Adaptive Wind Turbine With Modified Blade And Compressed Cone Structure

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Abstract— Wind power is the conversion of wind energy into a useful form of energy, such as using wind turbines to make electrical power, windmills for mechanical power, wind pumps for water pumping or drainage, or sails to propel ships. Wind power, as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation and uses little land. The effects on the environment are generally less problematic than those from other power sources, with the sole exception being wind powers disproportionate effects on vulnerable to extinction avian wildlife, such as that observed with golden eagle and endangered raptor species.

Index Terms—Wind Turbine, Wildlife, Inner Cone, Compression, insert. (key words)

I. INTRODUCTION

A wind turbine is a device that converts kinetic energy from the wind, also called wind energy, into mechanical energy; a process known as wind power. If the mechanical energy is used to produce electricity, the device may be called wind turbine or wind power plant. Today's wind turbines are manufactured in a wide range of vertical and horizontal axis types. The blades of traditional wind turbines can kill birds, bats and other forms of flying wildlife. Estimates released during the last several years have ranged from several tens of thousands to more than 400,000 of such creatures dying annually.

This project deals with the design of bladeless wind turbine which is bird friendly so that they can coexist without any danger. The bladeless wind turbine unit does not have any external moving parts to hit the birds and all the moving parts are internal.

II. TRADITIONAL WIND TURBINE

Horizontal axis turbines sit high atop towers to take advantage of the stronger and less turbulent wind at 100 feet (30 meters) or more aboveground. Each blade acts like an airplane wing, so when wind blows, a pocket of low-pressure air forms on the downwind side of the blade. The low-pressure air pocket then pulls the blade toward it, which causes the rotor to turn. This is called lift. The force of the lift is actually much stronger than the wind's force against the front side of the blade, which is called drag. The combination of lift and drag causes the rotor to spin like a propeller, and the turning shaft spins a generator to make electricity. Figure 1 shows the descriptive diagram of Horizontal Axis and Vertical Axis Wind Turbine.

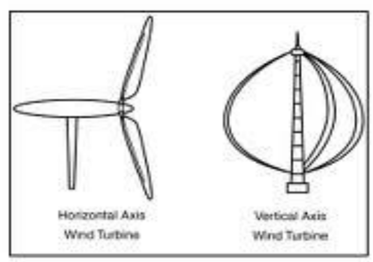

Figure 1 Horizontal and Vertical Axis Wind Turbine

Vertical-axis wind turbines (or VAWTs) have the main rotor shaft arranged vertically. Key advantages of this arrangement are that the turbine does not need to be pointed into the wind to be effective. This is an advantage on sites where the wind direction is highly variable, for example when integrated into buildings. The key disadvantages include the low rotational speed with the consequential higher torque and hence higher cost of the drive train, the inherently lower power coefficient, the 360 degree rotation of the aerofoil within the wind flow during each cycle and hence the highly dynamic loading on the blade, the pulsating torque generated by some rotor designs on the drive train, and the difficulty of modelling the wind flow accurately and hence the challenges of analysing and designing the rotor prior to fabricating a prototype.

III. Concept Of The Adaptive Wind Turbine

In this section, the design of the wind turbine is explained. This device features an ***Inner Compression Cone*** Technology, which will squeeze and compress the incoming air in order to create more power in the turbine. Compressed Air Enclosed Wind Turbine completely eliminates the three massive blades seen on most wind turbines. The blades are internal, closer together and smaller. Therefore eliminating the sound, the traditional blades make as they spin and swoop past a tower.

Inner compression cone technology squeezes the incoming air and compresses it to more than 4 times the pressure. The compressed air then collides with the static wheel which has blade on its rim.

The blade re-directs the air into dynamic wheel which has blade placed exactly opposite to the previous blade structure. This causes the wheel to rotate in the shaft producing mechanical energy. The generator is connected in the other end of the shaft which generates electricity.

IV. Brief Description Of The Several Views Of The Drawing

In this section, a brief description of the adaptive wind turbine (AWT) is represented along with its working path. Figure 2 shows the top plan view of the apparatus of the AWT with a section of the chute shown in broken-away configuration.

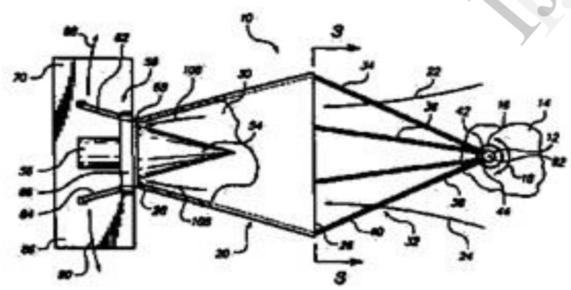

Figure 2 Top Plan View

Figure 3 represents the rear elevation view of the apparatus of the AWT.

