

TITLE OF INVENTION: ENERGY GENERATING APPARATUS USING GRAVITATIONAL FORCE

FIELD

[0001] The present invention relates to an energy generating apparatus using gravitational force.

BACKGROUND

[0002] The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

[0003] With the ongoing high demand for electricity in every part of the world, and the high current costs for electricity, there is a need to develop alternative sources of energy such as electricity. This is especially the case in various energy hungry technological applications such as in drying, indoor farming, electric vehicles and so on. However, conventional electricity production that rely on burning fossil fuels result in significant carbon emissions which has contributed to the progressively increasing levels of carbon dioxide within the atmosphere. This is now well understood that this has resulted in global warming which has to date lead to an increasing level of climatic natural disasters internationally.

[0004] Alternative energy generation processes such as solar and wind power are now being used in many countries for electricity generation. However, large land areas of open land or water bodies are required to generate sufficient electricity for a densely populated region using such technology. This limits the use of such technology in countries such as Singapore that only has a limited land area.

[0005] The gravitational force is a freely available source of energy that can potentially be used to generate energy. Many machines using gravitational force to produce rotational motion have been conceived in the past, with examples being

described in U.S. Patent Document Nos. 3625089, 6237342B1, 6694833B2, 2007/0137328A1, 5921133, 6601471B2, and 578062 and Chinese Patent Document No. 104863804A. Typical operational characteristics of these prior art machines include the following:

- Fixed weights with fixed locus are used, making it difficult to control the rotational speed.
- These prior art machines generally have the inability to regulate rotational speed due to the high speed in which they operate at.
- These prior art machines do not have a controllable wheel speed function.
- These prior art systems encounter high friction during their operation due to the interaction with the surrounding environment and the utilization of many gear trains.
- The prior art machines generally use light “weights”.
- The prior art machines need to operate at very fast speeds as they typically focus on increasing the velocity to increase the torque. Therefore, due to the high speeds at which they rotate, there will be a significant amount of friction and vibration.
- In these prior art machines, an external motor (power) is typically required to start the system and overcome the residual friction during operation.

These typical operational characteristics limit the torque that can be generated thereby preventing these prior art machines from being practically used to generate energy using gravitational force.

[0006] It would therefore be advantageous to provide an alternative energy generating process that ameliorates one or more of the above-mentioned difficulties.

SUMMARY

[0007] According to an aspect of the present disclosure, there is provided an energy generating apparatus comprising:

a support wheel assembly rotatable about a central axis;

at least two weight displacement units supported on the support wheel assembly, each said weight displacement unit comprising at least one actuator connected to an associated weight;

wherein each said actuator is adapted to displace the associated weight along a path of travel extending on the support wheel assembly between the central axis and an outer periphery of the support wheel assembly, the relative displacement of a said weight relative to another said weight resulting in torque being generated about the central axis of the support wheel assembly leading to rotational motion thereof.

[0008] In some embodiments, the support wheel assembly is rotatable through an extension zone where the weights are displaceable away from the central axis when located therein, and a retraction zone where the weights are displaceable towards the central axis when located therein.

[0009] In some embodiments, the extension zone and retraction zone are separated by a generally vertical line extending through the central axis of the support wheel assembly.

[0010] In some embodiments, the path of travel of at least one of the weights extends generally radially between the central axis and the wheel periphery.

[0011] In some embodiments, the paths of travel extend angularly equidistant from each adjacent said path of travel along the support wheel assembly.

[0012] In some embodiments, the weights are displaceable from a fully retracted position near the central axis of the support wheel assembly, and a fully extended position near the periphery of the support wheel assembly.

[0013] In some embodiments, the weights are displaceable to an intermediate position between the fully retracted position, and the fully extended position.

[0014] In some embodiments, the support wheel assembly comprises at least one planar wheel disc for supporting the weight displacement units thereon.

[0015] In some embodiments, the support wheel assembly comprises two said planar wheel discs provided in an adjacent relationship with each of the weight displacement units comprising adjacent said actuators on each said wheel for supporting a said associated weight generally located between the support wheels.

[0016] In some embodiments, the apparatus comprises a housing within which is supported the support wheel assembly, the support wheel assembly comprising a central shaft upon which the at least one wheel disc is mounted, the central shaft being pivotally mounted on the housing.

