WATER WAVE-BASED ENERGY GENERATOR

Inventor: Donald R. Morrison, Hot Springs, AR (US)

Correspondence Address:
LITMAN LAW OFFICES, LTD.
P.O. BOX 15035
CRYSTAL CITY STATION
ARLINGTON, VA 22215 (US)

Appl. No.: 11/483,088
Filed: Jul. 10, 2006

Related U.S. Application Data

Provisional application No. 60/755,772, filed on Jan. 4, 2006.

Publication Classification

Int. Cl.
E02B 9/08 (2006.01)

U.S. Cl. .......................................................... 405/76

ABSTRACT

The water wave-based energy generator is a system for extracting usable mechanical energy from a body of water, such as an ocean. A support frame is provided having a central portion, which is suspended over the body of water, and a plurality of legs, extending downwardly therefrom. A pivotal frame is pivotally joined to the central portion of the support frame and has a planar sheet mounted on a lower end thereof. The planar sheet is at least partially suspended in the body of water, such that waves in the body of water cause rotation of the planar sheet and the pivotal frame with respect to the support frame. An elongated rod is pivotally joined at a proximal end thereof to the pivotal frame, such that rotation of the pivotal frame generates lateral movement in the elongated rod. The lateral movement of the distal end of the elongated rod may be used to drive an external mechanically driven system.
WATER WAVE-BASED ENERGY GENERATOR

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Patent Application Ser. No. 60/755,772, filed Jan. 4, 2006.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a water wave-based energy generator, which is a system for extracting usable mechanical energy from a body of water, such as an ocean. Particularly, a planar sheet is mounted to a pivotal frame, which is suspended in the body of water, and natural waves within the body of water cause the planar sheet and pivotal frame to rotate. This rotation is translated into usable mechanical energy for powering an external mechanically-driven system.

[0004] 2. Description of the Related Art

[0005] Systems for the extraction of usable energy from bodies of water, such as an ocean, are known in the art. One such system utilizes a series of floats, which are mechanically linked to a rotational system, such that vertical motion of each float caused by a wave drives rotation of an axle. The multiplicity of floats are all mechanically interconnected, and the gear-transfer system required to translate the motion into rotational energy is complex, requiring a large number of mechanical parts which must be maintained in perfect alignment.

[0006] Similarly, a wide variety of other systems for converting water wave energy into usable energy have been utilized, such as propellers suspended under the surface of the water to tap into the energy of the transverse water currents, and these systems also require complex mechanical interconnections with a large number of mechanical parts requiring precision alignment. These systems, however, are used in oceans and similar environments. They are constantly under mechanical stress and strain, are subjected to heavy waves and currents, are exposed to the environment and are subject to quick corrosion.

[0007] It would be preferable to provide an energy extraction system which does not rely on complex mechanical interconnections or easily misaligned energy translation systems. Thus, a water wave-based energy generator solving the aforementioned problems is desired.

SUMMARY OF THE INVENTION

[0008] The water wave-based energy generator is a system for extracting usable mechanical energy from a body of water, such as an ocean. A support frame is provided having a central portion, which is suspended over the body of water, and is further provided with a plurality of legs, extending downwardly therefrom. The legs are embedded in a support surface, such as the ocean floor. A pivotal frame is pivotally joined to the central portion of the support frame and has a planar sheet mounted on a lower end thereof. The planar sheet is at least partially suspended in the body of water, such that waves in the body of water cause rotation of the planar sheet and the pivotal frame with respect to the support frame. Further, user-adjustable masses may be supported on the pivotal frame, allowing the user to control the resistance to motion of the pivoting system.

[0009] An elongated rod is pivotally joined at a proximal end thereof to the pivotal frame, such that rotation of the pivotal frame generates lateral movement in the elongated rod. The lateral movement of the distal end of the elongated rod may be used to drive an external mechanically driven system. The elongated rod may be a linear gear, such that lateral movement of the linear gear can be translated directly into rotational motion through interconnection with a rotational gear. The power output of the system may be controlled by the addition or subtraction of mass from the user-adjustable masses.

[0010] These and other features of the present invention will become readily apparent upon further review of the following specification and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 is a side schematic view of a water wave-based energy generator according to the present invention.

[0012] FIG. 2 is a perspective view of an energy transfer system of the water wave-based energy generator of the present invention.

[0013] FIG. 3 is a schematic view illustrating the rotation of a pivotal frame and associated planar sheet of the subject water wave-based energy generator.

