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Gehring

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(54) **APPARATUS OF WAVE GENERATORS AND A MOORING SYSTEM TO GENERATE ELECTRICITY**

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(21) Appl. No.: **14/249,910**

(22) Filed: **Apr. 10, 2014**

Related U.S. Application Data

(60) Provisional application No. 61/862,338, filed on Aug. 5, 2013.

(51) **Int. Cl.**
H02P 9/04 (2006.01)

(52) **U.S. Cl.**
USPC **290/53**; 290/42

(58) **Field of Classification Search**
USPC 290/42, 43, 53, 54
See application file for complete search history.

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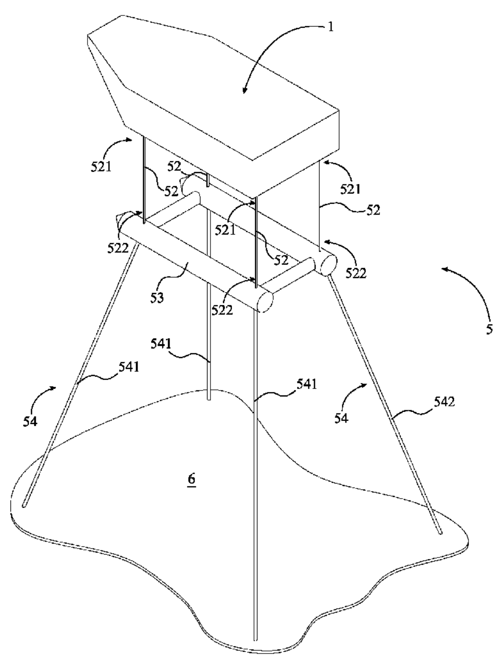
Primary Examiner — Nicholas Ponomarenko

(57) **ABSTRACT**

An apparatus of wave generators and a mooring system is used to generate electricity includes a floating hull and an anti-drift mooring system. The floating hull that functions as the floating member is tensionably coupled with a subsurface environment by the anti-drift mooring system, where the anti-drift mooring system can include different embodiments depending on the subsurface environment. Articulated pulley systems of the floating hull allow the anti-drift mooring system to efficiently maximize the power output of wave generator units of the floating hull as the articulated pulley systems and the wave generator units are positioned within the floating hull.