[0017] In some embodiments, the housing comprises opposing bearings for supporting the central shaft for rotation therein.

[0018] In some embodiments, the actuators are pneumatically or hydraulically actuated, and the support shaft further comprises a rotary joint through which pneumatic or hydraulic control lines can be in fluid communication with each said actuator.

[0019] In some embodiments, the actuators are electrically actuated, the support shaft further comprises an electrical slip ring through which electrical control lines can be electrically connected to each said actuator.

[0020] In some embodiments, the periphery of the at least one wheel disc is provided with gear teeth engaging an output gear supported on the housing to allow for the transfer of energy from the support wheel during rotation thereof.

[0021] In some embodiments, the output gear is mounted on an output shaft extending from the housing.

[0022] In some embodiments, the energy generating apparatus further comprises a speed sensor provided on the output shaft for measuring the rotational speed of the support wheel assembly.

[0023] In some embodiments, the energy generating apparatus further comprises

a brake for engaging the outer periphery of the support wheel assembly.

[0024] According to another aspect of the present disclosure, there is provided a method of producing energy using an energy generating apparatus as described above.

[0025] In some embodiments, the method comprises controlling the displacement of the weight of at least one weight displacement unit along the path of travel to thereby control the rotational speed of the support wheel assembly.

[0026] Other aspects and features will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] In the figures, which illustrate, by way of example only, embodiments of the present invention,

[0028] [Figure 1] respectively shows side and front views of an energy generating apparatus according to an example embodiment of the present disclosure

[0029] [Figures 2a to 2c] respectively show the energy generating apparatus of [fig. 1] at three different stages of operation;

[0030] [Figure 3] is a schematic side view of a weight displacement unit according to the present disclosure respectively showing the associated weight at a fully retracted position and a fully extended position; and

[0031] [Figure 4a and 4b] respectively show front views of another example embodiment of the energy generating apparatus according to the present disclosure using two different weight loading configurations.

[0032] Other arrangements of the invention are possible and, consequently, the accompanying drawings are not to be understood as superseding the generality of the preceding description of the invention.

DETAILED DESCRIPTION

[0033] Throughout this document, unless otherwise indicated to the contrary, the terms “comprising”, “consisting of”, “having” and the like, are to be construed as non-exhaustive, or in other words, as meaning “including, but not limited to”.

[0034] Furthermore, throughout the specification, unless the context requires otherwise, the word “include” or variations such as “includes” or “including” will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0035] Example embodiments of the present invention will now be described with reference to the accompanying drawings. The terminology used herein is for the purpose of describing particular embodiments only and is not intended to limit the scope of the present invention. Other definitions for selected terms used herein may be found within the detailed description of the invention and apply throughout the description. Additionally, unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art to which this invention belongs. Where possible, the same reference numerals are used throughout the figures for clarity and consistency.

[0036] The energy generating apparatus according to the present disclosure is based on two fundamental principles of physics. The first principle is demonstrated in the conversion of potential energy into kinetic energy in a pendulum when the mass of that pendulum is swung from an elevated position towards a lower position. The second principle is demonstrated in the pivoting motion induced about the fulcrum of a seesaw, when similar masses located at opposing ends of the seesaw are spaced at different distances from the fulcrum of the seesaw. This therefore induces pivoting about the fulcrum due to the different torque applied to the fulcrum by each mass. These principles are combined in the energy generating apparatus according to the present disclosure which uses the fundamentals of a rotating wheel supporting unbalanced loads to create auto rotation using gravitational force.

[0037] [Fig. 1] shows an example embodiment of the energy generating apparatus 1 according to the present disclosure comprising a housing 3 supported on a base 4, and a rotating wheel assembly 5 supported for rotation within the

housing 3. The wheel assembly 5 has two generally planar wheel discs 6 positioned in a parallel and adjacent relation, with each wheel disc 6 mounted on a common shaft 15. The shaft 15 is rotationally supported via bearings 17 supported by the housing 3. Each wheel disc 6 is shown having a series of spokes 6a extending between a central hub 6b to a peripheral ring 6c. It is however also envisaged that the wheel disc may be in the form of a solid disc. Four weight displacement units 7 are supported on the wheel assembly 5. Each weight displacement unit 7 comprising two actuators 9, each actuator 9 respectively mounted on a said wheel disc 6 for supporting an associated weight 11 therebetween. In [fig. 1], each actuator 9 is mounted on a spoke 6a of a said wheel disc 6, and together support a common weight 11 positioned in the space between the opposing wheel discs 6. Each actuator may be in the form of a linear actuator for urging the associated weight along a linear path of travel. It is however also envisaged that the path of travel may be non-linear, for example a curved path. This non-linear path could be achieved for example by using a motor and gear configuration.