[0014] FIG. 4 is a perspective view of an alternative embodiment of the water wave-based energy generator according to the present invention.

[0015] Similar reference characters denote corresponding features consistently throughout the attached drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] The water wave-based energy generator 10, shown in FIG. 1, provides a system for extracting usable mechanical energy from the natural waves passing through a body of water, such as an ocean, sea or large lake, for example. As will be described in greater detail below, a planar sheet 14 is at least partially submerged in the body of water, and is mounted on a pivotal frame 44. Due to conservation of momentum, waves striking the planar sheet 14 cause the planar sheet 14 and the pivotal frame 44 to rotate, and this rotation is then translated into mechanical energy for driving an external system, such as, for example, a separate mechanically driven motor or an electrical generator.

[0017] As shown in FIG. 1, a support frame 12 is placed in the body of water to support the planar sheet 14, which is at least partially submerged in the water. The support frame 12 has a central region and a plurality of legs, which extend downwardly and are embedded in a support surface, such as the ocean floor. Alternatively, the frame 12 could be built on a separate structure, such as a dock or a barge, with planar sheet 14 being held within the water.

[0018] Though the dimensions of the support frame 12 are dependent upon the needs and desires of the user, a typical generator system 10 of the preferred embodiment would include a support frame 12 with legs submerged in approxi-
mately 9 feet of ocean water, with each leg being approximately 48 feet long, with a spacing between adjacent legs being approximately 72 feet. The support frame 12 is preferably formed from a sturdy material which is resistant to corrosion by salt water, such as aluminum, stainless steel or the like.

[0019] A pivotal frame 44 is suspended from the central portion of support frame 12 by a pivotal mounting 24. Pivotal mounting 24 may include pillow block bearings or the like. The support frame includes a vertical support 20 and a horizontal support 22. In the preferred embodiment, matching the figures given above for the preferred support frame 12, the vertical support 20 has a length of approximately 36 feet, and the horizontal support 22 has a length of approximately 32 feet. The vertical and horizontal supports 20, 22 are preferably formed from a sturdy material which is resistant to corrosion by salt water, such as aluminum, stainless steel or the like, similar to support frame 12.

[0020] As shown, the planar sheet 14 is fixed to the lower end of pivotal support 44, and extends into the body of water. Though shown as having a substantially triangular contour, the contour and dimensions of the planar sheet 14 are dependent upon the needs and desires of the user. The planar sheet 14 is formed from a material which can withstand the fluid currents it will be subjected to in use, and also which will not corrode in salt water. Preferably, the planar sheet 14 is light-weight, so as not to add appreciable mass to the system, and may be formed from aluminum, plastic, treated lumber or the like.

[0021] Removable and adjustable masses 16 and 18 are supported on horizontal support 22, as shown. Through selective addition or subtraction of mass from horizontal support 22, the user may control how much power is to be generated by system 10. Further, depending on the natural waves and currents, which the user cannot control, it may be necessary to provide greater inertial resistance in order to maintain the rotating parts of system 10 in alignment, particularly during storms and the like.

[0022] In use, a wave impinging upon planar sheet 14, with the wave heading towards the right in FIG. 1, will cause pivotal frame 44 and planar sheet 14 to pivot about pivot point 24, in the direction indicated by arrow 30. As shown, an elongated rod 26 is pivotally attached to vertical support 20 at pivotal mounting 46. The elongated rod 26 is preferably a linear gear, as shown.

[0023] As vertical support 20 pivots along direction 30, elongated rod 26 is drawn in the direction indicated by arrow 34. The distal end of elongated rod 26 is connected to an energy transfer system or generator 28, as will be described below, with specific reference to FIG. 2. This induced movement of elongated rod 26 drives the energy transfer system or generator 28 for the creation of usable mechanical energy.

[0024] Under the weight of gravity, frame 44 rotates in the opposite direction once the wave passes, indicated by directional arrow 32, like a pendulum. This rotation causes a similar translation in position for elongated rod 26, now in the direction indicated by directional arrow 36. This movement is also converted into usable energy by system 28. This induced oscillatory movement of elongated rod 26 is what generates the mechanical energy which may be used to power external systems.

