLTAIC SYSTEM FOR VESSELS, MAINLY FOR LEISURE VESSELS**

(57) A pleasure boat comprising a modular photo-voltaic system with retractable panels provides housings (2) formed in horizontal structural supporting elements such as the deck plan or flybridge plan, of appropriately increased thickness, and supporting structures (3, 4) which support photovoltaic panels (26), arranged inside

the housings and able to slide, through an actuation mechanism, between a closure configuration in which they are completely inside the housings (2) and an opening configuration in which they protrude horizontally from the side of the hull or frontally from the plan of the flybridge.

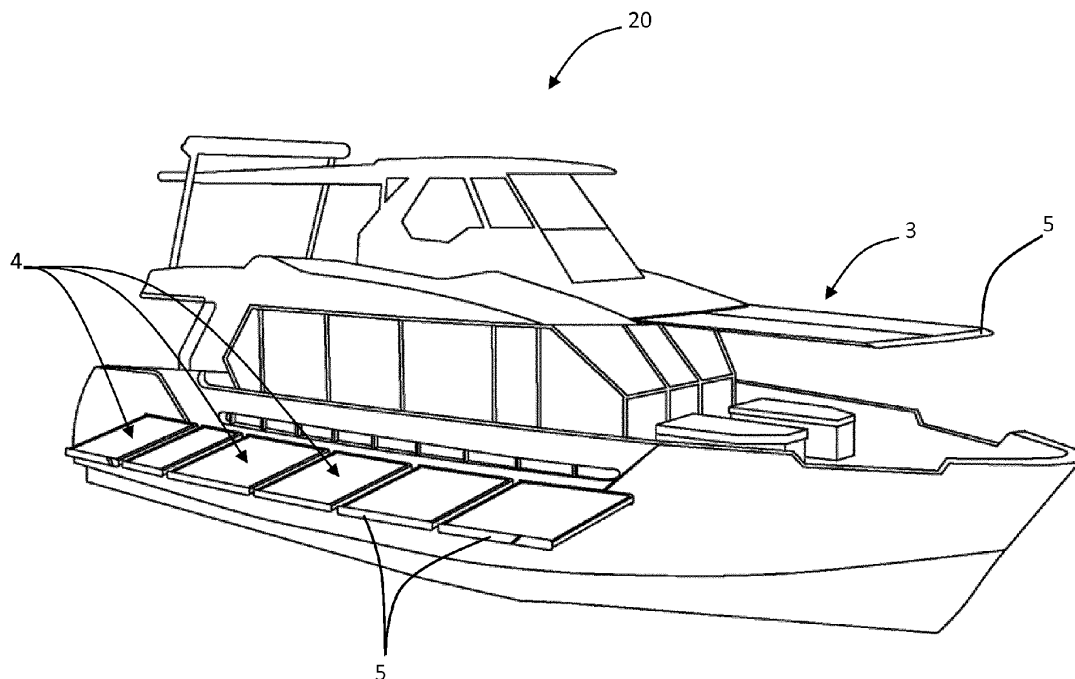


FIG. 2

Description

TECHNICAL FIELD

[0001] The invention relates to a pleasure boat comprising a modular photovoltaic system with retractable panels.

STATE OF THE ART

[0002] To date, the research and applications for the use of renewable energies in boating have produced above all purely prototype boats which, although with a certain amount of autonomy, have been built using materials, technologies and forms not much compatible with amateur pleasure boating or, even less, for professional boats.

[0003] In fact, there has been a "surge" in the adoption of systems based on renewable energy in the nautical sector, only when tax incentives allowed them to be repaid. But the decline of these government initiatives, and above all detecting the poor results obtained in those first "experiments", was followed by a decline in applications of a certain significance; while perhaps they diffuse more like "gadgets" of fashion, installations of small surfaces of panels that may keep the batteries charged during long periods of inactivity of the boat, or less more.

[0004] The prototypes, or even some concrete "hybrid" realization proposed to the public of boaters (more like "illusion" of environmental safeguard than for other), have however received lukewarm welcome; because, in fact, the benefits are laughable in that the energy obtainable with a few solar panels can be used almost exclusively to power on-board services and/or some marginal users (although this still constitutes a small economic saving, charging the batteries with energy also produced with the fuel of the boat, or "purchased tout-court" from the supply panel of the quay of the port); but certainly not to make up for the massive use of the classic "fuels" for propulsion.

[0005] For example, from FR2484356A1 it is known the possibility of applying photovoltaic panels over the main decks of the boat and also the possibility of providing panels mounted one on the other in a transversely sliding manner so that the photovoltaic surface can be increased also the overall dimensions of the deck plan. However, in solutions of this type the walkable decks of the boat are sacrificed as the solar panels occupy its surface. Furthermore, the solar panels are always exposed to the weather and other possible causes of damage.

[0006] In DE4136479, among various solutions proposed for housing photovoltaic panels in a boat, it is also mentioned the possibility of adding a second walkable deck above the main walkable deck, spaced from it, so as to obtain a space in which to house a photovoltaic panels system removable in a telescopic way. This solution makes it possible to not obstruct the walking deck

with photovoltaic panels and yet requires having to weigh down the boat with the presence of an additional walking deck through which the compartment is built in which to house the retractable sliding photovoltaic panels.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is to propose a pleasure boat which includes a set of retractable photovoltaic panels.

[0008] Another object of the present invention is to propose a pleasure boat comprising a very large area of solar panels.

[0009] Said purposes are achieved by means of a pleasure boat (20) comprising a retractable photovoltaic assembly, in which the boat is provided with:

- housings made in the thickness of substantially horizontal structural supporting elements extending in a vertical direction between a walkable deck plan (6) of an upper plan and a false countertop (11) of a lower plan,
- structural panels arranged to slide in said housings between a closure configuration in which they are located completely inside said housings and an opening configuration in which they protrude outwardly from perimetral openings, solar panels (26) being applied on said structural panels (3, 4),
- a mechanism for actuating said panels (3, 4) suitable for sliding said panels between said closure configuration and said opening configuration.