16 Claims, 23 Drawing Sheets



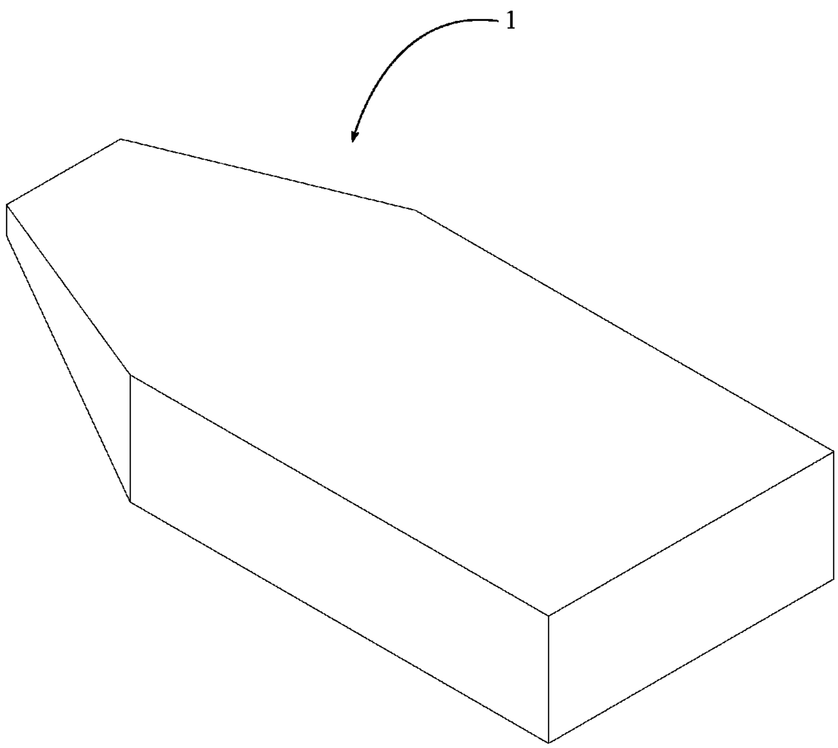


FIG. 1

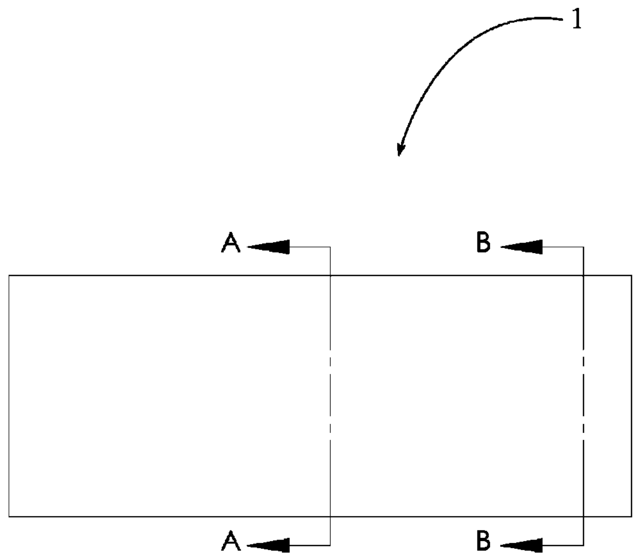


FIG. 2

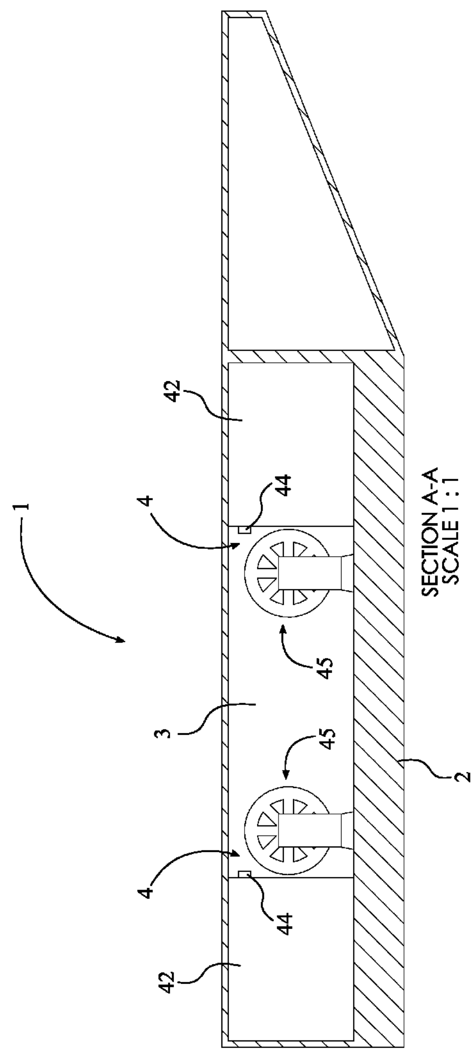


FIG. 3

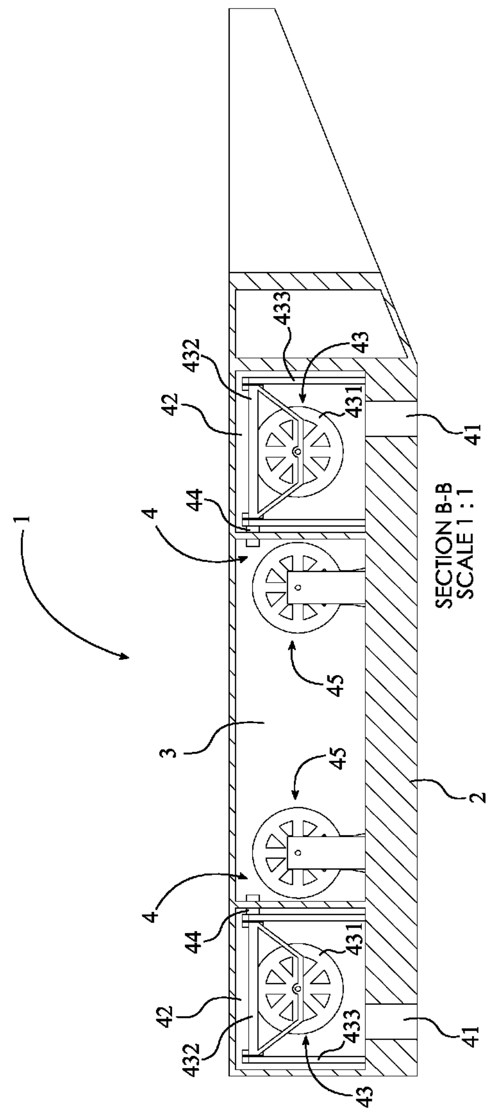


FIG. 4

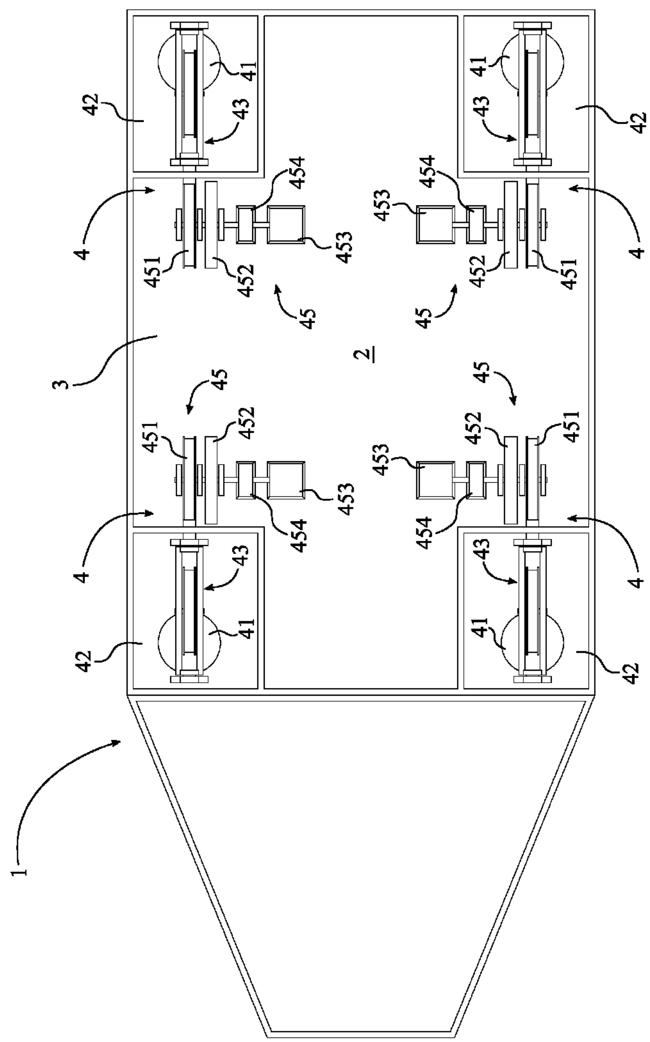


FIG. 5

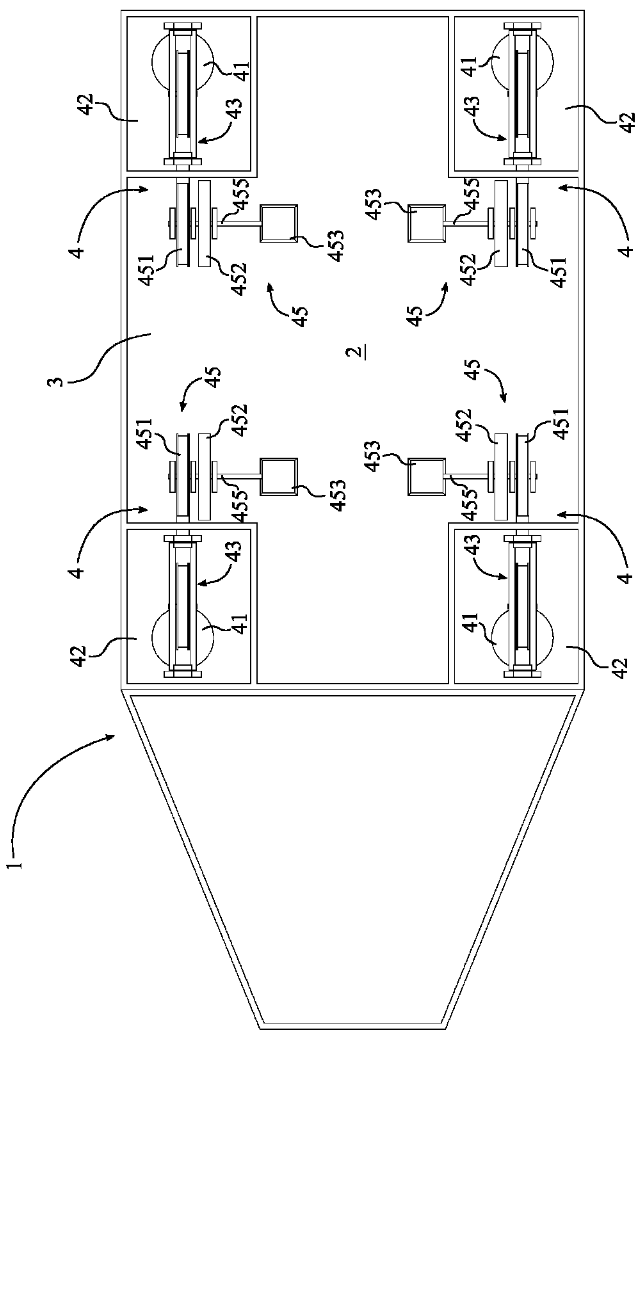


FIG. 6

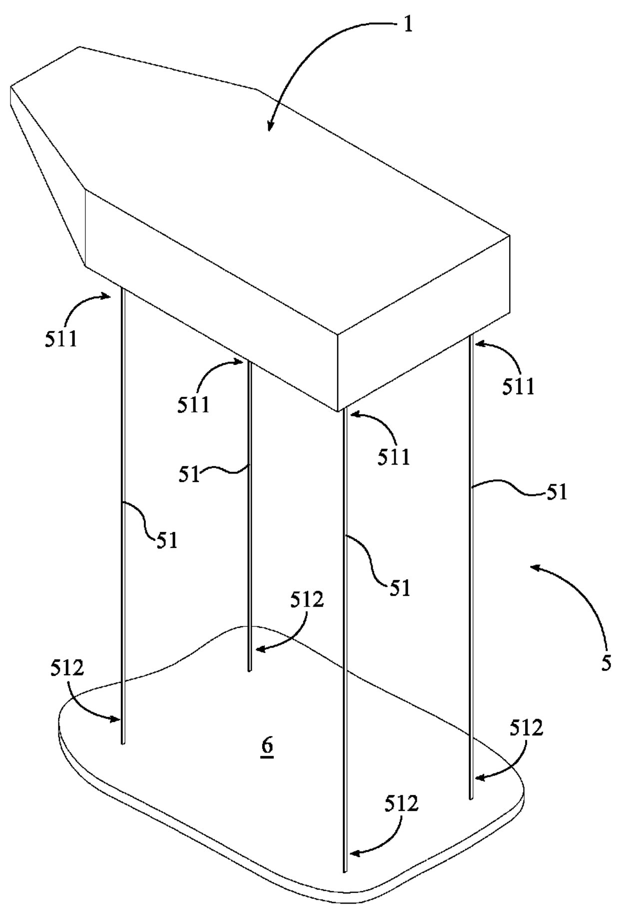


FIG. 7

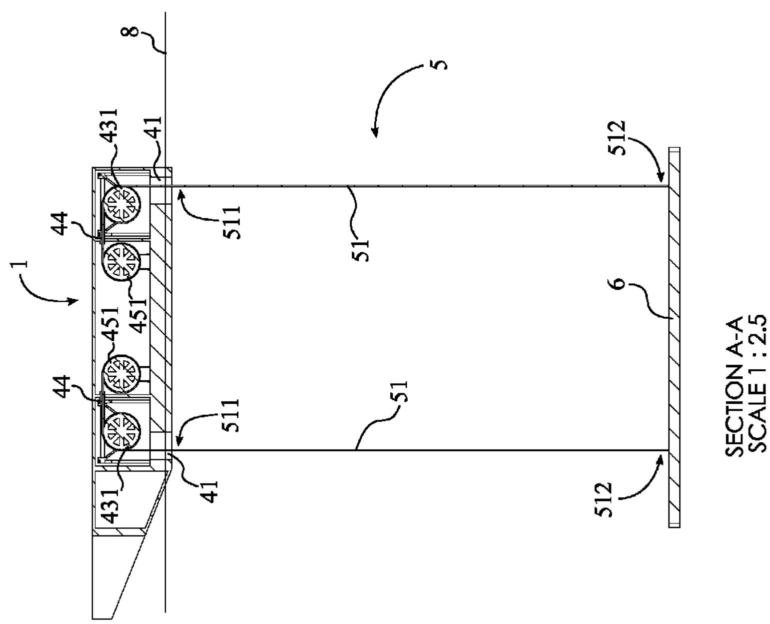


FIG. 9

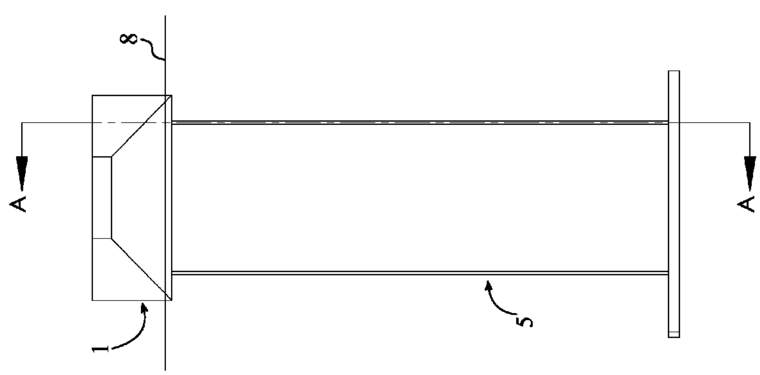


