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A NOVEL DESIGN OF A HYBRID SOLAR PV, WIND AND TIDAL ENERGY CONVERSION SYSTEM

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Abstract

A NOVEL DESIGN OF A HYBRID SOLAR PV, WIND AND TIDAL ENERGY CONVERSION SYSTEM

The present invention discloses a system of energy conversion for fulfilling continuous demands of energy in areas where the natural resources like wind, solar and tidal energies are in abundance. The three different energy conversion techniques are combined to produce a surplus amount of energy. The invention uses wind, solar and tidal power generation modules (205). The three modules are coupled to a hollow member at three different locations. The wind power generation module (201) is coupled at the top of the hollow member, the solar power generation module (203) is in the middle and the tidal power generation module (205) is coupled at the lower side of the hollow member which is submerged in the water. This hybrid system offers enhanced renewable energy harnessing per sq. meter of land i.e., energy density, better productivity, increased system reliability and lesser space requirement compared to the conventional renewable energy systems.

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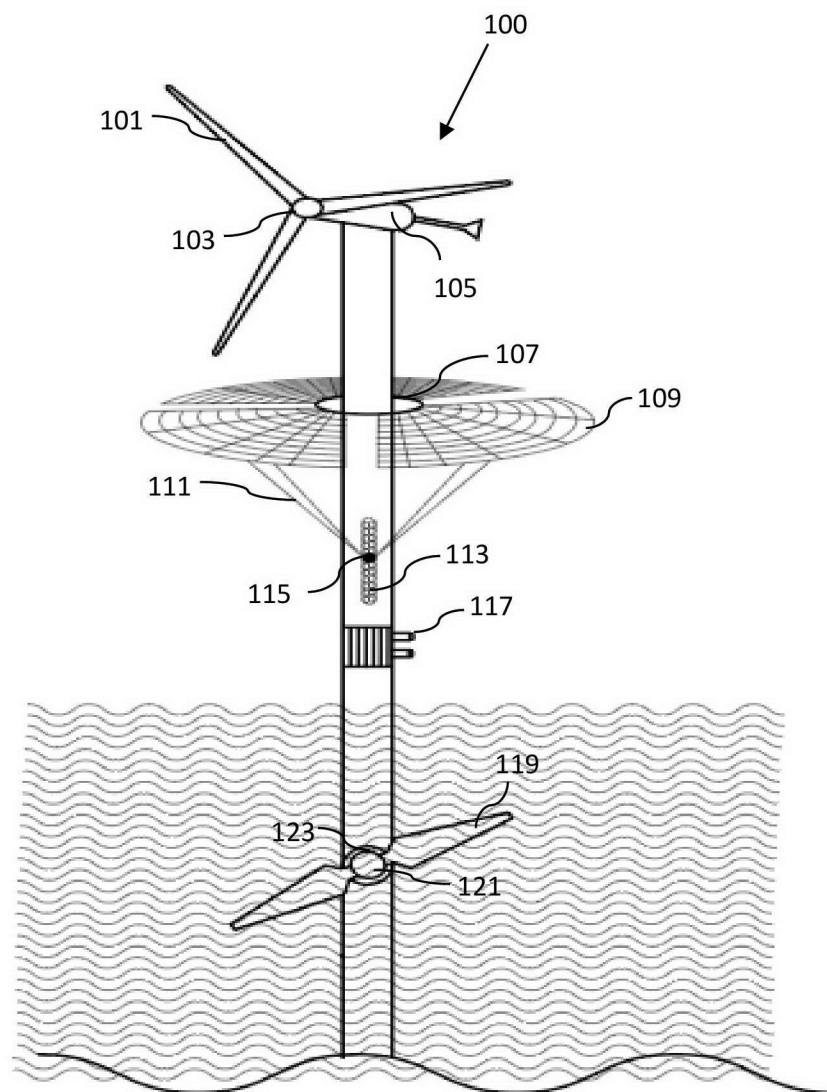


FIG. 1

TITLE: A NOVEL DESIGN OF A HYBRID SOLAR PV, WIND AND TIDAL ENERGY CONVERSION SYSTEM

FIELD OF THE INVENTION

[0001] The present invention is related to a hybrid solar PV, wind and tidal energy conversion, and more specifically to the technique of continuous power supply using the combined effect of the energy conversion using solar, wind and tidal energy.