[0010] The boat of the invention allows to have a photovoltaic surface that extends beyond the dimensions of the walkable deck plans of the boat which can be extracted as needed and which does not clutter, nor in the phase of use or in the phase of non-use, the treadable surfaces of the boat. The photovoltaic panels are housed in the thickness of the horizontal structural plans normally present in a boat of conventional type. According to the invention, these structural plans are designed appropriately to obtain housings and actuation mechanisms without, however, allowing the boat to require modifications and structures that alter its appearance with respect to that of a conventional boat.

[0011] Advantageously, the panels comprise end covers which form a perimetally protruding abutment which stops the retraction movement at the end of the stroke towards the stopping position, on said abutment being present a gasket which makes the internal compartment air-tight with respect to the external splashes potentially coming from the waves or from meteoric precipitation. Furthermore, the panels are made of carbon fiber or lightened alveolar fiberglass or other material with corresponding mechanical characteristics, and solar panels are applied to them. In the position of maximum extraction and therefore of maximum protrusion out of its housing, each structural panel is sized to support a load

greater than a person's weight.

[0012] Still advantageously, the housings are located between the surface of the walkable deck plan and a false countertop which branches off into all the rooms of the sleeping area, and of the engine room and of other environments present at this level. The false countertop is integrated with a system of watertight laminates provided with gutters to convey any water penetrated into the housings towards collection points. Furthermore, the countertop can be removed so that by removing the countertop, it is possible the inspection, maintenance and cleaning of the organs/systems, that is to say of the housings (2), of the structural panels (3, 4) and of the relative support and actuation mechanisms.

[0013] Alternatively, or in addition, longitudinal housings are provided obtained in the thickness of the walking surface of the flybridge.

[0014] Advantageously, the actuation mechanism of the panels comprises gears located at the end of the shaft of an electric motor fixed to a structural wall of the boat, said motor imparting motion to a metal bracket integral with said panel and in which it is located a rack which meshes with said gears.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] These and other features and advantages of the invention will become apparent from the following description of preferred embodiments provided below, in accordance with the proposed claims, and with the aid of the accompanying drawings, in which:

- Fig. 1 shows a schematic perspective view of a boat according to the present invention with a relative photovoltaic assembly in the closed configuration;
- Fig. 2 shows a view similar to that of Fig. 1 in which the boat of the invention has the photovoltaic assembly in a completely open configuration, also referred to as a working position;
- Fig. 3 shows a simplified section of the deck plan of the boat in the configuration of Fig. 2;
- Fig. 4 shows a partial view of a cross-section of the boat of Fig. 1, relating to the portion of the boat that goes from the deck plan downwards, performed through a vertical plan passing through the longitudinal center line of a pair of panels;
- Fig. 5 shows a partial view of a cross-section of the boat of Fig. 1, relating to the portion of the boat that goes from the deck plan downwards, performed through a vertical plan passing through a longitudinal end area of a pair of panels;
- Fig. 6 shows a view similar to that of Fig. 4, with the panels in the opening configuration of Fig. 2;
- Figs. from 7 to 12 show in detail, in transverse or longitudinal partial sections with respect to the boat, various areas in which there are mechanisms for guiding and moving the solar panels in the space formed in the thickness of the deck plan: Fig. 7 shows

in cross-section, a mechanism for actuating the panels, Fig. 8 shows the actuation mechanism of Fig. 7 in a longitudinal section; Fig. 9 shows a cross-section of a support for supporting and centering/aligning the panels, Fig. 10 shows a longitudinal section of the support for supporting and centering/aligning of Fig. 9, Fig. 11 shows a longitudinal section of a central area of the boat in which in the closed configuration two panels are partially superimposed, Fig. 12 shows in section a longitudinal side area of the boat in which in the vertical thickness there is only one panel.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] With reference to the figures, a boat, 20, according to the present invention comprises a retractable photovoltaic assembly.

[0017] The boat 20 is for example a pleasure boat with a hybrid engine with one or two diesel engines and one, two or four electric motors, and batteries sufficient to allow hybrid or even only electric propulsion. However, in other embodiments, the boat, while preferably remaining a pleasure boat, could also be a sailing vessel in which the photovoltaic complex is intended to supply on-board users other than propulsion engines.

[0018] The boat comprises housings 2 formed in correspondence with horizontal bulkheads, roofs, or other substantially horizontal structural supporting elements. For example, in the depicted embodiment, there are extended housings transversely obtained in the thickness of the deck plan, and longitudinal housings formed in the thickness of the walking surface of the flybridge, i.e. the dividing plan between the flybridge and the underneath main cabin cruiser. Obviously in boats of different types, longitudinal and/or transverse housings 2 can be obtained in correspondence of each deck of the boat (for example in common pleasure boats we can consider the actual deck plan, set to "cover" the deadwork of the hull). The thickness of the horizontal supporting structure is increased and the horizontal supporting structure is internally hollow so that inside it are housed the housings 2 provided with horizontal sliding members perpendicular or parallel to the longitudinal axis of the boat 20, through which are moved structural panels, 3, 4, in carbon fiber or lightened alveolar fiberglass, or other, on which are applied solar panels, 26.

[0019] In the housings 2 of the roof, that is to say within the thickness of the roof of the cabin below the flybridge, suitably increased with respect to that of a conventional boat, are included structural panels 3, arranged to slide along the longitudinal axis of the boat 20 in order to exit from front openings of the roof.