FIG. 8

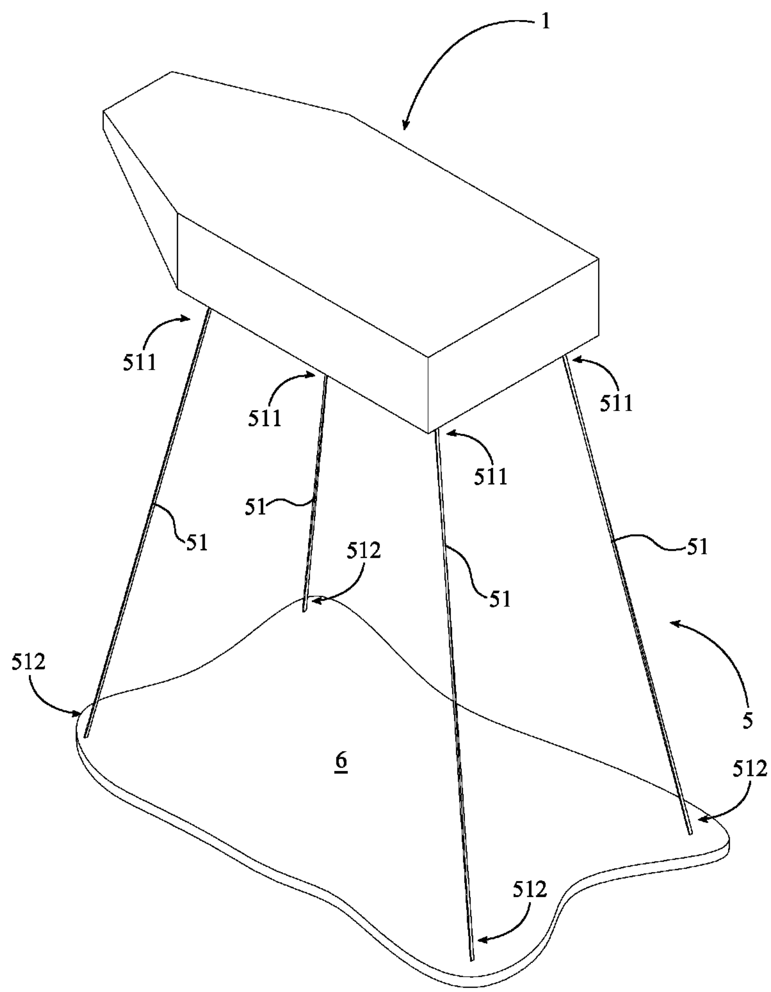


FIG. 10

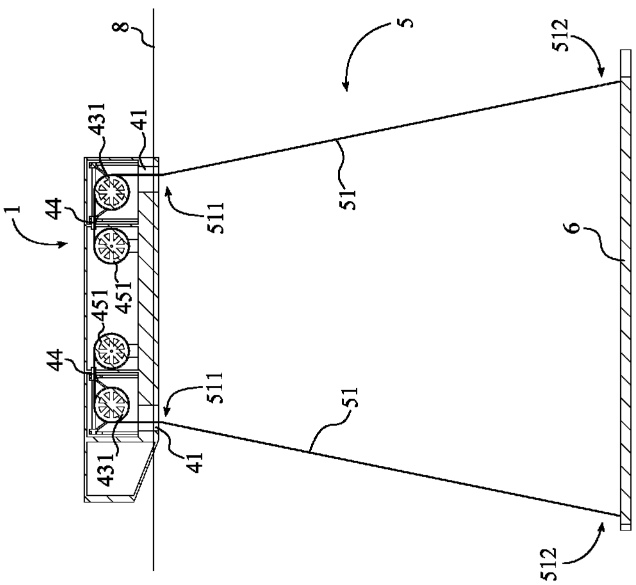


FIG. 12

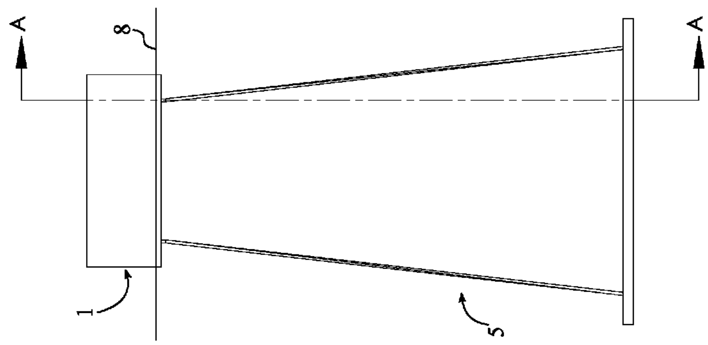


FIG. 11

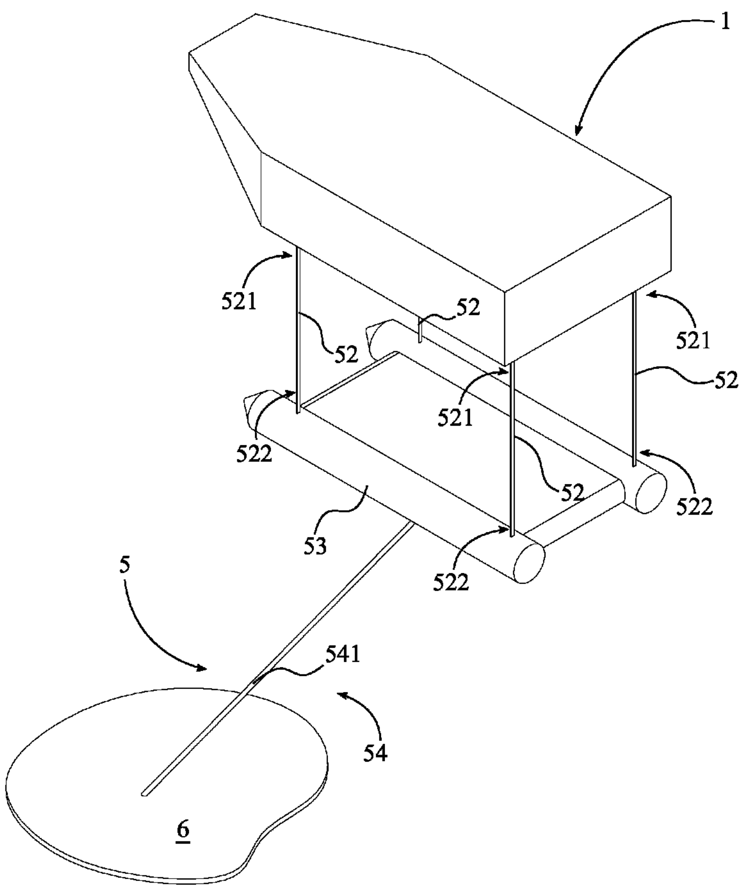


FIG. 13

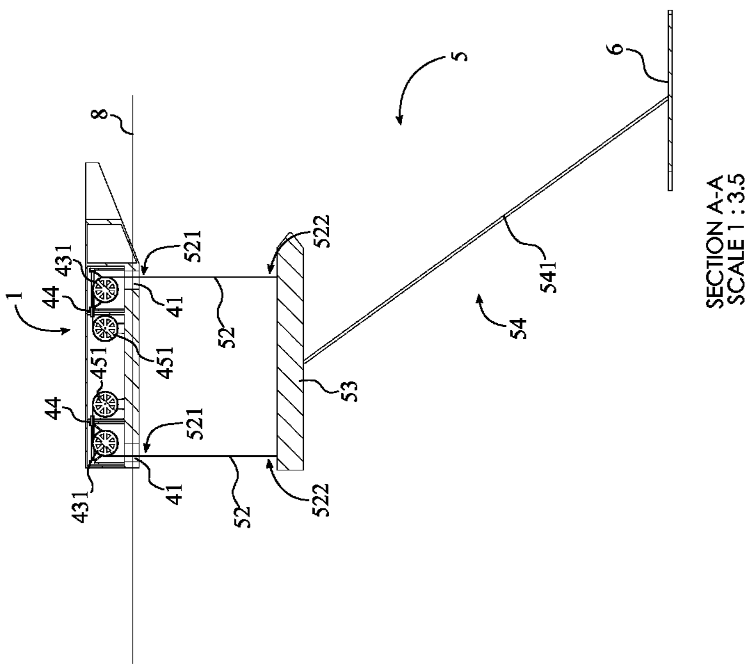

1
5
6
8
41
44
52
53
54
431
451
521
522
541
SECTION A-A
SCALE 1 : 3.5

FIG. 15

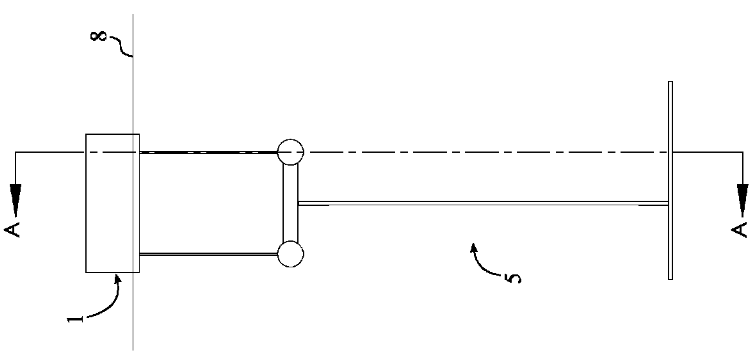

A
A
1
5
8

FIG. 14

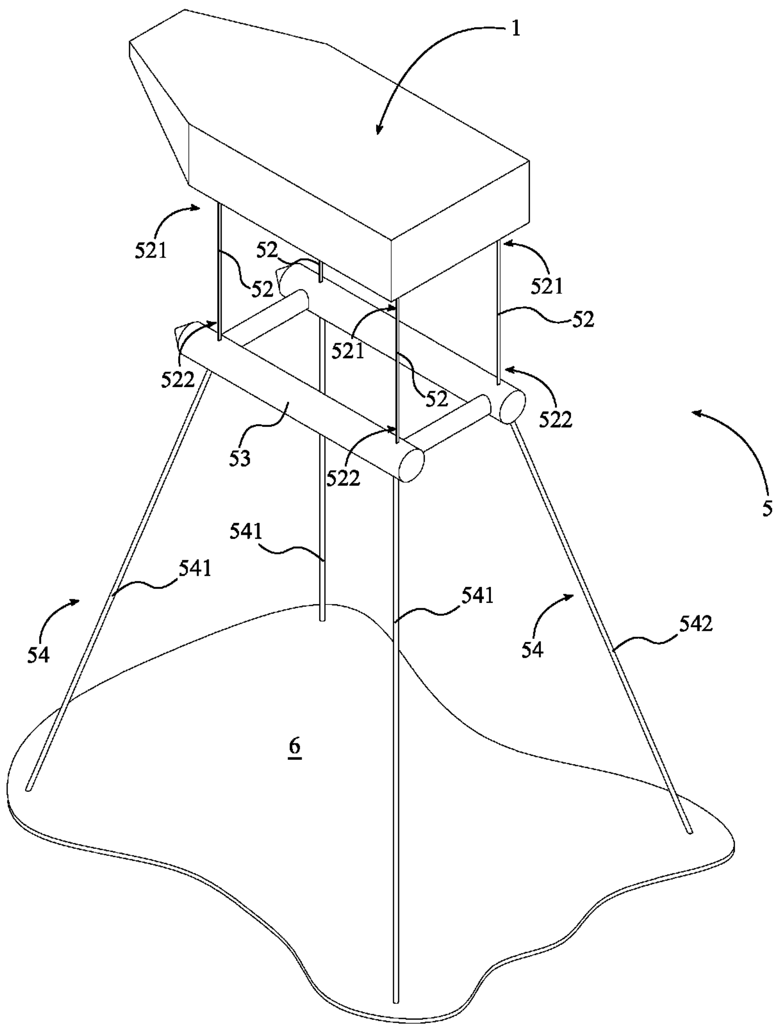
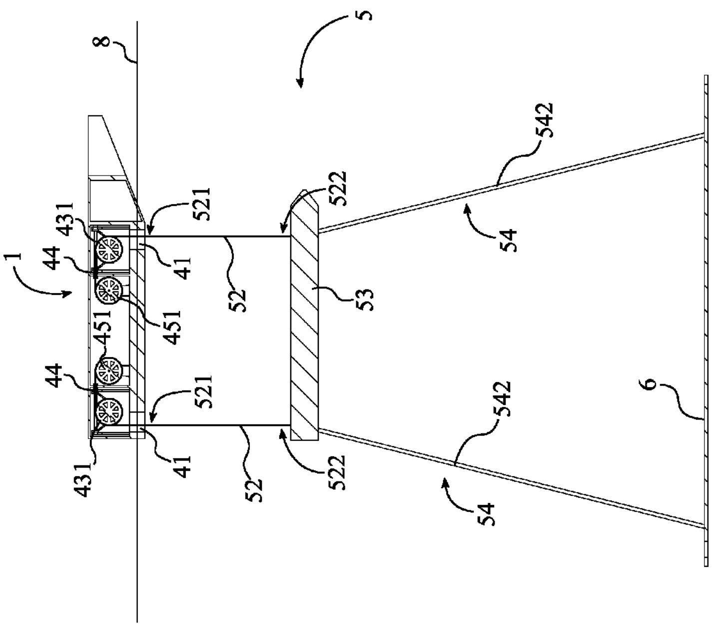