[0038] In the example embodiment of the energy generating apparatus shown in [fig. 1], each actuator 9 displaces the associated weight 11 along a path of travel that extends radially between the central axis of rotation 2 of the wheel assembly 5 and the peripheral edge 21 of each wheel disc 6. The path of travel for each weight 11 are angularly equidistant from the path of travel of each adjacent weight 11, with the paths of travel therefore being spaced 90° apart relative to the adjacent paths of travel in the example embodiment shown in [fig. 1]. Each actuator may be either electrically, pneumatically or hydraulically actuated, or a combination thereof. In the case where the actuators are electrically actuated, an electrical slip ring 31 may be provided at an end of the shaft 15 to allow electrical control lines to be electrically connected to each actuator 9. In the case where the actuators are pneumatically or hydraulically actuated, a rotary joint 19 may be provided at one end of the shaft 15 to enable pneumatic or hydraulic control lines to be in fluid communication with each actuator 9.

[0039] The peripheral edge 21 of at least one of the wheel discs 6 may be provided with gear teeth for engaging an output gear 23 which is supported on an output shaft 25 extending from the housing 3. The support shaft 25 is rotatably

supported by a bearing 29 mounted on the housing 3. A brake 27 is also provided to engage the peripheral edge 21 of at least one wheel disc 6 and thereby prevent ongoing rotational movement of the wheel assembly 5. A speed sensor 33 is also provided on the shaft 11 to measure the rotational speed of the wheel assembly 5, and to provide feedback to a machine controller regulating the desired speed of rotation of the wheel assembly 5.

[0040] A vertical line passing through the central axis 2 of the wheel assembly 5 divides the area within which the wheel assembly 5 can rotate into an extension zone 35, and a retraction zone 37. [Figs. 2a to 2c] shows different stages of operation of the energy generating apparatus 1 shown in [fig. 1] as the wheel assembly 5 rotates through each zone 35,37. The wheel assembly 5 is shown rotating in a counter clockwise direction R, with the extension zone 35 therefore being to the left of the central axis 2, and the retraction zone being to the right of the central axis. The actuators 9 will typically extend towards the peripheral edge 21 of the wheel assembly 5 thereby displacing the associated weight 11 towards that peripheral edge 21 when located within the extension zone 35, and will typically retract towards the central axis 2 when the actuators 9 are located within the retraction zone 37 thereby displacing the associated weight 11 closer to the central axis 2. The energy generating apparatus 1 is started by creating an unbalanced weight within that apparatus. [Fig. 2a] shows an example of how this can be achieved. Actuators 9B and 9C initially retract to bring the associated weights 11B and 11C closer to the central axis 2. This results in a greater torque being produced by weight 11D about the central axis 2 than by weight 11C which is positioned on the opposing side of the wheel assembly 5 to weight 11D. This results in weight 11D moving downwards as the wheel assembly rotates in a counter clockwise direction R.

[0041] [Fig. 2b] shows the wheel assembly 5 when rotated 45° counter clockwise from the position shown in [fig. 2a]. The total torque produced by the two weights 11A, 11D positioned within the extension zone 35 is greater than the total torque produced by the two weights 11B, 11C located within the retraction zone 37. This results in the wheel assembly 5 continuing to rotate about the central axis 2 in a counter clockwise direction R. [Fig. 2c] shows the wheel assembly 5 rotated 90° counter clockwise from the position shown in [fig. 2a]. Actuator 9C begins to extend

as it enters the extension zone 35 thereby displacing the associated weight 11C towards the peripheral edge 21 of the wheel assembly 5. The actuator 9D on the opposite of the wheel assembly 5 to actuator 9C begins to retract as it enters the retraction zone 37, the retraction of actuator 9D displacing its associated weight 11D towards the central axis 2. The ongoing displacement of the weights 11A,11B,11C,11D as they travel between the extension and retraction zones 35,37 results in the total torque produced by the weights when located within the extension zone 35 being greater than the torque produced by the weights when located within the retraction zone 37 thereby maintaining the rotation in a counter clockwise direction R of the wheel assembly 5. The rotation of the wheel assembly 5 can continue perpetually as long as the actuators 9A,9B,9C,9D continue to extend in the extension zone 35, and retract in the retraction zone 37. It is to be appreciated that the direction of rotation of the support wheel assembly 5 can be reversed by swapping the position of the extension and retraction zones 35,37 for the support wheel assembly 5.