[0020] Similarly, in the housings 2 of the deck plan, suitably increased with respect to that of a conventional boat, are arranged structural panels 4, arranged to slide along the transverse axis of the boat 20 in order to exit from a series of openings in the hull held closed with end

covers, 5, of the structural panels which, when the photovoltaic system is not in use, that is to say in the closure configuration of Fig. 1, are coplanar to the side of the hull itself with the boat in this configuration taking on an aspect similar to many other boats of similar type and tonnage. The end covers 5 of the panels constitute a protruding perimetral abutment which stops the retraction movement at the end of the stroke towards the stop position on the side of the hull. On this abutment there is a soft rubber gasket that makes the internal compartment air-tight with respect to external splashes potentially coming from waves or from meteoric precipitations.

[0021] Said covers 5 are only the part that is always in view, designed to protect against the infiltration of meteoric, washing or marine water. The rear panels 3 and 4 can therefore come out, by means of mechanisms which will be described later with reference in particular to the panels 4 of the deck plan, being understood that similar mechanisms are adopted in the housings of the roof plan.

[0022] In Fig. 3, which represents a simplified view of the deck plan, are shown the two series of structural panels 4 extending outwardly from the hull on the starboard side and on the left side of the boat 20. In the position of maximum extraction and therefore of maximum protrusion out of its housing, each structural panel 4 is sized to withstand a load greater than a person's weight. Furthermore, the panels 4 are in shape, quantity and dimensions conditioned by the size of the boat in general, and by the possibility of sliding the panels themselves, in relation to structures or systems of which the boat is equipped; especially with regards to overall dimensions, connections and systems or vertical walkways.

[0023] With reference to Figs. 4 and 5, the right and left panels 4, when completely retracted (Fig. 4), overlap for a good part of their length, in order to preserve a section embedded in the hull that ensures the necessary resistance to bending due to the relevant overhang of the protrusion when they are in the operating position (Fig. 6). The housing 2 inside which the structural panels 4 are housed is located between the surface of the walkable deck plan, 6, and a false countertop, 11, which branches off into all the rooms of the sleeping area, and of the engine room and of the other environments present at this level. The false countertop 11 will be integrated with a system of sealed laminates equipped with gutters to convey any water penetrated into the housings 2 towards collection points (in the bilge) where are commonly located the pumps for lifting and removing possible meteoric, marine water, or other. Moreover, the false countertop 11 is removable so that by removing the false countertop 11 it is possible to inspect, maintain and clean the members/systems, that is to say the housings 2, the structural panels 3 and 4 and the relative support and actuation mechanisms.

[0024] With reference to Figs. from 5 to 12, the sliding members of each panel 4 comprise gears, 8, placed at the end of the shaft of an electric motor, 12, fixed to a vertical structural wall of the boat 20 or to a suitable dif-

ferent structure. Said motor 12, imparts the motion to a metal bracket, 23, integral with the panel 4 on which is placed a long rack (10) (modular) which meshes with the gear 8 of the electric motor 12. By virtue of this actuation mechanism the panel 4 slides towards the inside or the outside of the hull. The metal bracket 23 is held in guide and stiffened by the presence at appropriate intervals of supports with two wheels, 7. The same functions could be performed by means of various other solutions instead of said electric motors (electric actuators, hydraulic cylinders, jacks, etc.). With reference in particular to Fig. 6, inside the housing 2, for each panel 4 there is an electric cable-carrying channel 9, advantageously of the so-called "chain" type, in which are collected and pass the cables connected to the photovoltaic panels 26, which are conveyed to a small electrical panel (not shown), from which the current produced flows into a switchboard. From the latter, the electromotive force switches to an inverter system, storage in batteries and propulsion management not shown as they are outside the scope of the present discussion.

[0025] Where there are no relevant functional elements of the actuation mechanism there is a horizontal supporting guide 13, which in the central zone of the boat (Fig. 11) comprises two superimposed and spaced guide elements so as to be structured to support two superimposed structural panels 4, while in the lateral areas (Fig. 12) it includes only one guide element and is therefore structured to support only one panel 4.

[0026] The mechanical handling systems of the panels 4, whether they are those described above or others, admit mechanically reversible movements, so in the event of failures that leave one or more panels protruding from the side, with increasing wave motion or in the need to return quickly to the port, they can be hooked with a sort of small winch and dragged to close by hand. The control logic provides that each panel can be individually moved in order to be able to select partial openings when in restricted areas.

[0027] An alternative embodiment of a boat according to the present invention provides that the photovoltaic complex described above is integrated with other solar panels placed in a "traditionally" way wherever there are adequate conditions and geometries. All of this can make it possible to adopt a real complementary and sometimes substitute propulsion system with respect to the one with an endothermic engine with the aim of allowing the boat, even with flat batteries, to proceed continuously with slow motion, without the use of fuel; or, otherwise, take advantage of the full initial charge of the batteries, moreover constantly supplemented by the energy produced by the solar panels, to navigate for a few hours at a faster speed.

Claims

1. Pleasure boat (20) comprising a retractable photovoltaic complex, said pleasure boat (20) comprising

horizontal bulkheads, roofs, or other structural supporting elements substantially horizontal extended into the vertical direction between a walkable deck plan of an upper plan and a countertop (11) of an under plan **characterized in that** it comprises:

- housings (2) obtained in the thickness of substantially horizontal supporting structural elements,
- structural panels (3, 4) arranged to slide in said housings (2) between a closure configuration in which they are completely inside said housings (2) and an opening configuration in which they protrude outwardly from perimetral openings, solar panels (26) being applied on said structural panels (3, 4),
- a mechanism for actuating said panels (3, 4) suitable for sliding said panels between said closure configuration and said opening configuration.