FIG. 16



SECTION A-A
SCALE 1 : 3.5

FIG. 18

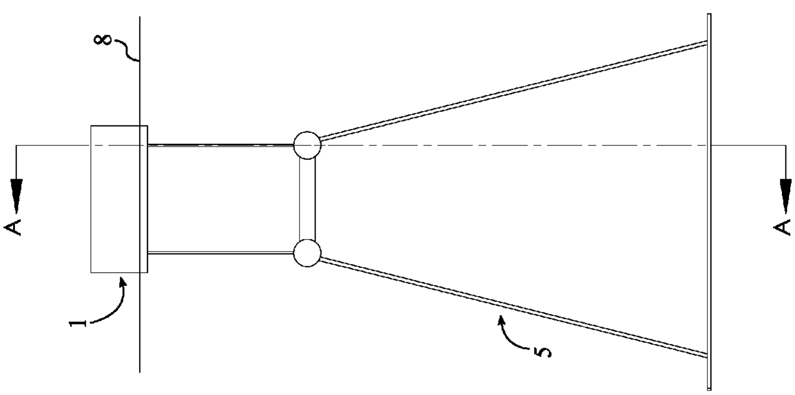


FIG. 17

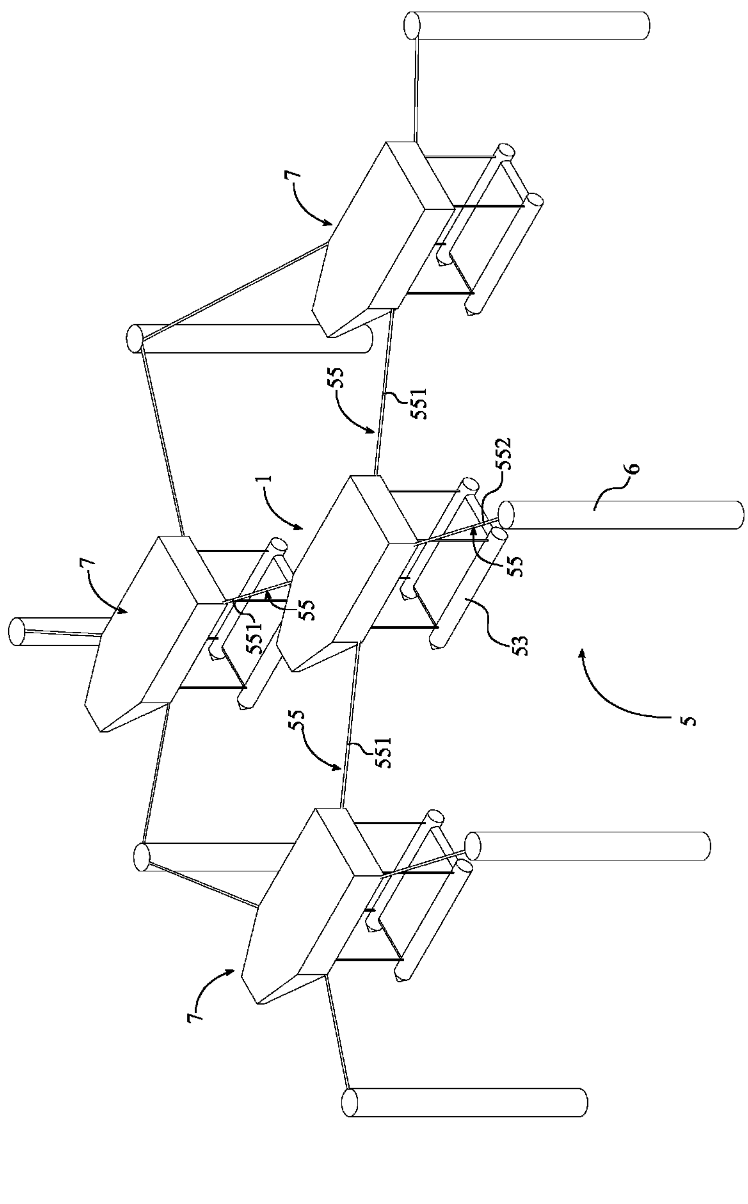


FIG. 19

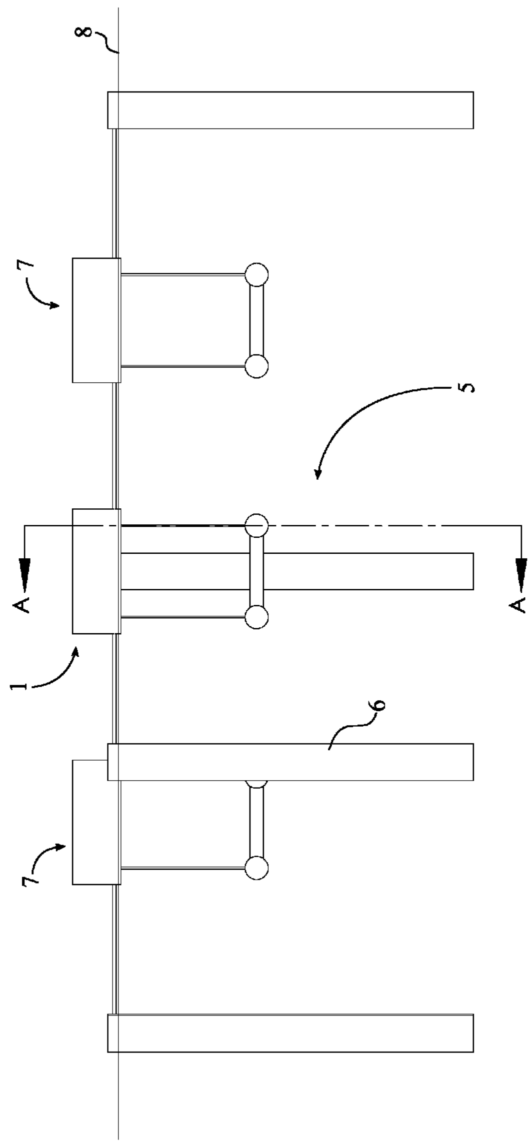


FIG. 20

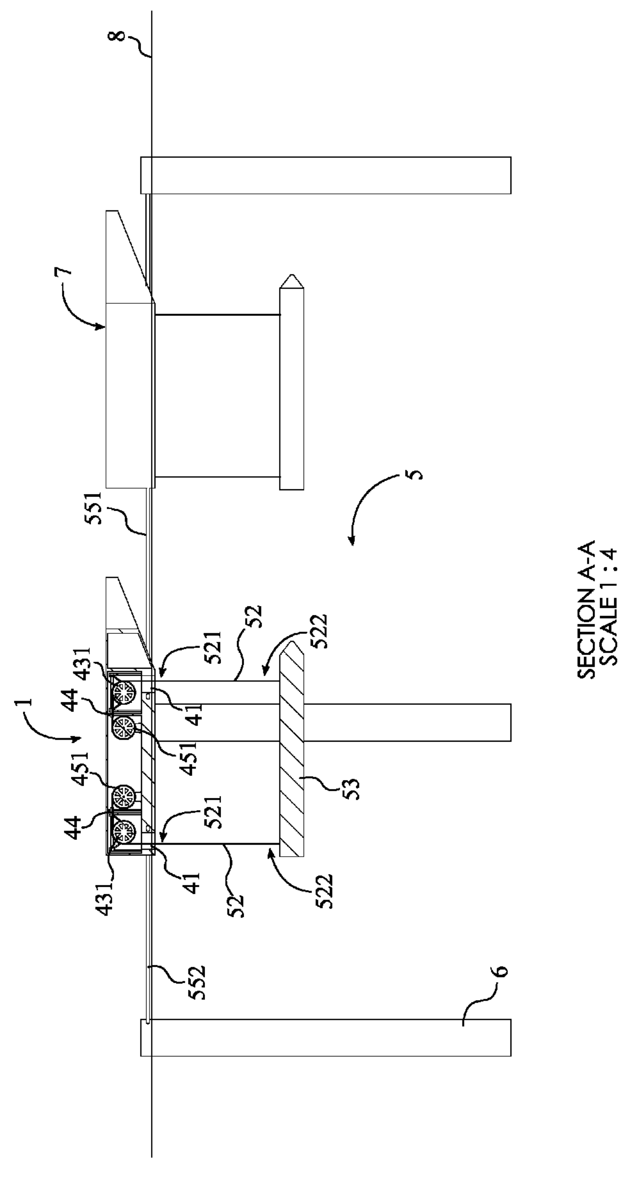