[0025] The internal components of energy transfer system 28 are shown in FIG. 2. As shown, the distal end of elongated rod 26, which is preferably a linear gear, contacts a rotating gear 40. Rotating gear may be a simple gear or may be a ratcheting gear, allowing for rotation in only one direction. The lateral movement of elongated rod 26 caused by the water wave drives rotating gear 40 to rotate. Gear 40 is, in turn, connected by an axle to a drive gear 42. Drive gear 42 may be connected directly to a mechanically driven system, or may power an electric generator or the like. Elongated rod 26 is mounted on a guide wheel 38, as shown, in order to maintain proper alignment between the elongated rod 26 and the rotational gear 40.

[0026] In order to approximate the range of energies which may be extracted from the ocean utilizing system 10, we can model frame 44 as a pair of pendula. If vertical and horizontal supports 20, 22, as well as planar sheet 14, have masses far less than those of masses 16, 18, then the rotation of masses 16, 18 about pivot 24 will approximate to the rotation of two pendula, one with mass 16 and one with mass 18, moving at the same angular velocity at all times about pivot point 24.

[0027] Referring to FIG. 3, if horizontal support 22 has a length D and vertical support 20 also has a length D (it should be noted that the equivalence in lengths is for purposes of simplifying this calculation only; the lengths of each support are dependent upon the needs and desires of the user and do not have to be equivalent), and the entire system rotates by an angle 0, as shown, then each of the masses 16, 18 moves vertically by a distance h, where h is given by

\[
h = \left( \frac{D}{V^2} \right) \left( 1 - \cos(0) \right).
\]

[0028] For purposes of simplifying the calculation, we can set both masses of weights 16, 18 to M, and we exclude such real-life factors as water resistance, etc. Once again, the equivalence of mass is for purposes of simplifying the calculation only, and the masses of weights 16, 18 do not need to be equivalent. For purposes of this approximation only, the amount of energy E required to rotate the frame, which can then be extracted via system 28, is given by

\[
E = 2.9782 \cdot M g D h (1 - \cos(0)),
\]

[0029] where g is the standard gravitational acceleration of 9.8 m/s². Thus, for a sample mass of M=1000 kg, rotated over an angle of 10°, with D equal to 56 feet, for example, we get E=2310.4 J.

[0030] The action of a wave on the system 10 does not take relatively long, so for an exemplary time of rotation of 1 s., we get a power production of approximately 2.3 kW from a simple rotation by water wave of 10°. This power may be transferred directly into usable mechanical power via system 28 and linkage to an external mechanically driven system.

[0031] This sample calculation is only an approximation to give an order of energies and powers which may be produced by system 10. Further, it should be noted that this calculation was performed for a single such system 10; multiple systems such as system 10 could be distributed over a body of water as an “energy farm” and linked together.
As illustrated in the embodiment of FIG. 4, system 10 may include a plurality of sheets 14 (herein shown as a pair of sheets 14, though it should be understood that any suitable number may be utilized), each being secured to a respective vertical support 20 and horizontal support 22. As shown, the horizontal supports 22 may be formed from substantially planar boards or sheets, suspended between of a pair of vertical frame members, forming vertical supports 20. In this embodiment, elongated rod 26 is pivotally joined to frame 44 at pivot 46, which is mounted on a central shaft 47, joining the vertical frame members of vertical supports 20.

It should be understood that system 10 may be sized or contoured dependent upon the needs and desires of the user. For example, relatively small systems 10 may be utilized for individual or small-business usage, and larger systems 10 may be utilized for large-scale energy production. In the preferred embodiment, systems 10 may produce, for example, between approximately 14 KW and 2000 KW of power, dependent upon the selected size and removable mass chosen for the system 10. For large-scale systems 10, additional weighting members may be further utilized, mounted to frame 12, for anchoring the system 10 within the ocean bed or the like. Further, a small-scale portable system may include wheels 21 (shown in the embodiment of FIG. 4), or the like, pivotally mounted to the lower end of the support frame 12, allowing the system 10 to be easily transported to a desired power-generation site.

System 10 may be operated continuously, as it relies on power generated from ocean waves or the like, rather than an external man-made power source. As the system employs a direct mechanical drive, the components of system 10 may be easily replaced or repaired. Further, a simple on-off type switch may be provided for ceasing power production when desired.

It is to be understood that the present invention is not limited to the embodiments described above, but encompasses any and all embodiments within the scope of the following claims.

