METHOD AND APPARATUS FOR WIND ENERGY SYSTEM

Abstract: The present invention relates to generating power using wind energy. According to some aspects, the invention uses a passive device to capture wind, and accelerate the wind toward off-the-shelf turbines and other fan blades to generate power in a confined structure. The passive devices to capture wind can have active electronic or mechanical controls to control the amount of wind flowing in the structure to generate power.
METHOD AND APPARATUS FOR WIND ENERGY SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority to U.S. Prov. Appln. No. 61/286,959 filed Dec. 16, 2009, the contents of which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

[0002] The present invention relates generally to generating power using wind energy, and more particularly to methods and apparatuses to capture and accelerate in a confined structure.

BACKGROUND OF THE INVENTION

[0003] The use of wind energy as an alternative energy source has been studied for a long time and has recently gained even more interest. Current wind turbine systems typically require large turbine blades to capture the wind energy. This causes issues such as ergonomic, aesthetic as well as environmental issues.

SUMMARY OF THE INVENTION

[0004] The present invention relates to generating power using wind energy. According to some aspects, the invention uses a passive device to capture wind, and accelerate the wind toward off-the-shelf turbines and other fan blades to generate power in a confined structure.

[0005] According to some aspects, an apparatus according to the invention includes one or more wind-catching segments, each segment having an outer opening for receiving wind, an inner opening for exhausting the wind to an inner chamber of the apparatus, and an accelerating portion for accelerating the wind from the outer opening to the inner opening.

[0006] According to other aspects, an apparatus according to the invention includes a plurality of wind-catching segments, each segment having an outer opening for receiving wind, an inner opening for exhausting the wind to an inner chamber of the apparatus, and an accelerating portion for accelerating the wind from the outer opening to the inner opening.
wherein the plurality of wind-catching segments are arranged in a substantially contiguous manner completely surrounding the inner chamber, so as to catch wind from a plurality of different directions with respect to the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] These and other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures, wherein:

[0008] FIG. 1 is a top view illustrating one example wind catching apparatus according to embodiments of the invention;

[0009] FIG. 2 is a top view illustrating another example wind catching apparatus according to embodiments of the invention;

[0010] FIG. 3 is an assembly view of a wind energy system according to embodiments of the invention;

[0011] FIGs. 4 and 5 provide different views illustrating a segment of a wind catching and wind accelerating apparatus according to embodiments of the invention;

[0012] FIG. 6 illustrates an inner structure of a wind energy system according to embodiments of the invention;

[0013] FIGs. 7A and 7B further illustrate an inner structure of a wind energy system according to embodiments of the invention;

[0014] FIG. 8 further illustrate another example of an inner structure of a wind energy system according to embodiments of the invention;

[0015] FIG. 9 illustrates an example of how a plurality of wind energy apparatuses can be combined together in a system such as being mounted on a pole;

[0016] FIG. 10 illustrates an example of how a wind energy system according to the invention can be affixed to a structure such as a roof; and

[0017] FIG. 11 illustrates an example of how a wind catching and accelerating segment of the invention can be adapted to be similar to existing slanted roof structures such as Dormer or other vents.
DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] The present invention will now be described in detail with reference to the drawings, which are provided as illustrative examples of the invention so as to enable those skilled in the art to practice the invention. Notably, the figures and examples below are not meant to limit the scope of the present invention to a single embodiment, but other embodiments are possible by way of interchange of some or all of the described or illustrated elements. Moreover, where certain elements of the present invention can be partially or fully implemented using known components, only those portions of such known components that are necessary for an understanding of the present invention will be described, and detailed descriptions of other portions of such known components will be omitted so as not to obscure the invention. Embodiments described as being implemented in software should not be limited thereto, but can include embodiments implemented in hardware, or combinations of software and hardware, and vice-versa, as will be apparent to those skilled in the art, unless otherwise specified herein. In the present specification, an embodiment showing a singular component should not be considered limiting; rather, the invention is intended to encompass other embodiments including a plurality of the same component, and vice-versa, unless explicitly stated otherwise herein. Moreover, applicants do not intend for any term in the specification or claims to be ascribed an uncommon or special meaning unless explicitly set forth as such. Further, the present invention encompasses present and future known equivalents to the known components referred to herein by way of illustration.

[0019] According to certain aspects, the invention relates to a method and device for catching and accelerating wind for purposes of generating wind energy, providing ventilation, etc.

[0020] In embodiments, a device according to the invention is affixed to a structure such as the roof of a building and includes one or more wind-catching segments so as to capture wind from a plurality of different directions (as opposed to being rotatable in conjunction with the wind direction as in a conventional free-standing wind turbine, for example).