BACKGROUND OF THE INVENTION

[0002] Conventional systems of energy conversion using renewable resources does not fulfill the continuous supply demand due to the variable nature of renewable sources of energy such as solar and wind. The renewable energy generation, especially wind and photovoltaic, has experienced a rapid growth in recent years. However, the stochastic nature of these resources poses additional challenges to the stability of the system. The deployment of large –scale energy storage systems (ESSs) can reduce the fluctuation of renewable power generation and increase the capability of renewable power generation connections. Scientist and engineers working in the field of renewable energy must overcome the challenges of conversion, transmission and storage before it can replace more traditional power sources such as oil and gas.

[0003] One of the prior art available DE102010022966A1, has discussed the kleinstenergiehybridstation using an asor device which has high

efficiency with little technical effort and thus can be used for small energy producers. This device is used for supplying energy to buildings using solar energy as an energy source. The solar energy and/or wind energy is used for domestic power supply. In this prior art, a container is arranged on a slewing ring, above the container at least one photovoltaic surface and a solar mirror with a two-circuit absorber is attached. There is a tube coupled to the container above which a wind turbine is arranged. The first and the second solar device converts solar into electrical and solar into thermal energies respectively. A water electrolysis apparatus decomposes water into hydrogen and oxygen by means of the electric power supply from the first solar cell device, and the hydrogen is then further stored in a storage device, which is associated with a fuel cell block for generating electrical energy. The wind turbine is operated using the energy from the thermal oil which gets heated up to emit energy to a working fluid having a significantly lower boiling point than water. This energy is delivered to one of the turbines and converted by at least one generator into electrical energy.

[0004] The other prior art available US8552581B2, has disclosed a portable solar and wind-powered energy generating system. The system provides an eco-friendly as well as portable system for generating electricity. The system has a portable enclosure with a roof along with a first and a second solar modules. The first solar module is mounted on the roof of the portable enclosure. There is a portable vertical support

which can be removably positioned adjacent the portable enclosure. A wind turbine is coupled at the top of the portable support. There is a third solar module which is supported by a collapsible support preferably mounted over the portable vertical support for supporting the third solar module. The wind turbine is kept in the electrical communication with the first, second and the third solar module. The sum of all the power generated by this system is delivered to an electrical load (209). The electrical load (209) can be variable like a storage battery, a charger for electrical vehicles etc. This system provides a method of combined energy conversion by the solar and wind modules, but it does not disclose the tidal energy conversion. Also, the assembly of the system is quite complicated to maintain which includes supporting elements and movable elements.

[0005] However, all the prior art systems that are posed in this area are complicated to use. Also, none of the prior art discussed above utilizes a tidal energy generation. The prior arts discussed does not solves the problem of continuous power supply as efficiently as needed. The present invention proposes a method having the combined effect of solar, wind and tidal energy generation, which solves the problem of continuous supply of energy with the help of these three renewable sources of energy conversion.

SUMMARY OF THE INVENTION

[0006] The present invention provides a system for providing continuous power supply demand by combining different renewable energy conversion processes. The present invention utilizes a solar photovoltaic (PV) array, a horizontal axis wind turbine and a water turbine to offer a feasible solution to the problem of continuous power supply especially in those geographical locations where these resources are available in abundance like near the coastal areas.

[0007] The present invention proposes a system which is designed to harness the solar, the wind and the tidal power simultaneously. The system consists of the wind power generation module (201), the solar power generation module (203) and the tidal power generation module (205) which are coupled for continuous power supply. The wind power generation module (201) is coupled to the hollow member at a first location. The wind power generation module (201) comprises of a horizontal axis wind turbine (HAWT) having blades (101), rotor (103) and a generator (105) coupled with the HAWT. The HAWT utilizes the available natural wind current to make its blades (101) rotate. The rotor (103) carrying three blades (101) rotates with an inside ball bearing fixed at the top end. The horizontal axis-wind turbine is then further coupled to an electric generator (105) for producing an alternating (AC) current at the output, which is further rectified to convert to a DC value, before further transmitting, for the summing of the different energies produced. The solar power generation module (203) is coupled at the