FIG. 21

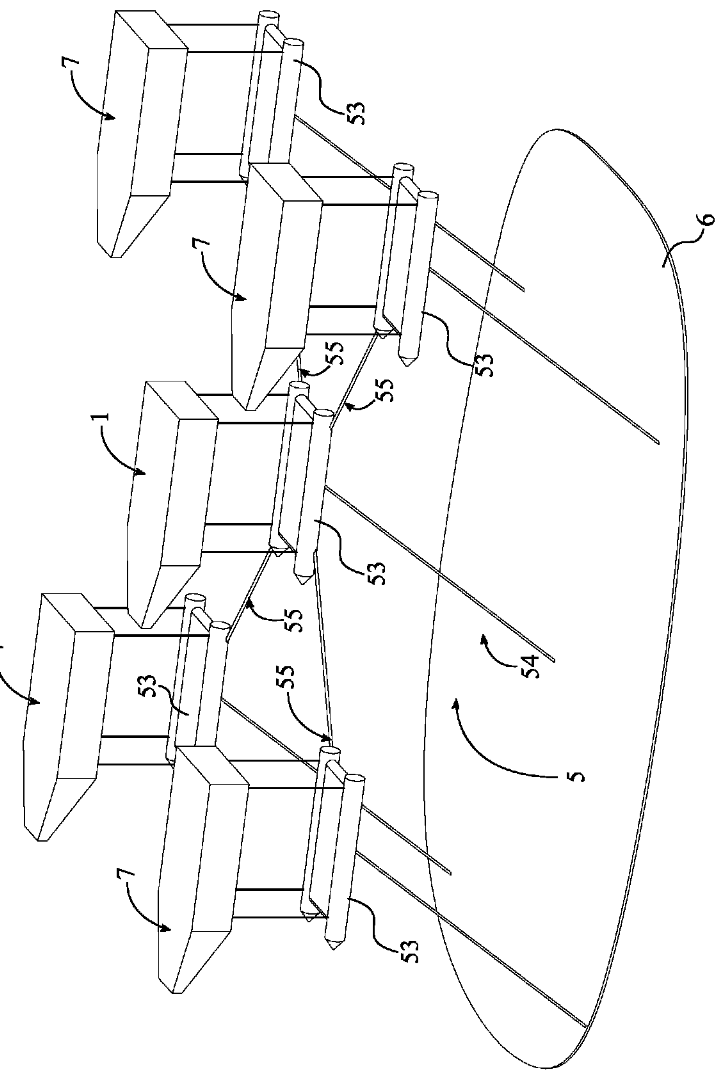


FIG. 22

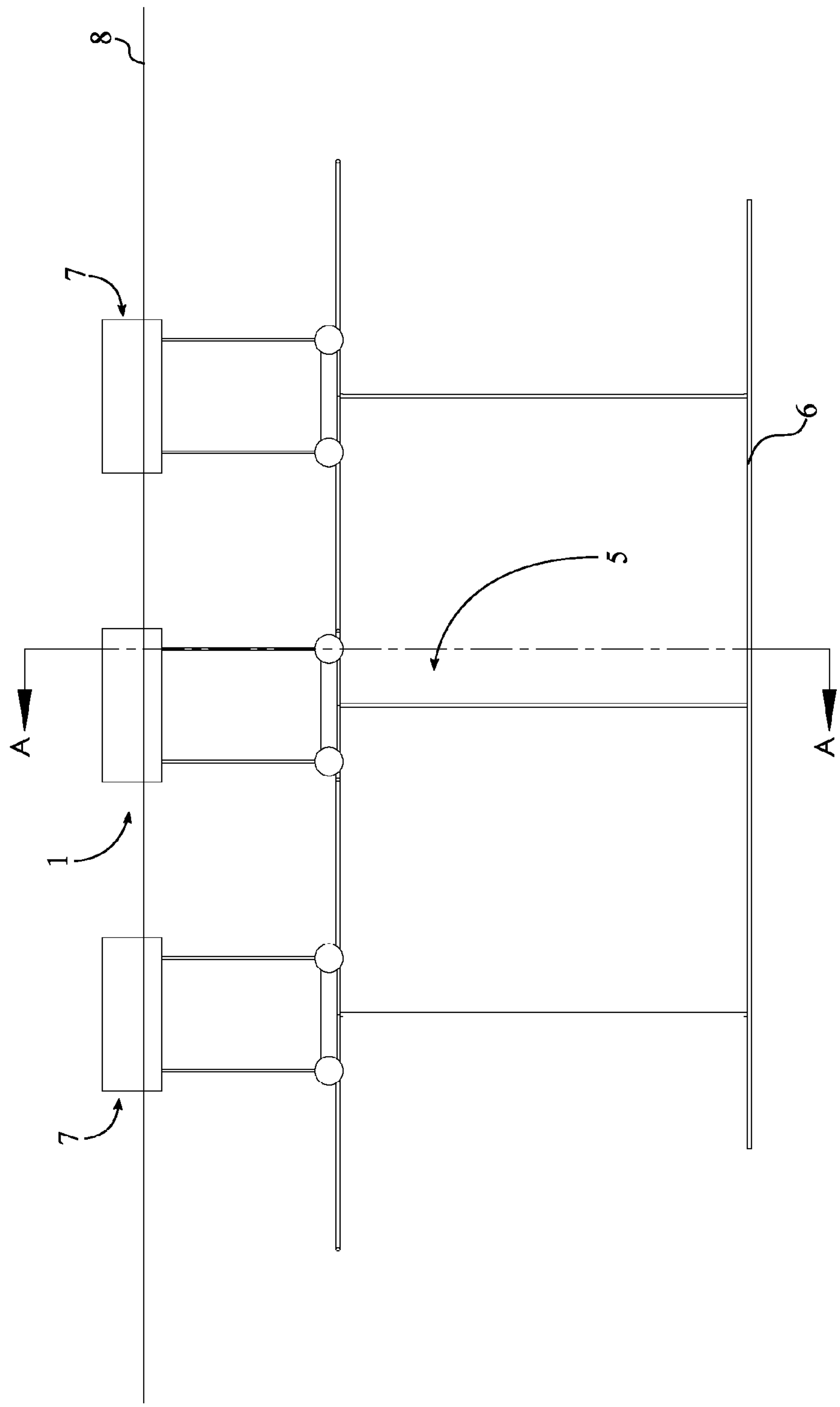


FIG. 23

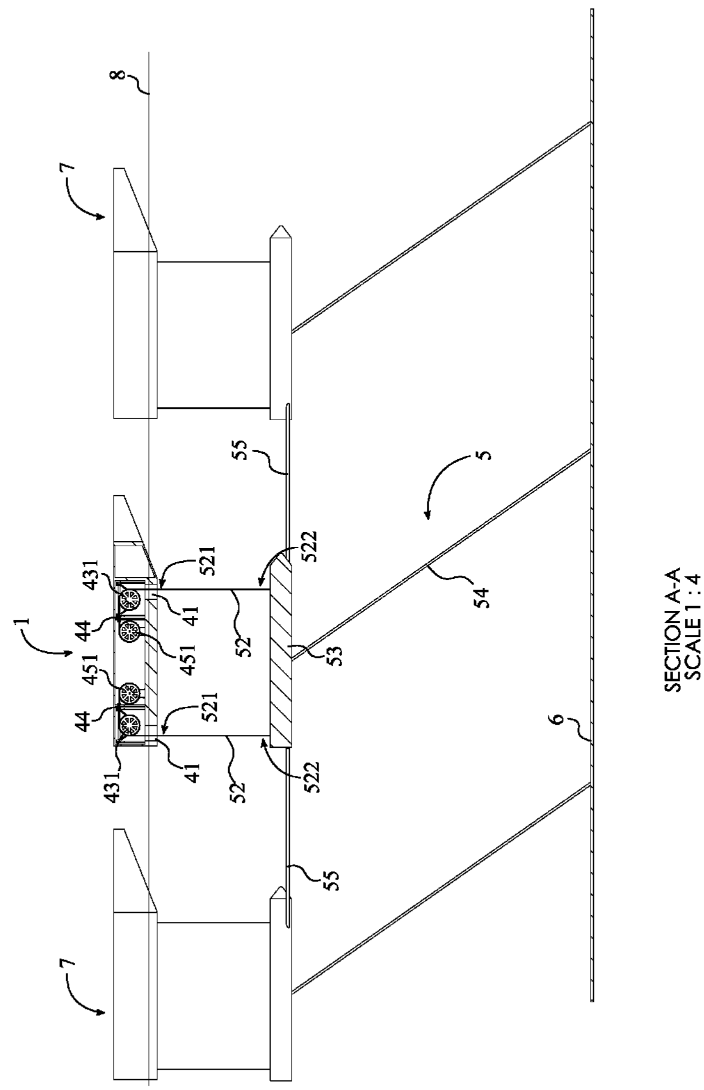


FIG. 24

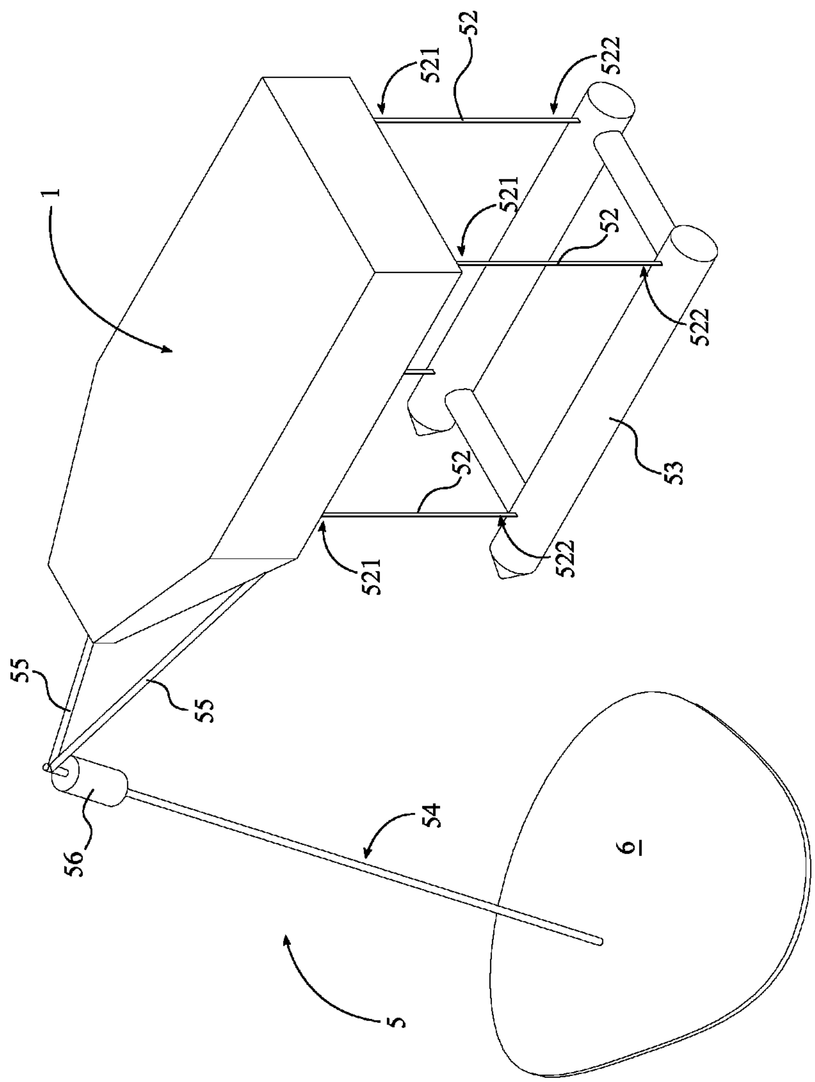
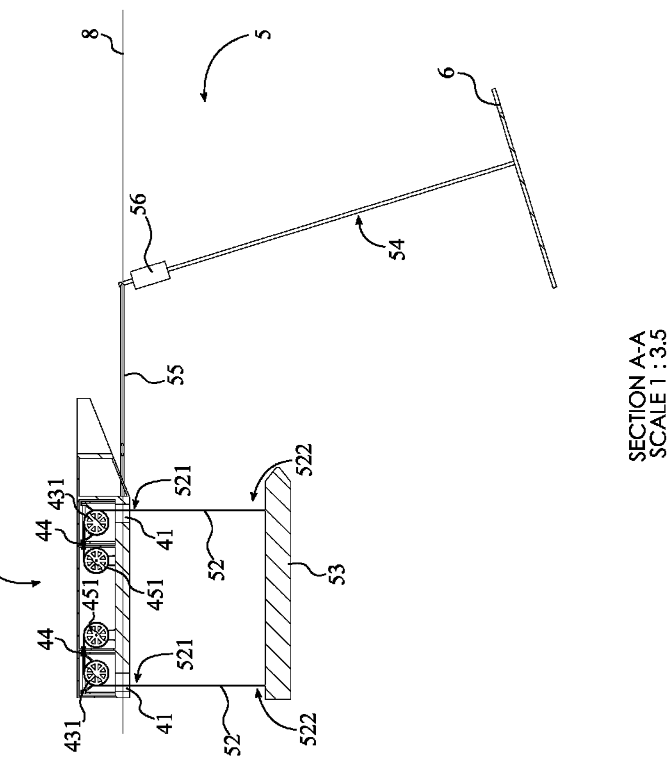