[0042] The embodiment of the energy generating apparatus 1 shown in [fig. 1] and [figs. 2a to 2c] uses a wheel assembly 5 having two generally planar wheel discs 6, which each weight displacement unit 7 having two actuators 9. It is however also envisaged that the energy generating apparatus 1 comprises a single wheel disc 6 mounted on the shaft 15, or that each weight displacement unit 7 be placed between the two wheel discs 6. In either of these alternative configurations, each weight displacement unit 7 may only require a single actuator 9 to displace the weight 11 associated with that actuator 9.

[0043] [Fig. 3] is a schematic side view of a weight displacement unit 7 according to the present disclosure respectively showing the actuator 9 and associated weight 11 at a fully retracted position X and a fully extended position Y. The rotational speed of the wheel assembly 5 can be regulated by controlling the position of the weight 11 along the actuator stroke S between the fully retracted position X and fully extended position Y. Therefore, the weight 11 may be positioned at an intermediate opposition between the fully retracted position X and the fully extended position Y.

[0044] The energy generating apparatus 1 according to the present disclosure requires at least a pair of weight displacement units 7 located on opposite sides of

the wheel assembly 5 to operate. A greater number of weight displacement units 7 can however be used depending on design requirements. [Figs. 4a and 4b] respectively show an energy generating apparatus 1A,1B according to the present disclosure using sixteen (16) weight displacement units 7 to thereby improve the smoothness of the rotating motion of the wheel assembly 5. Each weight displacement unit 7 can be individually controlled to regulate the rotational speed of the wheel assembly 5 by extending or retracting the associated weight 111A,111B of the weight distribution units 7 as respectively shown in [figs. 4a and 4b]. Furthermore, more power can be generated by increasing the mass of each weight 111B as shown in [fig. 4b].

[0045] Following the commencement of the rotational movement of the wheel assembly 5, the rotational speed of the wheel assembly 5 can be controlled by adjusting the weight displacement of individual weight displacement units 7 to either increase or decrease the rotational speed. This can be achieved by regulating the position of the weights 111 between the fully extended and fully retracted positions X,Y as shown in [fig. 3], and/or by extending and/or retracting only a portion of the weight distribution units 7.

[0046] The rotation of the wheel assembly 5 can be slowed down or stopped by retracting the actuators 9 at the extension zone 35, and extending the actuators 9 at the retraction zone 37. The speed sensor 33 can measure the slowing of the rotational speed of the wheel assembly 5, and the brake 27 can be activated to engage the wheel assembly 5 when the rotation speed has dropped to a predetermined speed and thereby completely stop the rotation of the wheel assembly 5.

[0047] The energy generating apparatus according to the present disclosure have significant advantages over the prior art machines previously discussed as follows:

- a) The energy generating apparatus uses actuators to vary the location of each weight to any position along the actuator's stroke. With the speed of rotation being relatively slow when compared with prior art machines, it enables the adjustment of the weight location from the central axis of the wheel assembly according to different needs at any time. Therefore, the invention can enable

varying locus depending on the resulting torque.

- b) The energy generating apparatus can regulate the position of the weight from the central axis and can rotate the weights at relatively slow speeds of less than 20rpm, for example. The slow rotational speed enables the adjustment of weight location to alter the speeds as and when required. The adjustment of the speeds will also ensure a smooth slowing and stopping of the rotating wheel assembly when required.
- c) The energy generating apparatus can operate at slow speeds, utilizes minimal gear trains and there is no contact of the weights with surrounding surfaces or tracks. These factors minimize the opportunity to generate friction, heat and vibration during operation, enabling higher efficiencies with net positive energy.
- d) The energy generating apparatus can leverage on “massive” weights even for small systems to generate adequate torque to produce substantial amounts of power.
- e) The energy generating apparatus can utilize the differences in actuator stroke to start the rotational motion of the apparatus without requiring any external motor.