second location of the hollow member. The module consists of a solar photo voltaic (PV) array mounted across the periphery of the hollow member. The solar photovoltaic array is mounted on the perforated metal quarters (109), which are further mounted around the stem. The metal quarters (109) are coupled to the hollow member through the hinge ring (107). The metal quarters (109) are coupled to the supporting legs which are fitted at the other end at a third location on the hollow member on a slot (113). The slot (113) is having a stepper motor (115) for the up-down or vertical movement of the metal quarters (109). The hinge ring (107) allows for the twisting movement of the metal quarters (109) in the horizontal direction. In order to attain the maximum incident solar radiation for a particular point of time, the PV assembly could be set at variable angles with respect to the horizontal axis. The photons of the sunlight incident over the solar PV arrays generate direct current that further be supplied to a battery storage system. The tidal power generation module (205) comprises of a water turbine placed at the horizontal axis, coupled to the lower side of the hollow member at a fourth location, and is submerged in the water. The water turbine is having blades (119) and a rotor (121) with a generator (123). The water turbine utilizes available tidal current from the ocean tides to make the blades (119) rotate. The rotor (121) carrying two blades (119) rotates with an inside ball bearing fixed at the top end. The rotor (121) is coupled to generator (123) for producing an alternating current at the

output which is further rectified to convert to a DC value for summing with the other energies produced, before further transmitting to the load (209). The electrical output generated, is either fed into the battery bank for storage or to the inverter unit for meeting the load (209) requirements at rated voltage and frequency.

The employment of tidal power generation module (205) improves the overall foot space utilization and productivity by the proposed system.

[0008] The present invention utilizes the solar power generation module (203) having angled wings of metal quarter (109) that avoid deposition of dust that would otherwise reduce the energy conversion efficiency of the installed solar PV arrays on the metal quarter (109).

[0009] The present invention discloses metal quarters (109), that are fitted at the second location of the hollow member, have perforations, which are provided on the wings. These perforations allow the heat energy of the solar PV arrays to dissipate as they allow cooling through the perforations when wind passes through them.

[0010] The present invention relates to a novel design of a hybrid solar, wind and tidal energy conversion system which is having advantage of enhanced renewable energy harnessing per sq. meter of land, better productivity in terms of energy harnessing efficiency, increased system reliability and lesser space requirement compared to conventional renewable energy systems. The proposed system would pave a way

forward towards developing a more sustainable, effective and rugged hybrid renewable energy system that could cater the global energy needs. The proposed solution is totally GREEN in the sense that GHG emissions are zero and also totally sustainable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The foregoing and other objects, aspects and advantages are better understood from the following detailed description of a preferred embodiment of the invention with reference to the drawings, in which:

[0012] FIG. 1 illustrates the schematic view 100 of the present invention.

[0013] FIG. 2 illustrates the block diagram 200 of the present invention showing different blocks and how they are coupled.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] Reference will now be made in detail to the preferred embodiment(s) of the invention, examples of which are illustrated in the accompanying drawings. Whenever possible, the same reference numerals will be used throughout the drawings to refer to the same or like parts.

[0015] With reference to FIG. 1, the schematic diagram 100 shows a hybrid energy generation apparatus comprising of a solar PV array, HAWT and a tidal based energy conversion system. The invention

comprises of a hollow member which is aligned vertically at the ground surface and is coupled to the solar, wind and tidal power generation module (205) with the help of coupling elements. The hollow member consists of three locations. These locations of the hollow member are used to couple different modules of energy conversation. A horizontal axis wind turbine (HAWT) is coupled at a first location of the hollow member, wherein the HAWT consists of blades (101), a rotor (103) and a generator (105). The blades (101) of the HAWT are coupled to the rotor (103). The rotor (103) is further coupled to a generator (105) to give out a variable frequency alternating current (AC) supply. The metal quarters (109) are coupled at the second location of the hollow member with a hinge ring (107) which allows twisting movement of the solar PV arrays mounted on the metal quarters (109) in the horizontal direction. The two solar PV arrays which are mounted on the metal quarters (109) are spaced at a vertical distance of 30 meters from the HAWT measured. Further, the metal quarter (109) are coupled to the support leg (111) for the movement of the metal quarters (109) in the vertical direction. The support leg (111) is coupled to the slot (113) at the third location at one end and at other end it is coupled to a metal plate. The slot (113) allows for the up and down movement of the metal plate. There will be as many support legs (111) as there will be the metal plates. The support legs (111) will enable the metal plate to move in a vertical direction. This is achieved with the help of a stepper motor (115) which is placed in the