FIG. 25



SECTION A-A
SCALE 1 : 3.5

FIG. 27

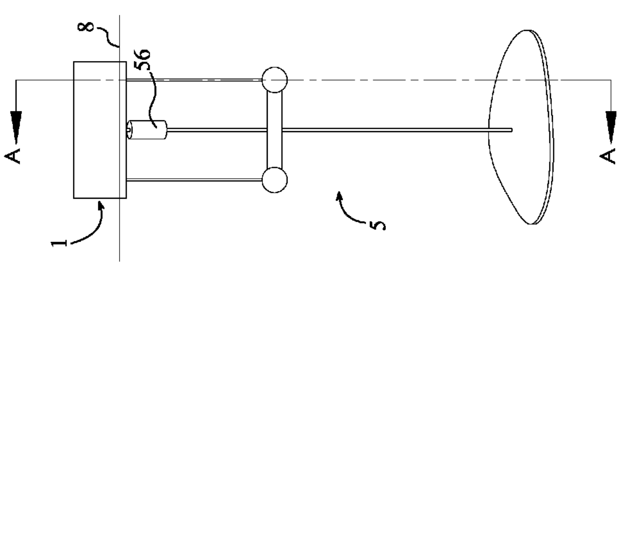


FIG. 26

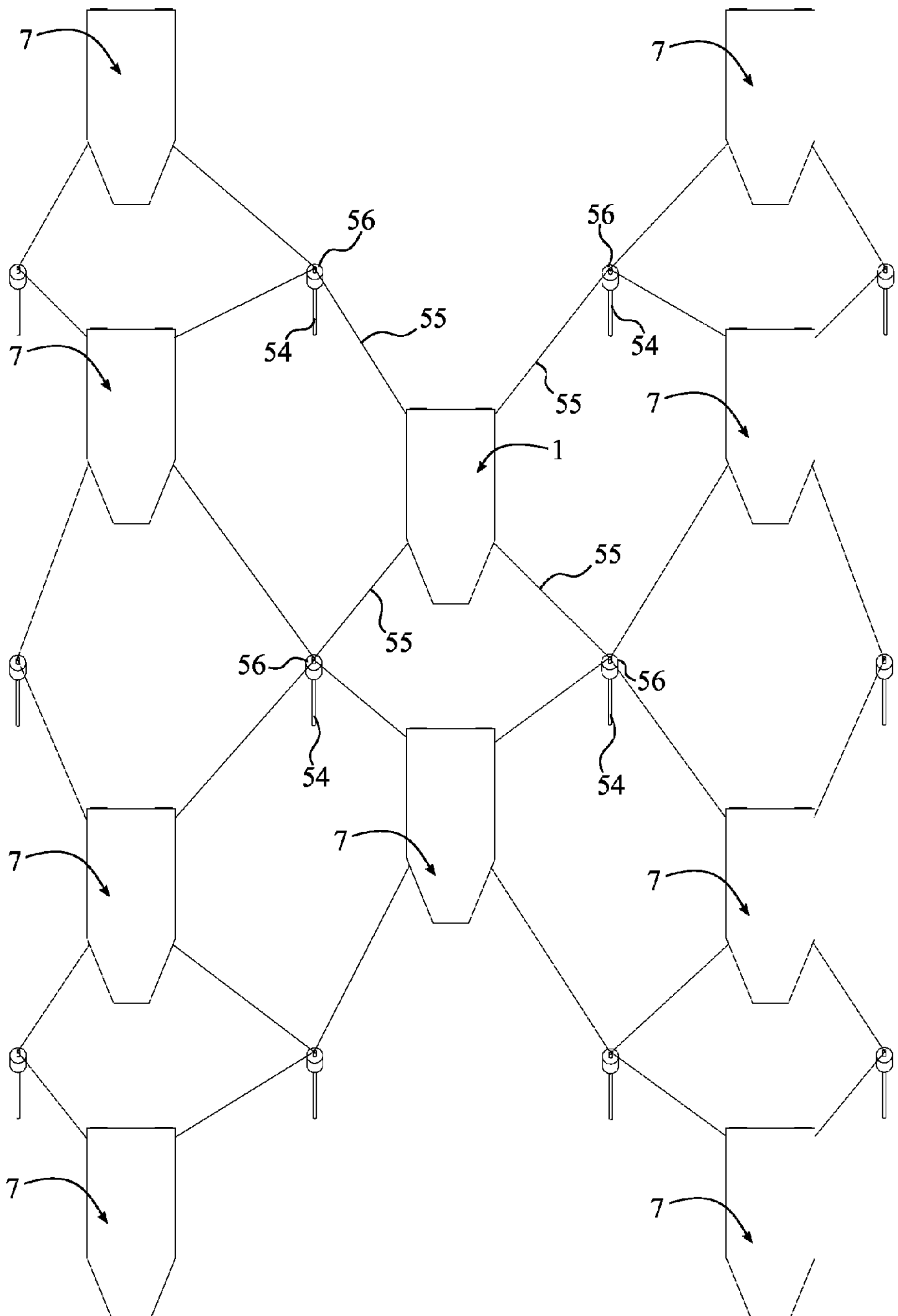


FIG. 28

APPARATUS OF WAVE GENERATORS AND A MOORING SYSTEM TO GENERATE ELECTRICITY

The current application claims a priority to the U.S. Provisional Patent application Ser. No. 61/862,338 filed on Aug. 5, 2013.

FIELD OF THE INVENTION

The present invention relates generally to power generation. More specifically, a floating hull and an anti-drift mooring system of the present invention collectively convert the marine wave forces into electrical energy.

BACKGROUND OF THE INVENTION

There are many sources of hydro-electric generating potential found in the moving water of rivers, tidal estuaries, and the oceans. The largest of all hydro-electric potential is found in the oceans in the form ocean current and ocean waves. The present invention focuses on harnessing the ocean wave energy. One of the unique methods of hydroelectric generation is to utilize the movement of marine waves. Marine waves are generated by the winds. The longer the distance over which the wind blows (also known as the fetch), the higher the wind velocity and the longer the duration of wind, the higher the waves. In some areas of the world the waves are normally very high because of the favorable wave making conditions. The normally high wave areas are likely to produce the best development economics for wave power generation. These large waves are found in deepwater harsh open ocean areas. The present invention can operate in these harsh open ocean areas from shallow water to ultra deep water opening up the power of most of the oceans to provide virtually unlimited renewable energy for the future without harming the environment.

Even though there are some hydro electric generators which use marine waves to produce power, most of these hydro electric generators are not able to capture significant amounts of wave energy due to their relatively small surface areas of wave exposure. Most of these generators limit the size of these surface areas due to the large forces that will be imposed on the system under maximum 100 year storm conditions so that the large forces don't damage the system.

It is therefore an objective of the present invention to provide a large floating hull and mooring system able to provide significant power in most water depths and still have the ability to survive maximum 100 year storm events. A light minimum draft low drag coefficient floating object on the ocean's surface, like a life raft, is not move horizontally a significant distance by sinusoidal oceans waves but is moved up and down on the crest of these waves. Horizontally movement of such an object is attributed to the oceans currents and ocean winds. The greatest contributor to horizontal drift is the wind; therefore, a hull with minimum wind area and a low wind drag coefficient will also be subjected to minimum drift forces. This horizontal movement, often referred to as drift, is normally resisted by the use of an anchor, and is often referred to as a mooring system.

This invention uses a large light floating near flat bottom hull which is easily moved up and down dynamically by ocean waves. The vertical force on the bottom of the hull is transferred into the hull's vertical mooring legs. The vertical mooring legs turn the generators and the flywheels as the hull is lifted by the waves. The flywheels keep the generators turning as the hull descends on the trough of the waves. Hull drift is resisted by the horizontal components of force in the near vertical mooring system or by various forms of near horizontal moorings. The best horizontal moorings minimize vertical load components on the hull allowing free hull vertical movement while preventing horizontal drift.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the floating hull of the present invention.

FIG. **2** is a side view of the floating hull of the present invention, showing the plane upon which cross sectional views are taken shown in FIG. **3** and FIG. **4**.

FIG. **3** is a cross section view thereof taken along line A-A of FIG. **2**.

FIG. **4** is a cross section view thereof taken along line B-B of FIG. **2**.

FIG. **5** is a top view of the floating hull of the present invention, showing the gearbox configuration of the present invention.

FIG. **6** is a top view of the floating hull of the present invention, showing the direct-drive configuration of the present invention.

FIG. **7** is a perspective view of the present invention, showing the first configuration of the first embodiment of the anti-drift mooring system.

FIG. **8** is a side view of the present invention with the first configuration of the first embodiment of the anti-drift mooring system, showing the plane upon which a cross sectional view is taken shown in FIG. **9**.

FIG. **9** is a cross section view thereof taken along line A-A of FIG. **8**.

FIG. **10** is a perspective view of the present invention, showing the second configuration of the first embodiment of the anti-drift mooring system.

FIG. **11** is a side view of the present invention with the second configuration of the first embodiment of the anti-drift mooring system, showing the plane upon which a cross sectional view is taken shown in FIG. **12**.

FIG. **12** is a cross section view thereof taken along line A-A of FIG. **11**.

FIG. **13** is a perspective view of the present invention, showing the first configuration of the second embodiment of the anti-drift mooring system.

FIG. **14** is a side view of the present invention with the first configuration of the second embodiment of the anti-drift mooring system, showing the plane upon which a cross sectional view is taken shown in FIG. **15**.

FIG. **15** is a cross section view thereof taken along line A-A of FIG. **14**.

FIG. **16** is a perspective view of the present invention, showing the second configuration of the second embodiment of the anti-drift mooring system.

FIG. **17** is a side view of the present invention with the second configuration of the second embodiment of the anti-drift mooring system, showing the plane upon which a cross sectional view is taken shown in FIG. **18**.

FIG. **18** is a cross section view thereof taken along line A-A of FIG. **17**.

FIG. **19** is a perspective view of the present invention, showing the third embodiment of the anti-drift mooring system.

FIG. **20** is a side view of the present invention with the third embodiment of the anti-drift mooring system, showing the plane upon which a cross sectional view is taken shown in FIG. **21**.

FIG. **21** is a cross section view thereof taken along line A-A of FIG. **20**.

FIG. **22** is a perspective view of the present invention, showing the fourth embodiment of the anti-drift mooring system.

FIG. **23** is a side view of the present invention with the fourth embodiment of the anti-drift mooring system, showing the plane upon which a cross sectional view is taken shown in FIG. **24**.

FIG. **24** is a cross section view thereof taken along line A-A of FIG. **23**.

FIG. **25** is a perspective view of the present invention, showing the fifth embodiment of the anti-drift mooring system.

FIG. **26** is a side view of the present invention with the fifth embodiment of the anti-drift mooring system, showing the plane upon which a cross sectional view is taken shown in FIG. **27**.

FIG. **27** is a cross section view thereof taken along line A-A of FIG. **26**.

FIG. **28** is a top view of the farm system of the present invention along with the fifth embodiment of the anti-drift mooring system.

DETAIL DESCRIPTIONS OF THE INVENTION

All illustrations of the drawings are for the purpose of describing selected versions of the present invention and are not intended to limit the scope of the present invention.

The present invention is an apparatus of wave generators and a mooring system used to generate electricity, where the present invention comprises a floating hull **1** and an anti-drift mooring system **5**. The present invention is able to harness marine wave forces so that the vertical wave forces can be converted into the electricity through the present invention. The generated electricity of the present invention can be transported into electricity distribution centers through underwater electricity cables or overhead electricity cables. The floating hull **1** which comprises a barge **2**, a watertight enclosure **3**, and a plurality of generator mechanisms **4** is tensionably coupled with a subsurface environment **6** by the anti-drift mooring system **5** in near vertical direction, where the subsurface environment **6** can be a seabed, a subsurface structure or any other underwater surface. Since the floating hull **1** does not extend much above the water surface and is difficult to see from shore, the present invention is an ideal apparatus for near shore as well as remote offshore applications.

In reference to FIG. **1** and FIG. **2**, the floating hull **1** preferably made into a rectangular shape with a tapered section. The tapered section minimizes the horizontal wave forces and maximizes the vertical forces on the floating hull **1**. The barge **2** functions as the floating vessel within the present invention providing a large horizontal surface area for vertical wave forces to react against and provides support for related components of the present invention. The barge **2** heaves more than any other form of floating vessel due to its near flat bottom and high vertical drag coefficient. Even though a rectangular shaped barge **2** is used within the preferred embodiment of the present invention, the barge **2** can be of almost any geometric shape known to the art of floating vessels. In reference to FIG. **5**, the watertight enclosure **3** is positioned on the barge **2**, where the watertight enclosure **3** provides a sealed compartment so that water does not flow into the watertight enclosure **3**. The plurality of generator mechanisms **4** is perimetrically positioned around the barge **2** in such way that the watertight enclosure **3** surrounds the plurality of generator mechanisms **4**.

In reference to FIG. **3** and FIG. **4**, each of the plurality of generator mechanisms **4** comprises an opening **41**, a wet room **42**, an articulated pulley system **43**, a watertight gasket **44**, and a wave generator unit **45**. The opening **41** is perpendicularly traversed through the barge **2** creating a complete pass through within the barge **2**. The wet room **42** is positioned on the barge **2** adjacent to the opening **41** so that the water is confined to only the wet room **42** through the opening **41**. The watertight gasket **44** is extended from the wet room **42** to the watertight enclosure **3** providing a cavity to the watertight enclosure **3** from the wet room **42** in such way the watertight gasket **44** seals the wet room **42** from the watertight enclosure **3**. Due to the structural integrity and the configuration of the watertight gasket **44**, splashed water within the wet room **42** does not flow into the watertight enclosure **3** through watertight gasket **44**.

The articulated pulley system **43** allows the mooring system **5** to vary as the floating hull **1** is moved by the waves keeping the anti-drift mooring system **5** within the confines of the articulated pulley system **43** and minimizing out-of-plane loads on the anti-drift mooring system **5** which in turn minimizes fatigue and wear of the anti-drift mooring system **5**. The articulated pulley system **43** that comprises an articulated pulley **431**, a pivotable arm **432**, and a base frame **433** is positioned on the barge **2** and within the wet room **42** adjacent to the opening **41**. More specifically, the base frame **433** is permanently connected to the barge **2** within the wet room **42**, and the pivotable arm **432** is hingedly connected with the base frame **433** as the articulated pulley **431** rotatably connects with the pivotable arm **432**.