[0048] It should be appreciated by the person skilled in the art that the above invention is not limited to the embodiment described. It is appreciable that modifications and improvements may be made without departing from the scope of the present invention.

[0049] It should be further appreciated by the person skilled in the art that one or more of the above modifications or improvements, not being mutually exclusive, may be further combined to form yet further embodiments of the present invention.

CLAIMS

[Claim 1] An energy generating apparatus comprising:

a support wheel assembly rotatable about a central axis;

at least two weight displacement units supported on the support wheel assembly, each said weight displacement unit comprising at least one actuator connected to an associated weight;

wherein each said actuator is adapted to displace the associated weight along a path of travel extending on the support wheel assembly between the central axis and an outer periphery of the support wheel assembly, the relative displacement of a said weight relative to another said weight resulting in torque being generated about the central axis of the support wheel assembly leading to rotational motion thereof.

[Claim 2] An energy generating apparatus according to claim 1, wherein the support wheel assembly is rotatable through an extension zone where the weights are displaceable away from the central axis when located therein, and a retraction zone where the weights are displaceable towards the central axis when located therein.

[Claim 3] An energy generating apparatus according to claim 2, wherein the extension zone and retraction zone are separated by a generally vertical line extending through the central axis of the support wheel assembly.

[Claim 4] An energy generating apparatus according to any one of the preceding claims, wherein the path of travel of at least one of the weights extends generally radially between the central axis and the support wheel periphery.

[Claim 5] An energy generating apparatus according to any one of the preceding claims, wherein the paths of travel extend angularly equidistant from each adjacent said path of travel along the support wheel assembly.

[Claim 6] An energy generating apparatus according to any one of the preceding claims, wherein the weights are displaceable from a fully retracted position near the central axis of the support wheel assembly, and a fully extended position near the periphery of the support wheel assembly.

[Claim 7] An energy generating apparatus according to claim 6, wherein the weights are displaceable to an intermediate position between the fully retracted position, and the fully extended position.

[Claim 8] An energy generating apparatus according to any one of the preceding claims, wherein the support wheel assembly comprises at least one planar wheel disc for supporting the weight displacement units thereon.

[Claim 9] An energy generating apparatus according to claim 8, wherein the support wheel assembly comprises two said planar wheel discs provided in an adjacent relationship with each of the weight displacement units comprising adjacent said actuators on each said wheel for supporting a said associated weight generally located between the wheel discs.

[Claim 10] An energy generating apparatus according to claim 9, further comprising a housing within which is supported the support wheel assembly, the support wheel assembly comprising a central shaft upon which the at least one wheel disc is mounted, the central shaft being pivotally mounted on the housing.

[Claim 11] An energy generating apparatus according to claim 10, wherein the housing comprises opposing bearings for supporting the central shaft for rotation therein.

[Claim 12] An energy generating apparatus according to any one of claims 10 to 12, wherein the actuators are pneumatically or hydraulically actuated, and the support shaft further comprises a rotary joint through which pneumatic or hydraulic control lines can be in fluid communication with each said actuator.

[Claim 13] An energy generating apparatus according to any one of claims 10 to 12, wherein the actuators are electrically actuated, the support shaft further comprises an electrical slip ring through which electrical control lines can be electrically connected to each said actuator.

[Claim 14] An energy generating apparatus according to any one of claims 10 to 13, wherein the periphery of the at least one wheel disc is provided with gear teeth engaging an output gear supported on the housing to allow for the transfer of energy

from the support wheel assembly during rotation thereof.

[Claim 15] An energy generating apparatus according to claim 14, wherein the output gear is mounted on an output shaft extending from the housing.

[Claim 16] An energy generating apparatus according to claim 15, further comprising a speed sensor provided on the output shaft for measuring the rotational speed of the support wheel assembly.

[Claim 17] An energy generating apparatus according to any one of the preceding claims, further comprising a brake for engaging the outer periphery of the support wheel assembly.

[Claim 18] A method of producing energy using an energy generating apparatus according to claim 1.

[Claim 19] A method according to claim 18, further comprising controlling the displacement of the weight of at least one weight displacement unit along the path of travel to thereby control the rotational speed of the support wheel assembly.