1 claim:
1. A water wave-based energy generator, comprising:
   a support frame having a central portion and a plurality of support legs extending downwardly therefrom, said central portion of said support frame being positioned over a body of water;
   a pivotal frame having an upper end a lower end, said upper end being pivotally secured to said central portion of said support frame;
   a planar sheet secured to said lower end of said pivotal frame, said planar sheet being at least partially suspended in said body of water; and,
   an elongated rod having a proximal end and a distal end, said proximal end being pivotally joined to said pivotal frame, whereby water waves in said body of water drive said planar sheet and said pivotal frame to rotate with respect to said support frame, rotation of said planar sheet causing said elongated rod to move in a lateral direction, said distal end of said elongated rod being adapted to transfer said lateral movement to an external mechanically driven system.
2. The water wave-based energy generator as recited in claim 1, whereby said elongated rod is a linear gear.
3. The water wave-based energy generator as recited in claim 2, further comprising:
   a rotational gear in contact with said distal end of said elongated rod, said lateral movement of said elongated rod driving said rotational gear to rotate;
   an axle, said rotational gear being mounted on a first end of said axle; and,
   a drive gear mounted on a second end, opposed to said first end, of said axle, said drive gear driving said external mechanically driven system.
4. The water wave-based energy generator as recited in claim 3, wherein said rotational gear is a ratcheting gear.
5. The water wave-based energy generator as recited in claim 3, further comprising a support wheel, wherein said linear gear has an upper surface and a lower surface, a plurality of teeth being formed on said upper surface, the support wheel rotatively contacting and supporting the lower surface of said linear gear.
6. The water wave-based energy generator as recited in claim 1, wherein said pivotal frame comprises a vertical support member and a horizontal support member, the horizontal support member having a proximal end and a distal end, said planar sheet being joined to the proximal end of the horizontal support member.
7. The water wave-based energy generator as recited in claim 6, further comprising a user-selectable distal weighting member being removably mounted on the distal end of the horizontal support member.
8. The water wave-based energy generator as recited in claim 7, further comprising a user-selectable proximal weighting member being removably mounted on the proximal end of the horizontal support member.
9. A water wave-based energy generator, comprising:
   a support frame having a central portion and a plurality of support legs extending downwardly therefrom, said central portion of said support frame being positioned over a body of water;
   a pivotal frame having an upper end a lower end, said upper end being pivotally secured to said central portion of said support frame;
   a plurality of planar sheets secured to said lower end of said pivotal frame, said plurality of planar sheets being at least partially suspended in said body of water; and,
   an elongated rod having a proximal end and a distal end, said proximal end being pivotally joined to said pivotal frame, whereby water waves in said body of water drive said plurality of planar sheets and said pivotal frame to rotate with respect to said support frame, rotation of said plurality of planar sheets causing said elongated rod to move in a lateral direction, said distal end of said elongated rod being adapted to transfer said lateral movement to an external mechanically driven system.
10. The water wave-based energy generator as recited in claim 9, whereby said elongated rod is a linear gear.
11. The water wave-based energy generator as recited in claim 10, further comprising:
   a rotational gear in contact with said distal end of said elongated rod, said lateral movement of said elongated rod driving said rotational gear to rotate;
   an axle, said rotational gear being mounted on a first end of said axle; and,
   a drive gear mounted on a second end, opposed to said first end, of said axle, said drive gear driving said external mechanically driven system.

12. The water wave-based energy generator as recited in claim 11, wherein said rotational gear is a ratcheting gear.

13. The water wave-based energy generator as recited in claim 11, further comprising a support wheel, wherein said linear gear has an upper surface and a lower surface, a plurality of teeth being formed on said upper surface, the support wheel rotatively contacting and supporting the lower surface of said linear gear.

14. The water wave-based energy generator as recited in claim 9, wherein said pivotal frame comprises a plurality of vertical support members and a plurality of horizontal support members, each of the horizontal support members having a proximal end and a distal end, each said planar sheet being joined to the proximal end of a respective one of the horizontal support members.

15. The water wave-based energy generator as recited in claim 14, further comprising a plurality of user-selectable distal weighting members being removably mounted on the distal ends of the plurality of horizontal support members.

16. The water wave-based energy generator as recited in claim 15, further comprising a plurality of user-selectable proximal weighting members being removably mounted on the proximal ends of the plurality of horizontal support members.

17. The water wave-based energy generator as recited in claim 9, further comprising a plurality of wheels, each said wheel being pivotally mounted to a lower end of a respective one of said plurality of support legs.

* * * * *

* * * * *