[0021] FIG. 1 is a top view of a wind-catching device according to one possible implementation of such an embodiment. In this example, the wind-catcher device 2 includes eight wind-catching segments 18 arranged contiguously in a circular shape, and which together
define the outer periphery 10 of the overall structure of device 2. There could be more or fewer such individual segments 18, depending on the application. Moreover, all segments need not be the same size. In this embodiment, the circular shape allows the air to flow from any direction from outer periphery 10 to interior wall 11, even when device 2 is stationary (e.g. affixed to a pole or building roof).

[0022] More particularly, in segment(s) 18 facing a wind direction, air enters in from outer periphery 10 and exits out through interior wall 11. In some embodiments, the opening at outer periphery 10 can be covered with a protective net or a mesh or other porous or permeable membrane to allow air in but keep other foreign particles, birds or other animals out.

[0023] As shown in FIG. 1, the side walls 7 are tapered from outer periphery 10 to interior wall 11 reduce the cross sectional area of the segment 18 between 10 and 11. According to some aspects of the invention, the reduction in the area increases the velocity of the air flowing from outer periphery 10 to interior wall 11.

[0024] Support for the structure is provided by walls 6. Each segment 18 is connected to device 2 by bolting or harnessing it to respective walls 6. Further strength can be provided by adding structures such as trusses or beams from segment 18 to an inner structure within interior wall 11 (or flanges such as shown in FIG. 5, for example).

[0025] In one example embodiment, device 2 is fabricated mainly using 1/16 and 1/8 inch aluminum. However, this example is not limiting and other materials such as sheet metal, fiberglass, cloth, glass, steel, plastic, iron, etc. may be used alone or in any combination together.

[0026] In some embodiments to be described in more detail below, the air flow through a segment 18 can be controlled by a vent shown by 5. The vent opens and closes over the area of the segment 18 that is bounded by 11.

[0027] It should further be noted that, although not shown, dampening material and/or sound mufflers can be used in some embodiments between certain elements to reduce vibration and/or noise as should be apparent to those skilled in the art.

[0028] FIG. 2 is a top view illustrating an alternative implementation of device 3, in which case the segments 18 are not rounded at the edge, such that the shape of outer periphery 10 is octagonal instead of circular. The descriptions of all like-numbered elements from FIG. 1 remain the same.
FIG. 3 shows a final assembly view of the implementation of device 3 shown in FIG. 2. The central (inner) housing 20 having wall 12 that is defined by interior walls 11 of segments 18 can contain a rotor and alternator(s). The housing 24 on top (as shown here, but can also be on the bottom or other locations on the structure in other embodiments) can also hold other electrical connectors, diodes, switches, electronic controls, brakes, inverters, etc. This housing can also be mounted on the side in other embodiments to be described below. The top of the structure can be flat or can be at an angle or any other shape. On a flat or other structure, other structures or devices can be installed. For example, solar panels can be mounted on the top surface to create a hybrid solar-wind energy generation system. In embodiments, the overall structure and segments can create an overall aerofoil structure so as to push the structure downward in case of high wind, for example. One advantage of the overall aerofoil is to minimize the risk of the structure flying off the roof in high wind. With an aerofoil structure, high velocity winds flow around the structure and the aerodynamics exert a downward pressure, providing additional stability to the overall mounting hardware.

It should be noted that the segment and overall structure dimensions may vary based on many variables, such as known location and average wind velocity, and those skilled in the art will appreciate that the overall size of the structure will determine the amount of wind captured, and power generated. Many variations in sizes are possible, while remaining within the scope of the invention. In one example, for an average office, a 5 KW unit could occupy an area bound by between 10 and 15 feet in diameter. Depending on the brand of the alternator used, however, the starting torque for the same wind speed would cause the unit to occupy a larger area. For example, for the same cut in speed, a different brand would cause the unit to occupy an area 15 to 20 feet in diameter. Those skilled in the art will appreciate that many variables besides the amount of wind captured could affect the dimensions required for a target amount of energy.

FIG. 4 illustrates an example of individual segment 18 in more detail. The segment shown in FIG. 4 has a circular outside edge such as that shown in FIG. 1.

At opposite side walls 7, the segment 18 is attached to walls 6 which provide rigidity, support and strength to the overall structure. Each of the segments are connected to each other using screws or nuts to bolt the segments together. In some embodiments, walls 6 and
sidewalls 7 can be combined into one structure which can be slid into a slot separated by two plates, effectively providing similar structure as the overall system design.