slot (113). A water turbine is placed at the horizontal axis and is coupled at the fourth location of the hollow member at the lower side. The water turbine is fully submerged in the water. The two solar PV arrays are placed over the metal quarters (109), around the hollow member, with the distance of 30 meters from the horizontal axis wind turbine and the water turbine. The water turbine comprises of blades (119) with a rotor (121) which is coupled to a generator (123). The rotor (121) is carrying two blades (119) that rotate inside a ball bearing fixed at the top end. The rotor (121) is coupled to the electric generator (123) for producing an alternating (AC) current. The AC is then converted to the DC equivalent for further processing. The output of the hybrid energy generation system is received at the electrical terminals (117). The employment of tidal power generation module (205) as the third power generation module improves the overall foot space utilization and productivity by the proposed system.

[0016] With reference to FIG. 2, the block diagram 200 of the present invention is shown. The different blocks of the diagram are coupled and then the output of each block is transmitted to a summer (207) for providing the sum of all the electrical outputs. The first block is of the wind power generation module (201). The second block is of the solar power generation module (203) and the third block is of the tidal power generation module (205). The outputs of all the three blocks are

transmitted to the summer (207) for the purpose of addition. The output of the summer (207) is transmitted to the load (209).

[0017] In the preferred embodiment the hybrid energy conversion system of the present invention comprises a HAWT having blades (101) that are coupled to the rotor (103). The HAWT works on the available natural wind current to make its blades (101) rotate. The output of the rotor (103) is transmitted to the generator (105) which is coupled to the rotor (103). The generator (105) is further coupled to the hollow member at the first location. The alternating (AC) current from the generator (105) is transmitted to the rectifier for the rectification purposes, i.e., for conversion of AC to DC for storage purpose in the battery storage system. The metal quarters (109) are coupled at the second location of the hollow member with a hinge ring (107) which allows twisting movement of the solar PV arrays that are mounted on the metal quarters (109) in the horizontal direction. The metal quarters (109) are coupled to the support leg (111) for the movement of the metal quarters (109) in the vertical direction. The support leg (111) is coupled to the slot (113) at the third location at one end. The other end of the support leg (111) is coupled to the metal plate. There will be as many support legs (111) as there will be the metal plates. The support legs (111) will enable the metal plate to move in the vertical direction. The movement in the vertical direction is achieved with the help of a stepper motor (115) which is placed in the slot (113). The solar PV array captures the energy

from the sun rays and converts them into electrical energy. During the availability of the sun, the photons of the incident sunlight generate direct current (DC) electricity that further be supplied to a battery storage system for storing. The water turbine is coupled at the lower side of the hollow member of the hollow member at the fourth location. Here, it is worth mentioning that ocean currents generate more energy than wind currents because density of water is 832 times that of the air. The water turbine is fully submerged in the water. The tidal current naturally available from the ocean is used by the blades (119) of the water turbine to rotate. The water turbine comprises of blades (119) with a rotor (121) that is coupled to the generator (123). The rotor (121) is coupled to the generator (123) for producing an alternating (AC) current. The AC is then converted to the DC equivalent by the rectifier unit. The electrical output generated from the system consists of the combined electrical output from the wind power generation module (201), solar power generation module (203) and tidal power generation module (205), which can be received at the electrical terminal (117). The electrical output generated, is fed to the inverter unit for meeting the load (209) requirements at rated voltage and frequency. The remaining electrical output, after meeting the load (209) requirements, is fed to the battery storage system for storage purposes. This, definitely improve the overall foot space utilization and the productivity by the proposed system. The energy generated using the proposed design is far more that

the solar PV array and wind counterpart because the density of the ocean water is far too high than that of air, resulting in greater pressure being exerted on the water turbine blades (119). Also, this hybrid system would offer the enhanced renewable energy harnessing per sq. meter of land (i.e., energy density), better productivity in terms of energy harnessing efficiency, increased system reliability, and lesser space requirement compared to conventional renewable energy systems. The proposed system would pave a way forward toward developing a more sustainable, effective and rugged hybrid renewable energy system that could cater the global energy needs.

[0018] In another embodiment of the present invention, the support legs (111) are enabled to move in the horizontal direction which allows the partial movement of the metal quarters (109), and hence the solar PV array, in the horizontal direction. The horizontal movement of the metal quarter (109) is provided with the one end of the support leg (111) that is attached with the metal quarter (109), whereas the other end is fixed at the slot (113) on the third location of the hollow member and hence is immovable.