The wave generator unit **45** is positioned within the watertight enclosure **3** adjacent to the wet room **42**, where the wave generator unit **45** comprises an uni-directional recoiling pulley **451**, a flywheel **452**, and an electric generator **453**. Within the present invention, the wave generator unit **45** can be configured into a first configuration and a second configuration. The first configuration is shown in FIG. **5**, where the uni-directional recoiling pulley **451** is axially connected with the flywheel **452**, and the flywheel **452** is axially connected with the electric generator **453** through a gearbox **454**. The second configuration is shown in FIG. **6**, where the uni-directional recoiling pulley **451** is axially connected with the flywheel **452**, and the flywheel **452** is axially connected with the electric generator **453** through a direct-drive system **455**. Since the wave generator units **45** are positioned within the watertight enclosure **3**, the watertight enclosure **3** further protects the wave generator units **45** from external environmental conditions. Depending on different embodiments, the watertight enclosure **3** may also provide a compartment door so that the wave generator units **45** and all of their associated sensitive equipments can be repaired and maintained without the need to disconnect them from the anti-drift mooring system **5** and the need to tow the floating hull **1** to shore. Even though the preferred embodiment of the present invention utilizes rotary armature generators as the electric generators **453**, the present invention can also used linear armature generators as the electric generators **453** along with at least one secondary counterweight.

The anti-drift mooring system **5** can comprise different embodiments depending on the water depth, the normal wave heights, the environmental regulations, and the subsurface environment **6**. Each of the different embodiments of the anti-drift mooring system **5** allows the floating hull **1** to be moored in optimum configuration for a particular set of circumstances so that the efficiency of the wave generator unit **45** can be maximized through the anti-drift mooring system **5**.

In reference to FIG. **7**-FIG. **12**, the first embodiment of the anti-drift mooring system **5** comprises a plurality of tension mooring legs **51**. Each of the plurality of tension mooring legs **51** comprises a first end **511** and a second end **512**, where the first end **511** and the second end **512** are oppositely positioned from each other along each of the plurality of tension mooring legs **51**. The first end **511** for each of the plurality of tension mooring legs **51** is tangentially connected with the uni-directional recoiling pulley **451** of a corresponding generator mechanism, wherein the plurality of generator mechanisms **4** includes the corresponding generator mechanism. More specifically, the first end **511** for each of the plurality of tension mooring legs **51** is traversed through the watertight gasket **44** of the corresponding generator mechanism as the first end **511** perimetrically engages around the articulated pulley **431** and traverses through the opening **41** of the corresponding generator mechanism. The second end **512** for each of the plurality of tension mooring legs **51** is connected with the subsurface environment **6** completing the anti-drift mooring system **5** of the first embodiment, where the second end **512** can be connected with two different configurations. A first configuration for the first embodiment of the anti-drift mooring system **5** is shown in FIG. **7**, where the plurality of tension mooring legs **51** is vertically positioned in between the barge **2** and the subsurface environment **6**. A second configuration for the first embodiment of the anti-drift mooring system **5** is shown in FIG. **10**, where the plurality of tension mooring legs **51** is angularly positioned in between the barge **2** and the subsurface environment **6**.

In reference to FIG. **13**-FIG. **18**, the second embodiment of the anti-drift mooring system **5** comprises a plurality of vertical mooring lines **52**, a submerged structure **53**, and at least one mooring line **54**. Each of the plurality of vertical mooring lines **52** comprises a top end **521** and a bottom end **522**, where the top end **521** and the bottom end **522** are oppositely positioned from each other along each of the plurality of vertical mooring lines **52**. The top end **521** for each of the plurality of vertical mooring lines **52** is tangentially connected with the uni-directional recoiling pulley **451** of a corresponding generator mechanism, wherein the plurality of generator mechanisms **4** includes the corresponding generator mechanism. More specifically, the top end **521** for each of the plurality of vertical mooring lines **52** is traversed through the watertight gasket **44** of the corresponding generator mechanism as the top end **521** perimetrically engages around the articulated pulley **431** and traverses through the opening **41** of the corresponding generator mechanism. The bottom end **522** for each of the plurality of vertical mooring lines **52** is connected with the submerged structure **53** as the submerged structure **53** functions as an anchor for the floating hull **1**. The submerged structure **53** is connected with the subsurface environment **6** by the at least one mooring line **54**, completing the anti-drift mooring system **5** of the second embodiment, where the at least one mooring line **54** can be connected with two different configurations. A first configuration for the second embodiment of the anti-drift mooring system **5** is shown in FIG. **13**, where the at least one mooring line **54** is positioned in between the barge **2** and the subsurface environment **6** as a catenary mooring line **541**. A second configuration for the second embodiment of the anti-drift mooring system **5** is shown in FIG. **16**, where the at least one mooring line **54** is positioned in between the barge **2** and the subsurface environment **6** as a plurality of taunt mooring lines **542**.

In reference to FIG. **19**-FIG. **21**, the third embodiment of the anti-drift mooring system **5** comprises the plurality of vertical mooring lines **52**, the submerged structure **53**, and a plurality of horizontal mooring lines **55**. Each of the plurality of vertical mooring lines **52** comprises a top end **521** and a bottom end **522**, where the top end **521** and the bottom end **522** are oppositely positioned from each other along each of the plurality of vertical mooring lines **52**. The top end **521** for each of the plurality of vertical mooring lines **52** is tangentially connected with the uni-directional recoiling pulley **451** of a corresponding generator mechanism, wherein the plurality of generator mechanisms **4** includes the corresponding generator mechanism. More specifically, the top end **521** for each of the plurality of vertical mooring lines **52** is traversed through the watertight gasket **44** of the corresponding generator mechanism as the top end **521** perimetrically engages around the articulated pulley **431** and traverses through the opening **41** of the corresponding generator mechanism. The bottom end **522** for each of the plurality of vertical mooring lines **52** is connected with the submerged structure **53** as the submerged structure **53** functions as a foundation for the plurality of vertical mooring lines **52**. The plurality of horizontal mooring lines **55** comprises a plurality of connecting lines **551** and at least one structural line **552**. More specifically, the plurality of horizontal mooring lines **55** is perimetrically positioned around the floating hull **1** in such way that the floating hull **1** connects with the subsurface environment **6** by the at least one structural line **552** and connects with a plurality of surrounding floating hulls **7** by the plurality of connecting lines **551**. The plurality of connecting lines **551** of the third embodiment of the anti-drift mooring system **5** allows the present invention to create a wave generation farm system as the plurality of connecting lines **551** connects the plurality of surrounding floating hulls **7** with the floating hull **1** while the wave generation farm system is kept stationary by the at least one structural line **552**.

In reference to FIG. **22**-FIG. **24**, the fourth embodiment of the anti-drift mooring system **5** comprises the plurality of vertical mooring lines **52**, the submerged structure **53**, at least one mooring line **54**, and the plurality of horizontal mooring lines **55**. Each of the plurality of vertical mooring lines **52** comprises a top end **521** and a bottom end **522**, where the top end **521** and the bottom end **522** are oppositely positioned from each other along each of the plurality of vertical mooring lines **52**. The top end **521** for each of the plurality of vertical mooring lines **52** is tangentially connected with the uni-directional recoiling pulley **451** of a corresponding generator mechanism, wherein the plurality of generator mechanisms **4** includes the corresponding generator mechanism. More specifically, the top end **521** for each of the plurality of vertical mooring lines **52** is traversed through the watertight gasket **44** of the corresponding generator mechanism as the top end **521** perimetrically engages around the articulated pulley **431** and traverses through the opening **41** of the corresponding generator mechanism. The bottom end **522** for each of the plurality of vertical mooring lines **52** is connected with the submerged structure **53** as the submerged structure **53** functions as a counterweight for the floating hull **1**. The submerged structure **53** is connected with the subsurface environment **6** by the at least one mooring line **54** as the at least one mooring line **54** functions as the catenary mooring line **541**. The plurality of horizontal mooring lines **55** is perimetrically positioned around the submerged structure **53** in such way that the submerged structure **53** connects with the plurality of surrounding floating hulls **7** by the plurality horizontal mooring lines **55**. The plurality horizontal mooring lines **55** of the fourth embodiment of the anti-drift mooring system **5** allows the present invention to create a wave generation farm system as the plurality horizontal mooring lines

55 connects the plurality of surrounding floating hulls **7** to the submerged structure **53** while the wave generation farm system is kept stationary by the at least one mooring line **54**.

In reference to FIG. **25**-FIG. **27**, the fifth embodiment of the anti-drift mooring system **5** comprises the plurality of vertical mooring lines **52**, the submerged structure **53**, the plurality of horizontal mooring lines **55**, at least one spring buoy **56**, and the at least one mooring line **54**. Each of the plurality of vertical mooring lines **52** comprises a top end **521** and a bottom end **522**, where the top end **521** and the bottom end **522** are oppositely positioned from each other along each of the plurality of vertical mooring lines **52**. The top end **521** for each of the plurality of vertical mooring lines **52** is tangentially connected with the uni-directional recoiling pulley **451** of a corresponding generator mechanism, wherein the plurality of generator mechanisms **4** includes the corresponding generator mechanism. More specifically, the top end **521** for each of the plurality of vertical mooring lines **52** is traversed through the watertight gasket **44** of the corresponding generator mechanism as the top end **521** perimetrically engages around the articulated pulley **431** and traverses through the opening **41** of the corresponding generator mechanism. The bottom end **522** for each of the plurality of vertical mooring lines **51** is connected with the submerged structure **53** as the submerged structure **53** functions as a counterweight for the floating hull **1**. The plurality of horizontal mooring lines **55** is perimetrically positioned around the floating hull **1** in such way that the floating hull **1** is connected with the at least one spring buoy **56** by the plurality of horizontal mooring lines **55**. Additionally, at least one of the horizontal mooring line **55** of the fifth embodiment of anti-drift mooring system **5** needs to be a rigid member so that the floating hull **1** does not impact with the at least one spring buoy **56** in slack environmental conditions while other horizontal mooring lines **55** of the fifth embodiment of anti-drift mooring system **5** can be conventional flexible members. The at least one spring buoy **56** is connected with the subsurface environment **6** by the at least one mooring line **54**, where the at least one spring buoy **56** and the at least one mooring line **54** allow the floating hull **1** to naturally weathervane for optimal performance. The at least one spring buoy **56** normally submerges below the water surface under normal environment, resulting a minimum wave energy losses for the floating hull **1**. In reference to the plan view of FIG. **28**, the fifth embodiment of the anti-drift mooring system **5** further comprises a plurality of surrounding floating hulls **7** that is held in position by the at least one mooring line **54** and the corresponding horizontal mooring lines **55**. More specifically, the plurality of surrounding floating hulls **7** interconnects with the at least one spring buoy **56** by the corresponding horizontal mooring lines **55** of the plurality of surrounding floating hulls **7**. This results in a wave generation farm system for the fifth embodiment of the anti-drift mooring system **5**.

The submerged structure **53** of the anti-drift mooring system **5** can be a counterweight, a sea anchor, a pre-installed underwater structure, or an underwater frame, where the submerged structure **53** is subjected to minimum marine wave forces. For example, the submerged structure **53** can be positively buoyant with the at least one mooring line **54** that is connected to the subsurface environment **6** and always remains in tension. The submerged structure **53** preferably utilizes in high depth conditions as the submerged structure **53** allows the plurality of vertical mooring lines **52** of the floating hull **1** to be near vertical and short for rapid connection to pre-installed submerged structure **53**. More specifically, the submerged structure **53** is made to have slightly negative buoyancy by balancing its mass with its trapped buoyancy so that the inertia mass of and the high vertical drag coefficient of the submerged structure **53** prevent the submerged structure **53** from undergoing significant vertical movement. This allows the submerged structure **53** to remain almost stationary as the floating hull **1** moves down with the wave trough and moves up with the wave crest. When the submerged structure **53** functions as the sea anchor within the present invention, the submerged structure **53** preferably shaped into a flat surfaced submerged structure **53**.