2. Pleasure boat (20) according to claim 1 **characterized in that** said panels (3, 4) comprise end covers (5) which form a perimetally protruding abutment which stops the retraction movement at the end of the stroke towards the stopping position, on said abutment being present a gasket which makes the internal compartment air-tight with respect to external splashes potentially coming from the waves or from meteoric precipitation.
3. Pleasure boat (20) according to claim 1 or 2, **characterized in that** said panels (3, 4) are made of carbon fiber or lightened alveolar fiberglass.
4. Pleasure boat (20) according to one of the preceding claims, **characterized in that** in the position of maximum extraction and therefore of maximum protrusion out of its housing, each structural panel (3, 4) is sized to support a load greater than a person's weight.
5. Pleasure boat (20) according to one of the preceding claims, **characterized in that** said housing (2) is located between the surface of the walkable deck plan (6) and a false countertop (11) which branches off into all the rooms of the sleeping area, and of the engine room and of other environments present at this level.
6. Pleasure boat (20) according to the previous claim, **characterized in that** said countertop (11) is integrated with a system of watertight laminates provided with gutters to convey any water penetrated into the housings (2) towards collection points.
7. Pleasure boat (20) according to claim 5 or 6, **characterized in that** said countertop (11) can be re-

moved so that by removing the countertop (11) it is possible the inspection, maintenance and cleaning of the organs/systems, that is to say of the housings (2), of the structural panels (3, 4) and of the relative support and actuation mechanisms.

8. Pleasure boat (20) according to one of the preceding claims, **characterized in that** said housings (2) are longitudinal obtained in the thickness of the walking surface of the flybridge.
9. Pleasure boat (20) according to one of the preceding claims, **characterized in that** said actuation mechanism of the panels (3, 4) comprises gears (8) located at the end of the shaft of an electric motor (12) fixed to a structural wall of the boat (20), said motor (12), imparting motion to a metal bracket (23) integral with said panel (3, 4) and on which it is located a rack (10) which meshes with said gears (8).