[0033] As shown in FIG. 4, and according to aspects of the invention, the sidewalls 7 taper in, providing a smaller area at an end adjacent to interior wall 11 as compared to the opening at outer periphery 10. As described earlier, wind enters in from the opening at outer periphery 10 and exits out from the end adjacent to interior wall 11.

[0034] As mentioned above, an optional vent 5 enables control on the wind inflow. The vent can be a simple vent (spring loaded) or active control. For example, each of the vents 5 for each of the segments can be opened or closed with a motor (not shown). A sensor (not shown) for wind speed and/or direction can be monitored and used to control which vents 5 open or close the vent to optimize flow of air into the inner housing 20. For example, if wind is coming from a certain direction, the vent 5 for the one segment oriented most in the direction of the wind can be opened, while all other vents 5 are closed. Alternatively, the vent 5 for the segment oriented most opposite the direction of the wind can be closed, while all other vents 5 are opened. Those skilled in the art will recognize many possible variations of how vents 5 can be controlled based on monitored wind speed/direction after being taught by this example. For example, a motor can control the vent and a controller (e.g. microcontroller with associated control code) can cause the motor to open or close the vent based on wind velocity and direction.

In another example, there could be flaps on the walls of the segment. These flaps could be spring loaded and/or configured with active electronics controls to open as the wind speed increases. In a simple embodiment, the tension of the spring keeps the flaps closed until the wind speed and pressure from the wind increases. Once the flaps open, the wind is diverted out instead of toward the interior wall. An anemometer coupled to the controller can measure the wind speed, and based on the wind speed, the controller can instruct the appropriate motor(s) to open or close the associated vent(s) or flap(s) based on safety, efficiency and other factors associated with overall operation of the structure.

[0035] FIG. 5 is a perspective view of a segment 18 such as that shown in FIG. 4. The area of segment facing outer periphery 10 is where air comes in and is directed to the inside wall 11. The flange 9 provides a means for harnessing a segment 18 to the inner housing 20 where the alternator and the rotor turbine are enclosed.
FIG. 6 is a perspective view of one example implementation of inner housing 20 according to embodiments of the invention.

The lid 240 closes the inner structure 20 and provides protection to the devices contained in the inner structure (e.g. turbine, alternator, etc.). Openings 13 in the inner structure mate with openings in segments 18 abutting the interior wall 11, such as via flanges 9, to provide an additional means for connecting the segments together and to the inner structure. It should be noted that opening 13 (or portion of wall 11) could be covered with a mesh or net or other similar structures to prevent wild life such as birds or butterflies from entering the inner structure 20.

More particularly, for each segment 18, where the air exits through interior wall 11, there is a corresponding opening 13, thus providing a path for the air from the outside of the device to the inner structure. Those skilled in the art will appreciate that the combinations of the separate structures shown as 11 and 13 can be modified into one or more structures to create different derivative designs of the overall device after being taught by this example. For example, the structure can be built using two cylindrical metallic or plastic or other drums. One drum has a larger diameter than the other drum. The drums are positioned one on the inside of the other. Segments can be created using sheet metal plates cut to size and welded to the drums or held in place using screws, bolts, nuts, etc. Slots are cut out of both drums to match the openings created by the segments, and the rotor is mounted inside the inner drum.

For stability and vibration dampening, the inter segment gap is preferably sealed with a sealant to prevent water and other materials from accumulating in between causing long term fatigue and other structural issues. The sealant material can be any suitable material usually used for sealing structures on the roof and meets code and other safety standards. The sealant material is also preferably flexible, dampening any vibrations arising from operation.

Diffuser 14 provides diffusion for air coming in through openings 13 and out of the inner housing of device 2, for example after passing through a turbine. Molding 15 provides aesthetics and support for the overall structure. Molding 15 can have bolts for bolting down the structure 2 to a flat surface.
FIGs. 7A and 7B further explain the example embodiments of the inner structure according to the invention. In these embodiments, the inner structure can include two separate units.

More particularly, as shown in FIGs. 7A and 7B, a top inner structure 24 holds an alternator 22 connected to lid 240 and/or a support plate 26. The electronics and electrical connections are stored in the housing shown as 24. The wiring from the housing 24 to the alternator is shown as 23 and can be a conduit pipe or a flexible conduit. Additionally, safety circuits can be connected via 23 and 24. For example, an anemometer can be connected via logic circuitry (e.g., a microcontroller and associated code) and a relay to disconnect the generator in case of high wind velocity via 23 and 24.