[0019] In yet another embodiment of the present invention, the metal quarters (109) consist of perforations, which further allows air ventilation to regulate the temperature of the at least one metal quarter (109). This is an important feature of the invention as it allows for the

cooling of the solar PV arrays whose function is degraded in case of improper dissipation of heat.

[0020] In yet another embodiment of the present invention, the tidal power generation module (205) is a horizontal-axis water turbine (HAWT).

[0021] In yet another embodiment of the present invention, the solar PV array is a 3rd generation flexible Photo Voltaic (PV) cell module. The solar PV array can further be a monocrystalline silicon PV panel.

What is claimed is:

1. A hybrid energy generation apparatus, characterized in that:
 - a hollow member, coupled to the ground surface partially submerged in the water, to provide support to the hollow member, wherein the hollow member is orientated, at least partially, vertically to the ground surface;
 - a wind power generation module (201), coupled at a first location of the hollow member is a horizontal axis wind turbine, wherein the wind power generation module (201) comprises:
 - a blade(101);
 - a rotor (103); and
 - a generator (105);
 - a solar power generation module (203), coupled at a second location of the hollow member, wherein the solar power generation module (203) comprises:
 - at least one metal quarter (109), enable to accommodate at least one solar PV array;
 - a slot (113), located at a third location of the hollow member;
 - at least one support leg (111), wherein one end of the support leg (111) is coupled to the at least one metal quarter (109) and the second end of the support leg (111) is coupled to the slot (113), wherein the second end of the support leg (111) is enabled to move in a vertical direction in the slot (113) to enable the movement of the metal quarters (109), at least partially, in a vertical direction;
 - a tidal power generation module (205), located at a fourth location of the hollow member, wherein the tidal power generation module (205) comprises:
 - a blade(119);
 - a rotor (121); and
 - a generator (123);

- an electrical terminal (117) enabled to supply power, generated from the wind power generation module (201), the solar power generation module (203) and the tidal power generation module (205).
- 2. The hybrid energy generation apparatus of claim 1, wherein the support leg (111) is enabled to move in a horizontal direction to enable to the movement of the metal quarters (109), at least partially, in a horizontal direction.
- 3. The hybrid energy generation apparatus of claim 1, wherein the at least one metal quarter (109) comprises perforations, allowing air ventilation, to regulate the temperature of the at least one metal quarter (109).
- 4. The hybrid energy generation apparatus of claim 1, wherein the tidal power generation module (205) is a horizontal axis water turbine.

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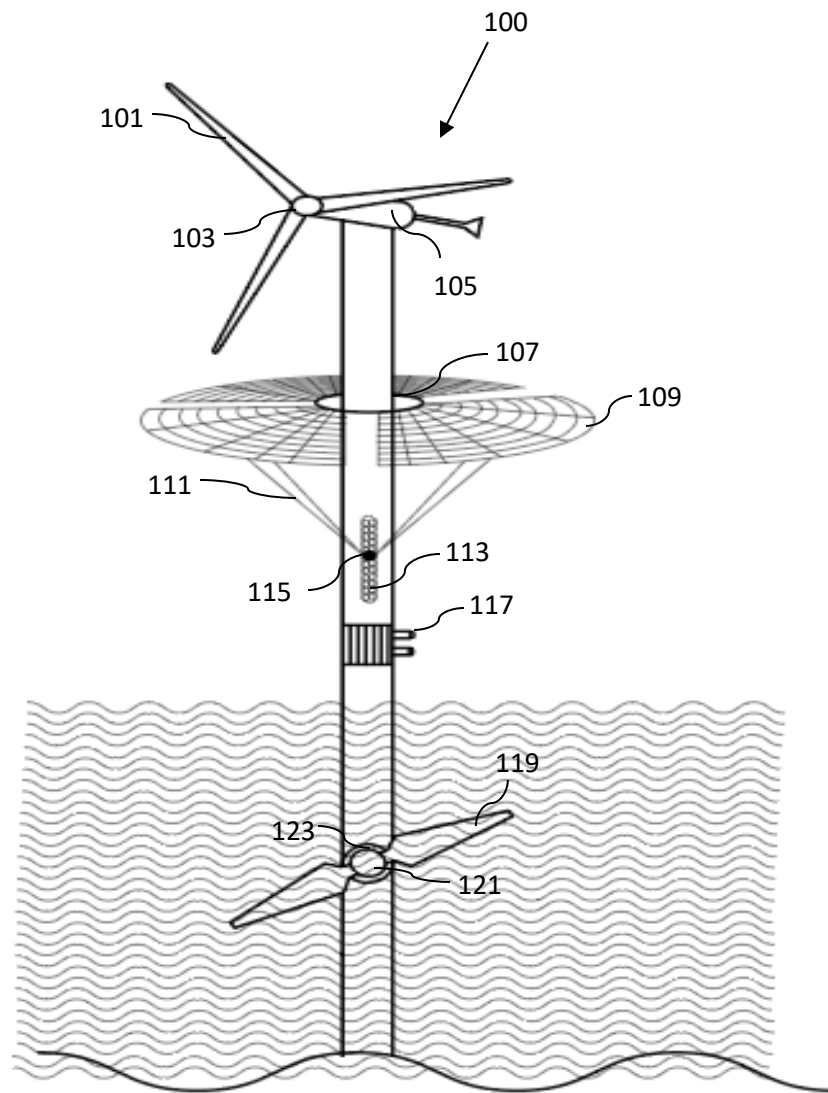