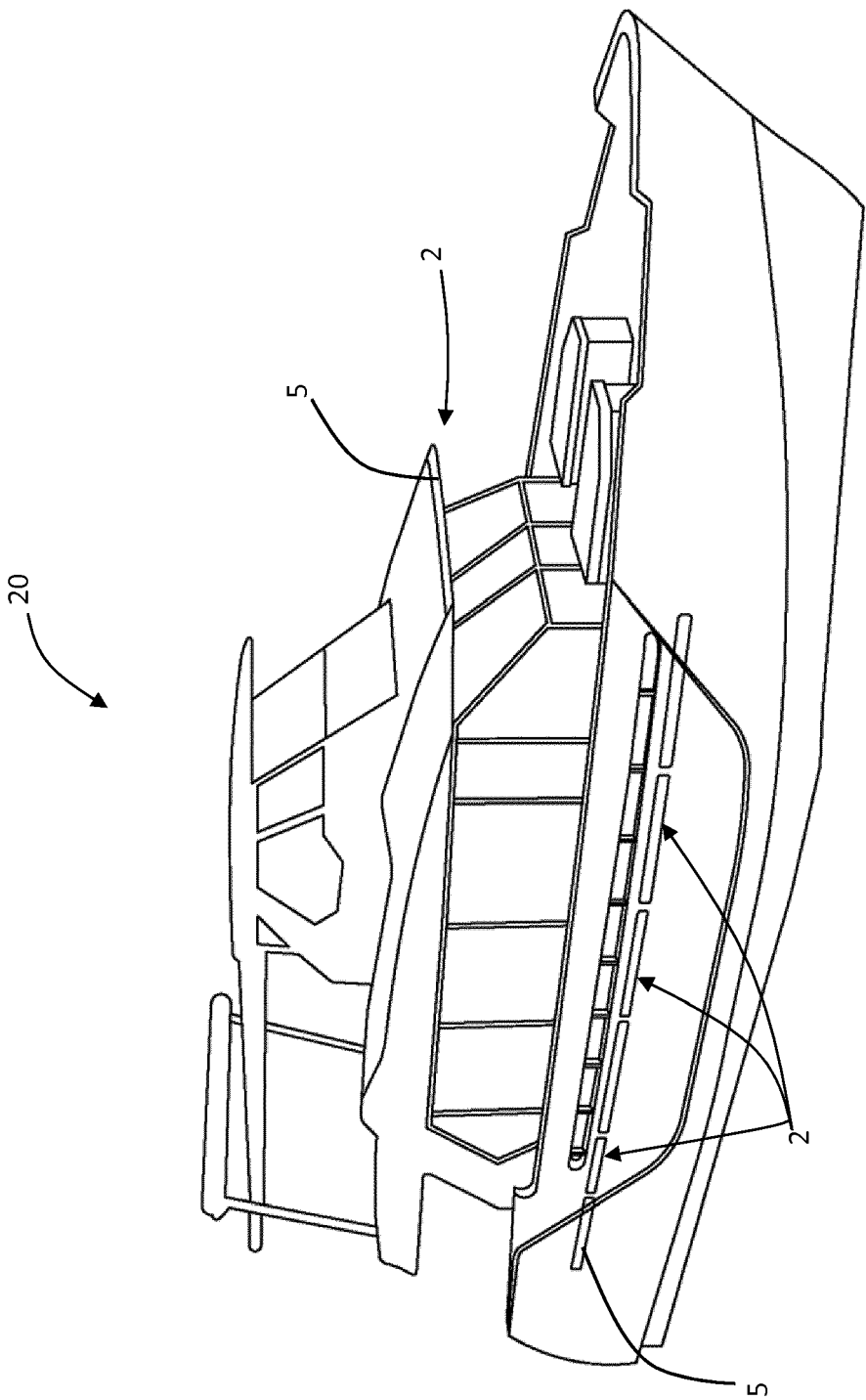


FIG. 1

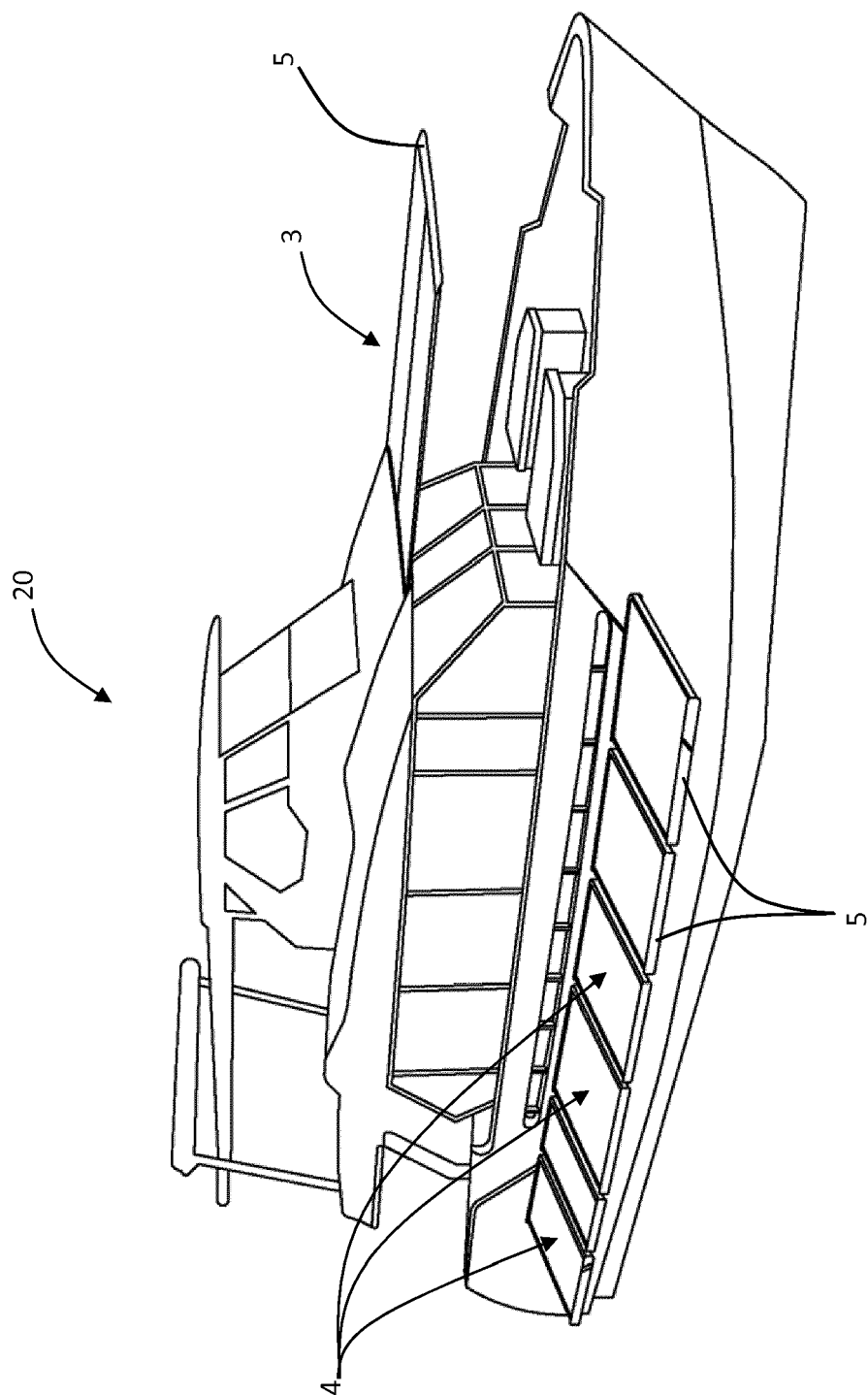


FIG. 2

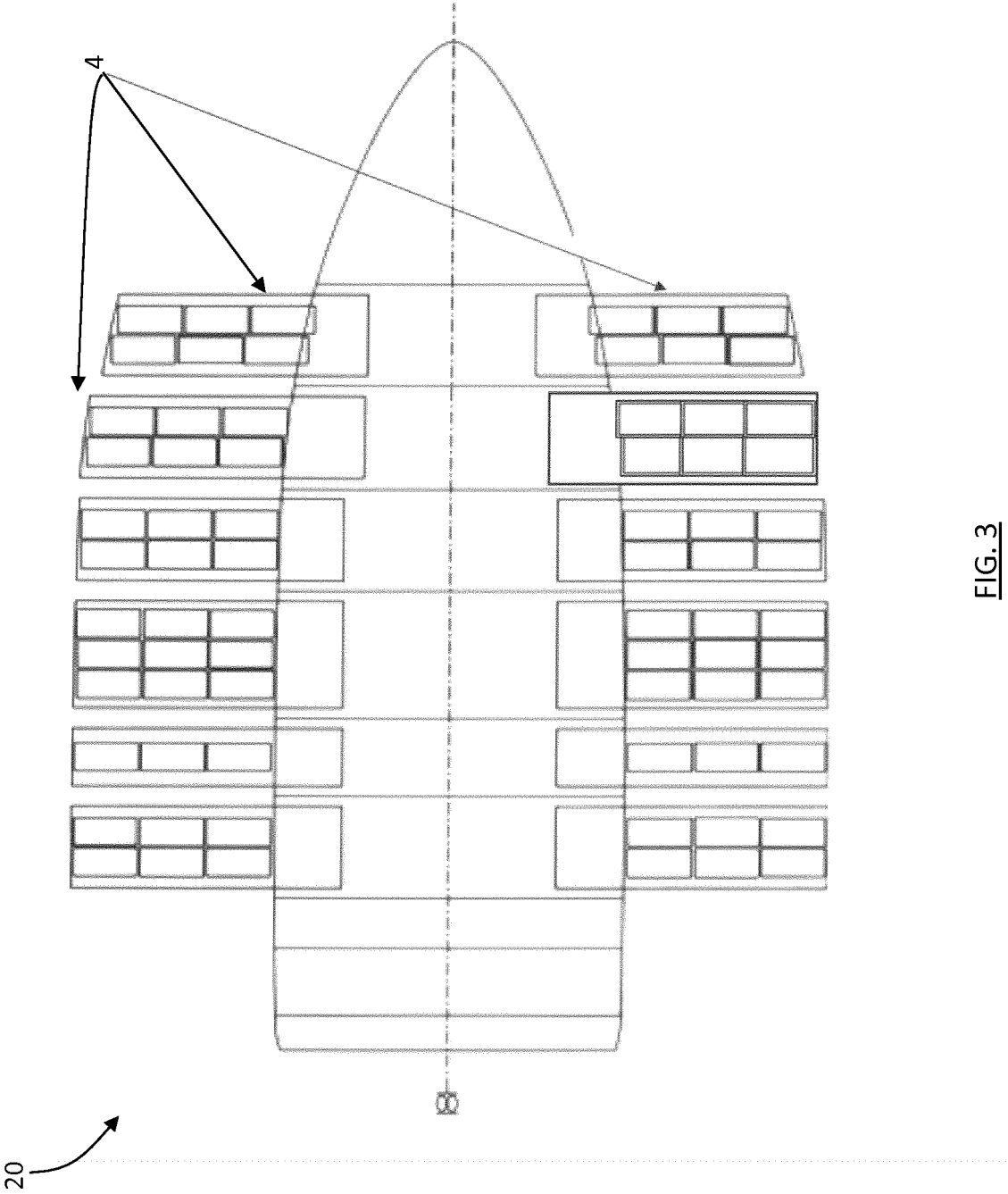


FIG. 3

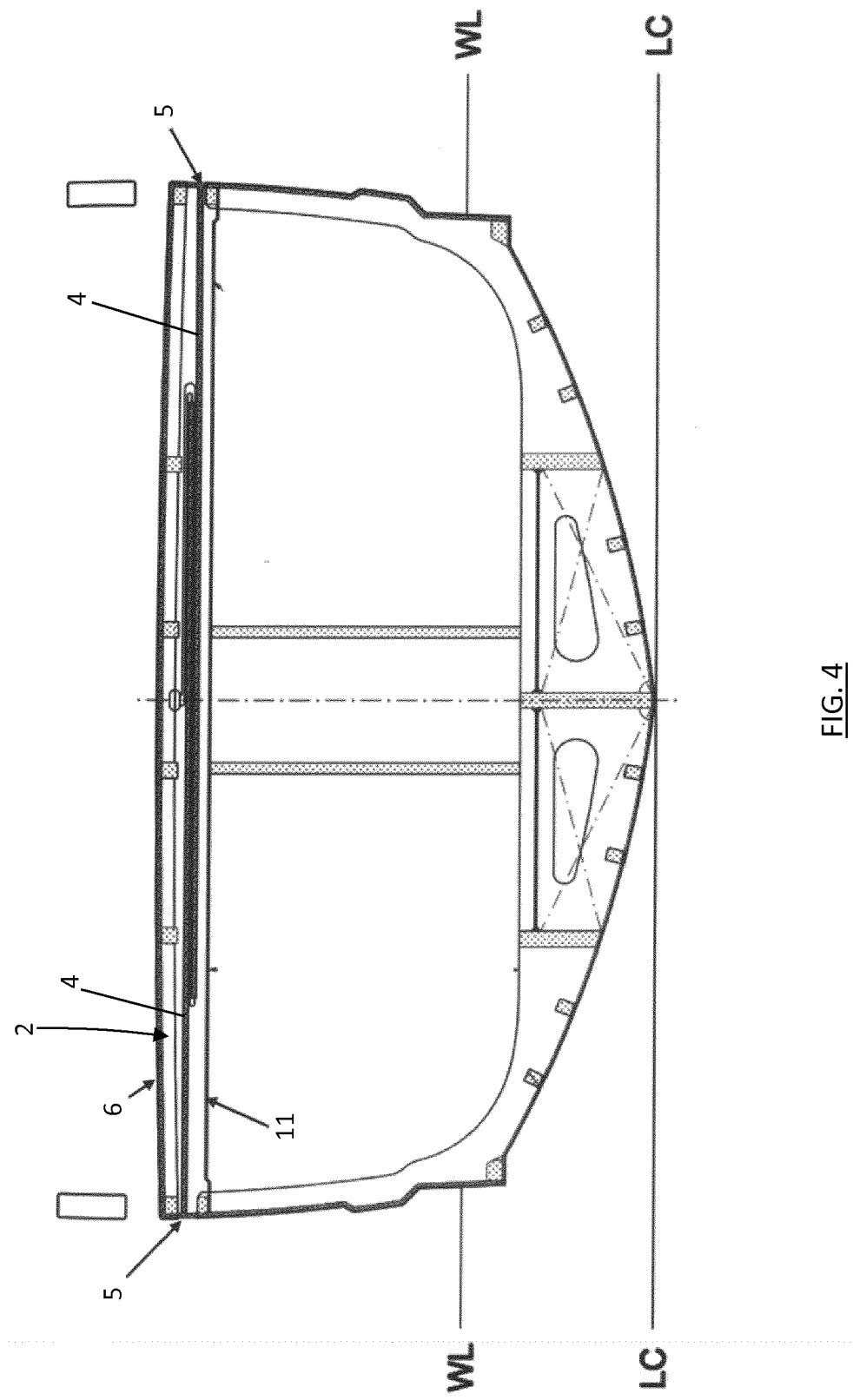


FIG. 4