The top inner structure alternator 22 is connected to a shaft 27 which connects to a rotor 25 in lower structure 12. Additionally or alternatively to alternator 22, the power generation assembly can include a dynamo or other means of producing AC or DC voltage and current (power) when the rotor 27 is turned by the fan blades or turbine 25. The rotor 25 can be designed simply by connecting two plates with several vanes, straight or aerodynamically designed. Alternately, a Savonius or a Darrieus rotor or other types or rotors and their combinations can be used for rotor 25. Moreover, rotor 25 can consist of other forms such as a Patton wheel or other forms of a wind collection and rotation device.

Internal supports 16 provide the necessary support and stability for the exhaust structure 14. The supports can be connected together with dampening material in between or non vibration material to reduce overall noise and vibration. They can also be welded or harnessed together. Support 16 is also designed to provide acceleration to wind exhausting 24 via exhaust structure 14. This could be beneficial if the structure 14 is connected to air ducts or other building climate control systems.

The air flowing into structure 12 (via openings 13, for example), and after impinging on rotor 25, gets directed by duct 16 to an exhaust collector 14. The air exits out through exhaust opening 17. As shown in FIG. 7A, the air exhaust can be configured to be tied to air ducts, attic cooling systems or other ducts if needed. Otherwise, as shown in FIG. 7B, the exhaust structure 14 could be inverted for proper exhaust of the air back into the outside environment. It should be noted that the air exhaust structure can be optional. It should be further
noted that the exhaust opening 17 can be open or covered with a protective net or a mesh or other porous or permeable membrane to allow the flow of air, but keep other foreign particles, birds or other animals out.

The connecting lip / moulding 15 is used for stationing the system on a flat surface. The lip 15 can also be bolted down for overall stability of the contraption.

In the example shown in FIG. 8, the inner structure is simplified by combining the two inner units. Instead of having two separate units such as those shown in FIGs. 7A and 7B, there is one chamber 12 + 24 which houses the rotor and the alternator.

All the details are the same as the previous slide. In this example embodiment, the alternator 22 sits in the same chamber with the rotor 25. The alternator is bolted to the support beam or support plate 26 at the bottom of the alternator instead the top of the alternator as shown in the previous slide.

FIG. 10 shows one example of how a wind-catching device 27 according to the invention can be mounted to the crest of an angled roof. In this embodiment, device 27 includes mounting rails 18, 19 at the bottom. The rails can be "S" shaped or any other shape. The rails preferably follow the dimensions as those standardized by the solar industry for solar panels. For example, standard solar panel mounts 19 (such as those provided Professional Solar Products of Oxnard, California) can be used for harnessing the unit on the roof. Many other types of mounts and positions will become apparent to those skilled in the art after being taught by this example. In this illustrated example, the inner mounting 18 is close to the roof. The outer mounting 19 is not as close to the roof as 18 and may have to be at an angle to mount it properly on a tapered roof. It should be apparent, however, that on a flat roof the inner mounting 18 and the outer mounting 19 can be of the same height. Other forms of mounting can be created using simple structures similar to legs of a table. These legs can be mounted to the side or other appropriate location on the structure.

As shown in FIG. 9, two or more wind-catching devices can be mounted on a single pole to form a wind-catching tower 28. The figure shows three such units mounted on a central pole with a base plate for support, however any suitable number is possible.

It should be noted that the invention is not limited to devices that capture wind from all directions. For example, embodiments with as few as one segment 18 can be used to
capture wind to be used for energy, ventilation, etc. In one possible embodiment, segment 18 can be used in place of an attic cooler inlet which is found commonly on many sloped roofs.

[0052] FIG. 11 illustrates that many implementations in the form of a Dormer vent 1102 and a Gable vent are also possible. These vents could have the general features of one or more segments 18 described above and can be used to collect wind on a roof 1100, generate electric and provide necessary cooling needed. The Dormer structure would have to be modified to suit the segment. The inner structure (e.g. 12 and 24) would also have to be modified to suit the single or fewer segments. The air exhaust system could also be tied to a climate system or a duct to exhaust the air out again.

[0053] Advantages and benefits of the invention are many. For example, using power storage mechanisms together with the invention, utilities can provide reliable clean power to their consumers. Individuals can benefit by reducing their electrical bills by offsetting their electrical usage from the inventions by connecting their electrical devices via inverters to the invention. Individuals can also benefit by charging batteries to create a reliable alternate source of power and create a buffer for loads and power. Communities can benefit the same way individuals can. Farmers can also benefit the same way individuals can. Farmers can also power their farming equipment. Industry can benefit the same way individuals can. Industry can also create an uninterruptable power supply (UPS) using the invention and charge a bank of batteries which can provide power in case the grid power goes down. To use the invention, a person would assemble the wind catcher 2 or 3 with the inner structure 20. Using mounting devices such as 18 and 19, the person would assemble this on some structure such as a roof or a pole or stack them on a pole or other structure. Using the power generation module enclosed in 24 the person would start producing power. This power could be used for power appliances with an inverter, charging batteries, operating electrical devices such as cooling or heating elements or other electrical loads.