FIG. 1

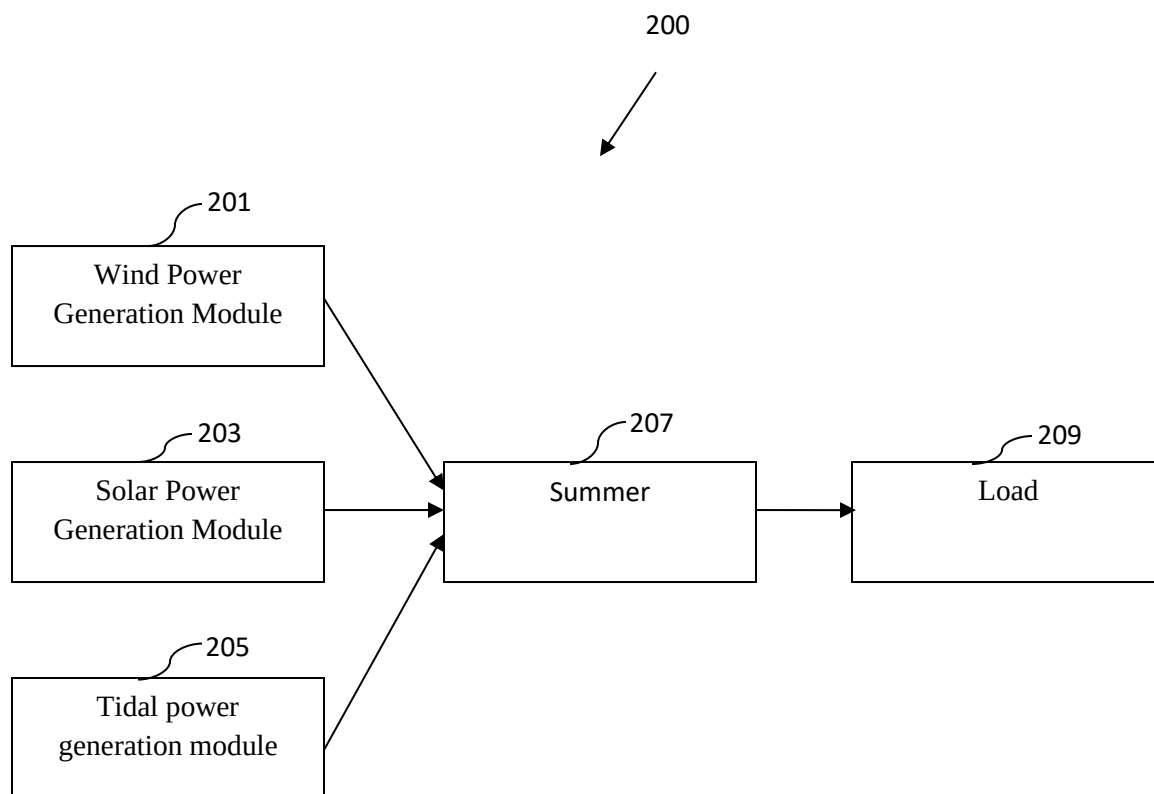


FIG. 2