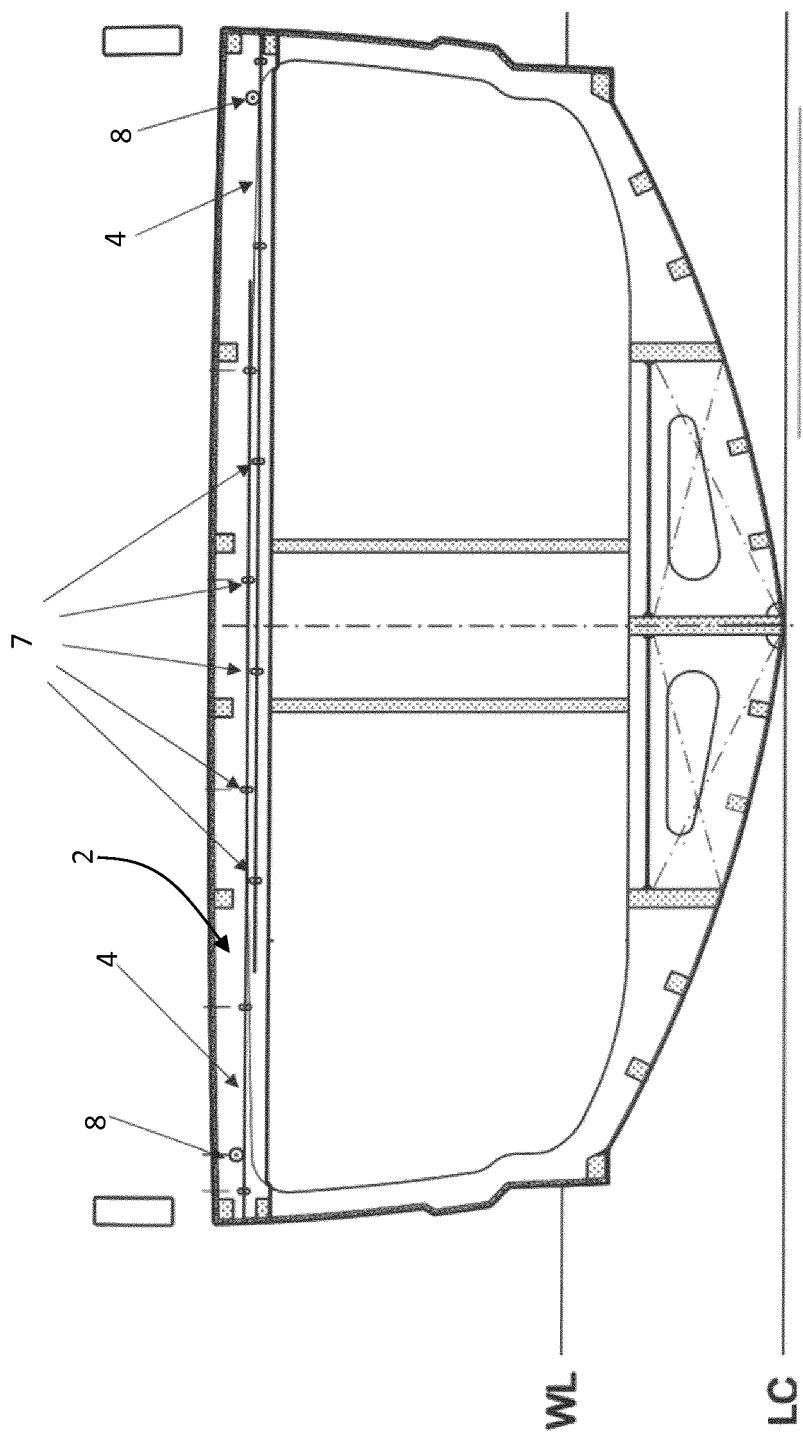


FIG. 5

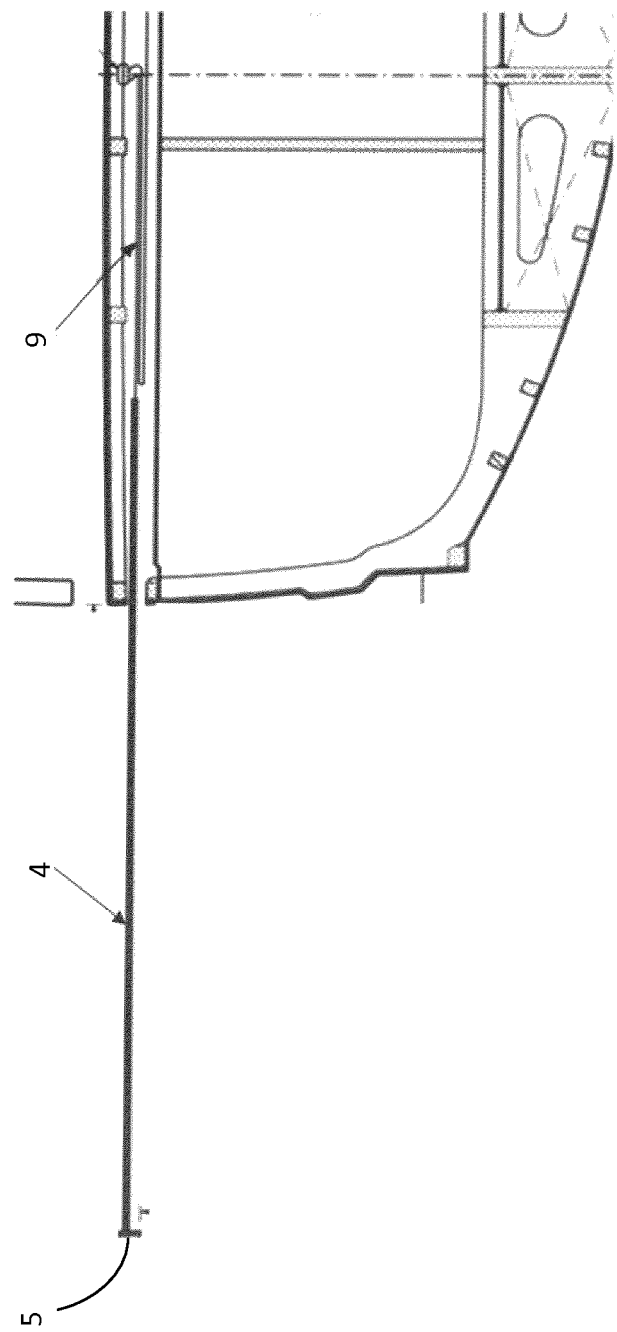


FIG. 6

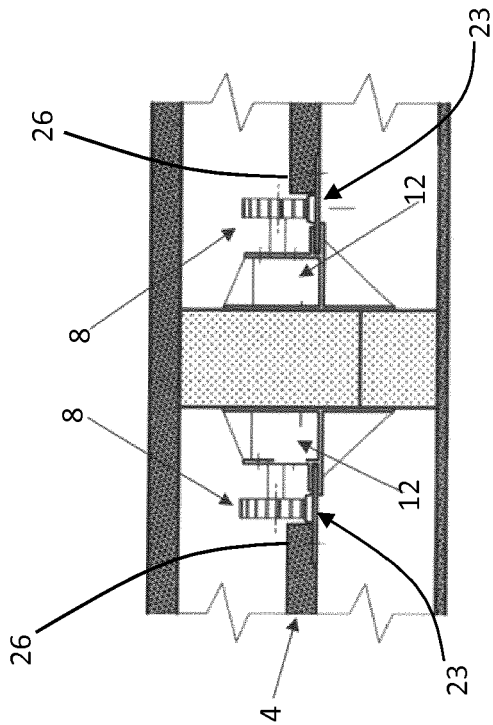


FIG. 8

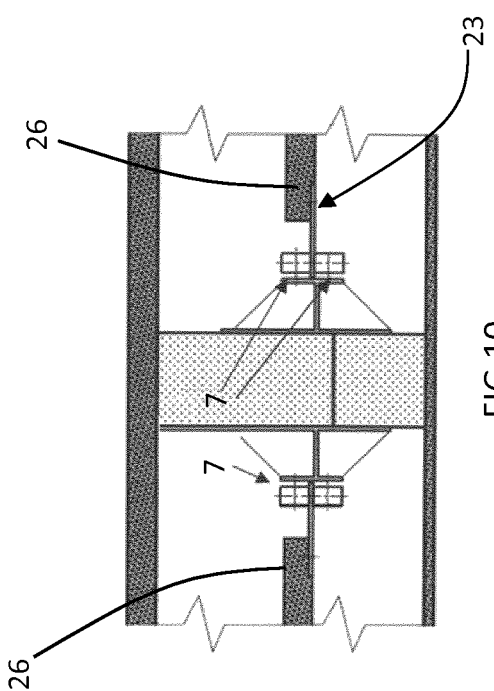


FIG. 10