Since the plurality of tension mooring legs **51** or the plurality of vertical mooring lines **52** traverse though the openings **41**, the openings **41** is of a sufficient diameter so that the plurality of tension mooring legs **51** or the plurality of vertical mooring lines **52** is able to move freely 360 degrees with respect to the horizontal movements of the floating hull **1**. The plurality of tension mooring legs **51** or the plurality of vertical mooring lines **52** also imposes vertical restraint on the floating hull **1** through the resistance of the plurality of generator mechanisms **4** during the upward heave following a wave crest and maintains some tension through the uni-directional recoiling pulley **451** during the downward heave following the trough of the wave. The downward heave of the floating hull **1** rewinds the plurality of tension mooring legs **51** or the plurality of vertical mooring lines **52** on the uni-directional recoiling pulley **451** in readiness for the next wave crest. The articulated pulley systems **43** allows the plurality of tension mooring legs **51** or the plurality of vertical mooring lines **52** to have multi-directional vertical movement below the articulated pulley systems **43** and only horizontal directional movement about the articulated pulley systems **43**. The resulting horizontal directional movement turns the uni-directional recoiling pulley **451**, the flywheel **452**, and the electric generator **453**. When the floating hull **1** impacts with the wave crest, the floating hull **1** moves up along with the wave crest in such way that the pulling forces of the plurality of tension mooring legs **51** or the plurality of vertical mooring lines **52** turns the wave generator units **45**, converting marine wave force into electricity within the present invention. When the floating hull **1** moves downward with the wave trough, the tension force of the plurality of tension mooring legs **51** or the plurality of vertical mooring lines **52** is maintained by recoil spring mechanism of the uni-directional recoiling pulleys **451** or the at least one secondary counterweight. If the wave generator units **45** use rotary armature generators as the electric generators **453**, the tension force of the plurality of tension mooring legs **51** or the plurality of vertical mooring lines **52** is maintained by the recoil spring mechanisms. More specifically, the uni-directional pulley and the recoil spring mechanism of the uni-directional recoiling pulley **451** functions in a similar manner to the manual starter rope assembly on a common lawn mower. The recoil spring mechanism rewinds the plurality of tension mooring legs **51** or the plurality of vertical mooring lines **52** back onto the uni-directional recoiling pulley **451** when the plurality of tension mooring legs **51** or the plurality of vertical mooring lines **52** loose tension as the hull descends on the wave trough. If the wave generator units **45** use linear armature generators as the electric generators **453**, the tension force of the plurality of tension mooring legs **51** or the plurality of vertical mooring lines **52** is maintained by the at least one secondary counterweight. More specifically, since the at least one secondary counterweight and the linear armature generators do not use the recoil spring mechanism and uses only the uni-directional pulley, the at least one secondary counterweight is either connected at the top ends **521** as the plurality of vertical mooring lines **52** positions around the uni-directional pulleys or at the first ends **511** as the plurality of vertical mooring lines **52** positions around the uni-directional pulley. Additionally, the flywheels **452** store potential energy as the wave crest lifts the floating hull **1** in upward direction, and the flywheels **452** release their energy to the electric generators **453** as the floating hulls **1** descend on the wave trough. Due to the continuous nature of marine wave forces, the present invention is able to continuously and efficiently generate electricity as the electric generators **453** are continuously turned through the plurality of tension mooring legs **51** or the plurality of vertical mooring lines **52** during the wave crests and through the flywheels **452** during the wave troughs.

Although the invention has been explained in relation to its preferred embodiment, it is to be understood that many other possible modifications and variations can be made without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. An apparatus of wave generators and a mooring system is used to generate electricity comprises:
a floating hull;
an anti-drift mooring system;
the floating hull comprises a barge, a watertight enclosure, a plurality of generator mechanisms;
each of the plurality of generator mechanisms comprises an opening, a wet room, an articulated pulley system, a watertight gasket, and a wave generator unit;
the articulated pulley system comprises an articulated pulley, a pivotable arm, and a base frame;
the wave generator unit comprises a uni-directional recoiling pulley, a flywheel, and an electric generator; and
the floating hull being tensionably coupled with the anti-drift mooring system.

2. The apparatus of wave generators and a mooring system to generate electricity as claimed in claim **1** comprises:
the watertight enclosure being positioned on the barge; and
the plurality of generator mechanisms being perimetrically positioned around the barge.

3. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **1** comprises:
the opening perpendicularly traversing through the barge;
the wet room being positioned on the barge adjacent to the opening;
the articulated pulley system being positioned on the barge;
the articulated pulley system being positioned within the wet room;
the watertight gasket being extended from the wet room to the watertight enclosure;
the wave generator unit being positioned within the watertight enclosure; and
the wave generator unit being adjacently positioned with the wet room.

4. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **1** comprises:
the base frame being permanently connected to the barge within the wet room;
the pivotable arm being hingedly connected with the base frame; and
the articulated pulley being rotatably connected with the pivotable arm.

5. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **1** comprises:
the uni-directional recoiling pulley being axially connected with the flywheel; and
the flywheel being axially connected with the electric generator through a gear box.

6. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **1** comprises:
the uni-directional recoiling pulley being axially connected with the flywheel; and
the flywheel being axially connected with the electric generator through a direct-drive system.

7. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **1** comprises:
the anti-drift mooring system comprises a plurality of tension mooring legs;
each of the plurality of tension mooring legs comprises a first end and a second end;
the first end and the second end being oppositely positioned from each other along each of the plurality of tension mooring legs;
the first end for each of the plurality of tension mooring legs being tangentially connected with the uni-directional recoiling pulley of a corresponding generator mechanism, wherein the plurality of generator mechanisms includes the corresponding generator mechanism;
the first end for each of the plurality of tension mooring legs traversing through the watertight gasket of the corresponding generator mechanism;
the first end for each of the plurality of tension mooring legs being perimetrically engaged around the articulated pulley of the corresponding generator mechanism;
the first end for each of the plurality of tension mooring legs traversing through the opening of the corresponding generator mechanism; and
the second end for each of the plurality of tension mooring legs being connected with a subsurface environment.

8. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **7**, wherein the plurality of tension mooring legs being vertically positioned in between the barge and the subsurface environment.

9. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **7**, wherein the plurality of tension mooring legs being angularly positioned in between the barge and the subsurface environment.

10. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **1** comprises:
the anti-drift mooring system comprises a plurality of vertical mooring lines, a submerged structure, and at least one mooring line;
each of the plurality of vertical mooring lines comprises a top end and a bottom end;
the top end and the bottom end being oppositely positioned from each other along the vertical mooring line;
the top end for each of the plurality of vertical mooring lines being tangentially connected with the uni-directional recoiling pulley of a corresponding generator mechanism, wherein the plurality of generator mechanisms includes the corresponding generator mechanism;
the top end for each of the plurality of vertical mooring lines traversing through the watertight gasket of the corresponding generator mechanism;
the top end for each of the plurality of vertical mooring lines being perimetrically engaged around the articulated pulley of the corresponding generator mechanism;
the top end for each of the plurality of vertical mooring lines traversing through the opening of the corresponding generator mechanism;
the bottom end for each of the plurality of vertical mooring lines being connected with the submerged structure; and
the submerged structure being connected with a subsurface environment by the at least one mooring line.

11. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **10**, wherein the at least one mooring line is a catenary mooring line.

12. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **10**, wherein the at least one mooring line is a plurality of taunt mooring lines.

13. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **1** comprises:

a plurality of surrounding floating hulls;

the anti-drift mooring system comprises a plurality of vertical mooring lines, a submerged structure, and a plurality of horizontal mooring lines;

each of the plurality of vertical mooring lines comprises a top end and a bottom end;

the top end and the bottom end being oppositely positioned from each other along the vertical mooring line;

the top end for each of the plurality of vertical mooring lines being tangentially connected with the uni-directional recoiling pulley of a corresponding generator mechanism, wherein the plurality of generator mechanisms includes the corresponding generator mechanism;

the top end for each of the plurality of vertical mooring lines traversing through the watertight gasket of the corresponding generator mechanism;

the top end for each of the plurality of vertical mooring lines being perimetrically engaged around the articulated pulley of the corresponding generator mechanism;

the top end for each of the plurality of vertical mooring lines traversing through the opening of the corresponding generator mechanism;

the bottom end for each of the plurality of vertical mooring lines being connected with the submerged structure;

the plurality of horizontal mooring lines comprises a plurality of connecting lines and at least one structural line;

the plurality of horizontal mooring lines being perimetrically positioned around the floating hull;

the floating hull being connected to a subsurface environment by the at least one structural line; and

the floating hull being connected to the plurality of surrounding floating hulls by the plurality of connecting lines.

14. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **1** comprises:

a plurality of surrounding floating hulls;

the anti-drift mooring system comprises a plurality of vertical mooring lines, a submerged structure, at least one mooring line, and a plurality of horizontal mooring lines;

each of the plurality of vertical mooring lines comprises a top end and a bottom end;

the top end and the bottom end being oppositely positioned from each other along the vertical mooring line;

the top end for each of the plurality of vertical mooring lines being tangentially connected with the uni-directional recoiling pulley of a corresponding generator mechanism, wherein the plurality of generator mechanisms includes the corresponding generator mechanism;

the top end for each of the plurality of vertical mooring lines traversing through the watertight gasket of the corresponding generator mechanism;

the top end for each of the plurality of vertical mooring lines being perimetrically engaged around the articulated pulley of the corresponding generator mechanism;

the top end for each of the plurality of vertical mooring lines traversing through the opening of the corresponding generator mechanism;

the bottom end for each of the plurality of vertical mooring lines being connected with the submerged structure;

the submerged structure being connected with a subsurface environment by the at least one mooring line;

the plurality of horizontal mooring lines being perimetrically positioned around the submerged structure; and

the submerged structure being connected with the plurality of surrounding floating hulls by the plurality of horizontal mooring lines.

15. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **1** comprises:

the anti-drift mooring system comprises a plurality of vertical mooring lines, a submerged structure, a plurality of horizontal mooring lines, at least one spring buoy, and at least one mooring line;

each of the plurality of vertical mooring lines comprises a top end and a bottom end;

the top end and the bottom end being oppositely positioned from each other along the vertical mooring line;

the top end for each of the plurality of vertical mooring lines being tangentially connected with the uni-directional recoiling pulley of a corresponding generator mechanism, wherein the plurality of generator mechanisms includes the corresponding generator mechanism;

the top end for each of the plurality of vertical mooring lines traversing through the watertight gasket of the corresponding generator mechanism;

the top end for each of the plurality of vertical mooring lines being perimetrically engaged around the articulated pulley of the corresponding generator mechanism;

the top end for each of the plurality of vertical mooring lines being inserted through the opening of the corresponding generator mechanism;

the bottom end for each of the plurality of vertical mooring lines being connected with the submerged structure;

the plurality of horizontal mooring lines being perimetrically positioned around the floating hull;

the floating hull being connected with the at least one spring buoy by the plurality of horizontal mooring lines; and

the at least one spring buoy being connected with a subsurface environment by the at least one mooring line.

16. The apparatus of wave generators and a mooring system is used to generate electricity as claimed in claim **15** comprises:

a plurality of surrounding floating hulls;

the plurality of surrounding floating hulls being positioned adjacent to the at least one spring buoy; and

the at least one spring buoy being connected to the plurality of surrounding floating hulls.

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