[0054] Other advantages of the invention include benefits such as safety. Since the moving rotor is enclosed within the structure, wildlife are protected from it. The rotor inside can be further protected using wire mesh on all openings of the structure or simply on the outside only opening of each of the segments or inside only opening of each of the segments of the
structure. Other benefits include reduced noise as compared to other wind energy devices, and no "light strobes" as the turbine does not rotate in and out of a light source such as the sun.

Although the present invention has been particularly described with reference to the preferred embodiments thereof, it should be readily apparent to those of ordinary skill in the art that changes and modifications in the form and details may be made without departing from the spirit and scope of the invention. It is intended that the appended claims encompass such changes and modifications.
WHAT IS CLAIMED IS:

1. An apparatus, comprising:
   one or more wind-catching segments, each segment having:
   an outer opening for receiving wind,
   an inner opening for exhausting the wind to an inner chamber of the apparatus,
   and
   an accelerating portion for accelerating the wind from the outer opening to the
   inner opening.

2. An apparatus according to claim 1, wherein the inner chamber includes a rotor that rotates in
   accordance with wind exhausted through the inner opening of each of the wind-catching
   segments.

3. An apparatus according to claim 2, wherein the rotor is coupled to an electricity generation
   device.

4. An apparatus according to claim 1, wherein the one or more wind-catching segments are
   arranged in a circle about the inner chamber, whereby wind from a plurality of different
   directions can be captured by respective wind-catching segments of the apparatus.

5. An apparatus according to claim 1, wherein an exhaust portion of the inner chamber is in fluid
   communication with a ventilation system such that wind caught by the one or more wind-
   catching systems is exhausted from the inner chamber to the ventilation system.

6. An apparatus according to claim 1, further comprising mounts for mounting the apparatus to a
   roof of a building.
7. An apparatus according to claim 1, wherein the accelerating portion includes tapered walls that reduce a cross-sectional area of the wind-catching segment between the outer opening and the inner opening.

8. An apparatus according to claim 1, further comprising protective netting covering substantially all of the outer opening.

9. An apparatus according to claim 1, further comprising one or more of a controllable vent on the inner opening or flaps for controllably exhausting air out of the segment instead of the into the inner chamber.

10. An apparatus according to claim 9, further comprising a motor coupled to the vent or flap that is adapted to open and close the vent or flap and a controller coupled to the motor, thereby controlling the amount of wind flowing from the outer opening into the inner chamber.

11. An apparatus according to claim 9, further comprising a controller for controlling the vent in accordance with a measured wind speed.

12. An apparatus, comprising:

   a plurality of wind-catching segments, each segment having:

      an outer opening for receiving wind,
      an inner opening for exhausting the wind to an inner chamber of the apparatus,

   and

      an accelerating portion for accelerating the wind from the outer opening to the inner opening,

   wherein the plurality of wind-catching segments are arranged in a substantially contiguous manner completely surrounding the inner chamber, so as to catch wind from a plurality of different directions with respect to the apparatus.
13. An apparatus according to claim 12, wherein the inner chamber includes a rotor that rotates in accordance with wind exhausted through the inner opening of each of the wind-catching segments.

14. An apparatus according to claim 12, wherein an exhaust portion of the inner chamber is in fluid communication with a ventilation system such that wind caught by the one or more wind-catching systems is exhausted from the inner chamber to the ventilation system.

15. An apparatus according to claim 12, further comprising mounts for mounting the apparatus to a roof of a building.

16. An apparatus according to claim 12, wherein the accelerating portion of each segment includes tapered walls that reduce a cross-sectional area of the wind-catching segment between the outer opening and the inner opening.

17. An apparatus according to claim 12, further comprising protective netting covering substantially all of the outer opening of each of the plurality of segments.

18. An apparatus according to claim 12, further comprising controllable vents on the inner opening of each of the plurality of segments.

19. An apparatus according to claim 18, further comprising one or more motors coupled to the vents that are adapted to open and close the vents, and a controller coupled to the motors, thereby controlling the amount of wind flowing from the outer openings into the inner chamber.

20. An apparatus according to claim 18, further comprising a controller for controlling the vents in accordance with a measured wind speed.