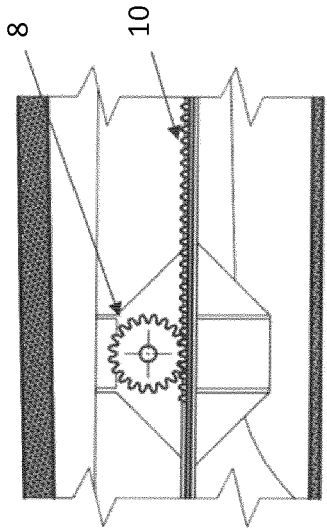


FIG. 7

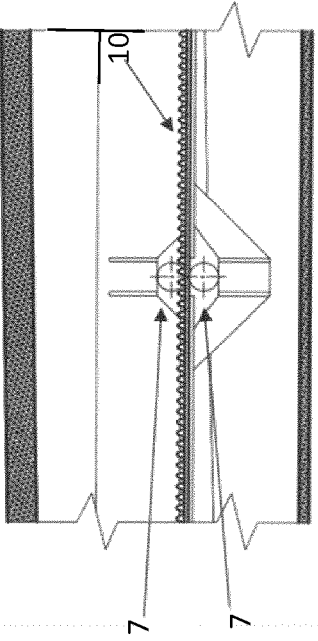
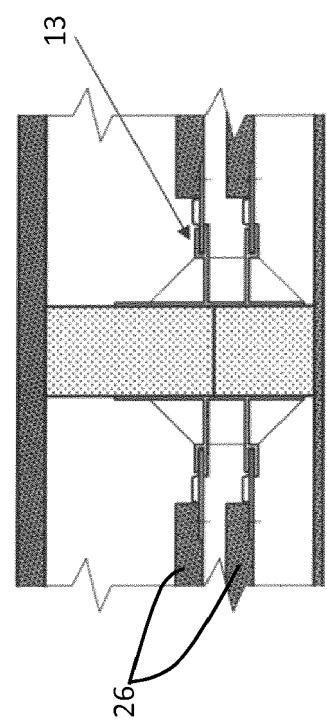
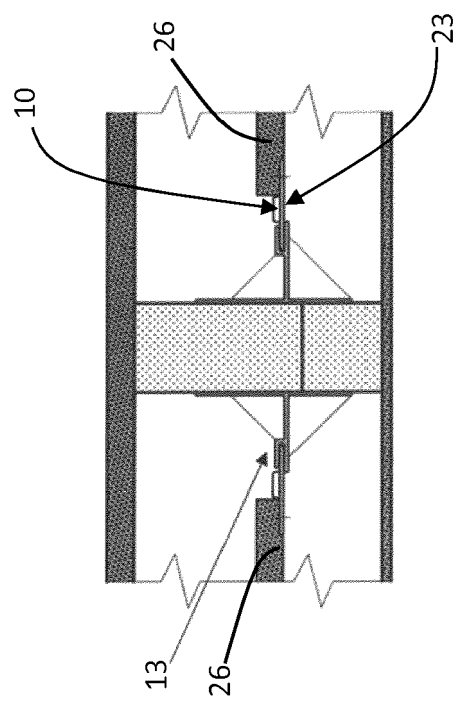


FIG. 9





EUROPEAN SEARCH REPORT

Application Number
EP 19 16 2966

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 17 January 2020	Examiner Balzer, Ralf
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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