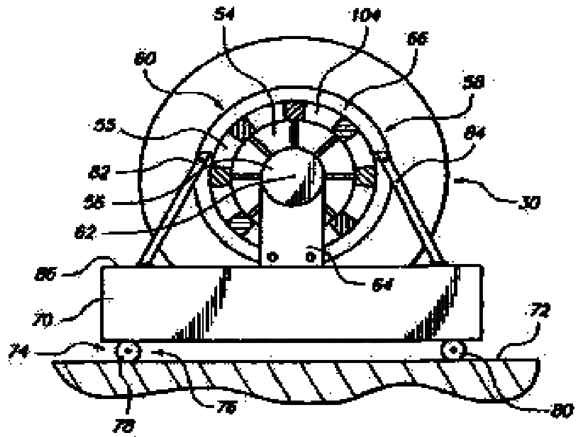

Figure 3 Rear Elevation View

Figure 4 shows the sectional view taken along line 3-3 of Figure 2.

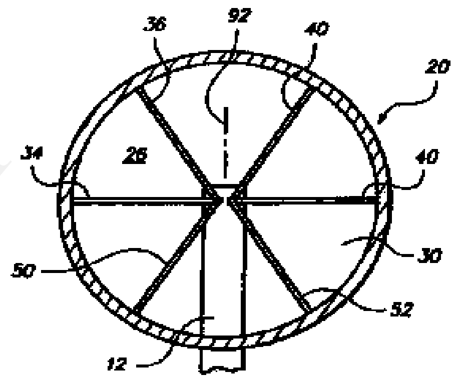

Figure 4 Sectional View

Figure 5 defines the top plan view of another embodiment of the apparatus of the AWT with a section of the chute broken-away.

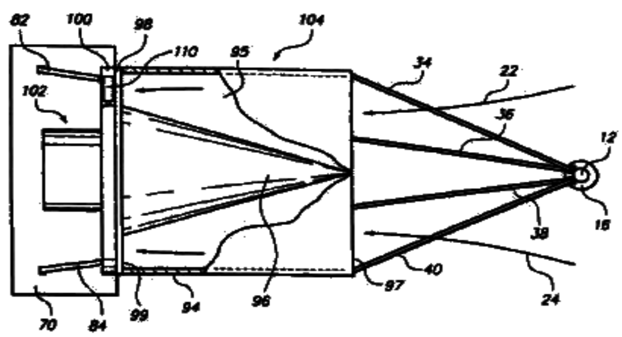

Figure 5 Top Plan View

Figure 6 shows the partial top plan view of another embodiment of the AWT with a section of the chute being shown section.

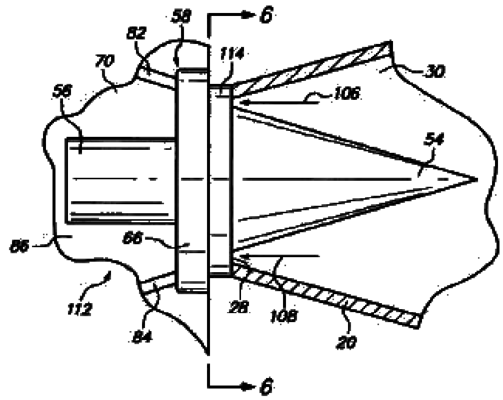

Figure 6 Sectional View

Figure 7 shows the sectional view taken along line 6-6 of Figure 6 and the enlarged top plan elevation view of an exemplary nozzle found at the chute chamber exit.

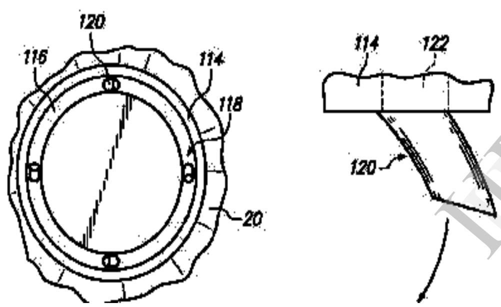

Figure 7 Sectional View

Various aspects of the adaptive wind turbine will evolve from the following detailed description of the preferred embodiments thereof which should be referenced to the prior described drawings.

The power production apparatus 10 includes as one of its elements an anchor 12 which is fixed to ground surface 14 by any conventional means. Anchor 12 possesses a rotatable base 16 which may be of conventional configuration. Rotatable base 16 allows anchor 12, which is the form of an upright member, to rotate according to directional arrow 18 about axis 92, Figures. 2 and 4. A chute 20 is also included in the AWT and may be formed of flexible and lightweight material such as coated cloth, plastic, and the like. Chute 20 is intended to capture wind shown by directional arrows 22 and 24.

As shown in Figure 2, chute 20 is in the form of a truncated cone and includes an entrance 26 and an exit 28. When wind is traveling according to directional arrows 20 and 22, chute is opened forming a chamber 30 there within. Connector or connecting means 32 holds chute 20 to anchor 12. As depicted in the drawings, Figures 2 and 4, connector 32 takes the form of lines 34, 36, 38, 40, 50 and 52. Lines 34, 36, 38, 40, 50 and 52 may be flexible. Rings or other fasteners 42 and 44 on anchor 12 connect to the ends of lines 34, 36, 38, and 40, FIG. 1, as well as lines 50 and 52 depicted in Figure 4.A chamber exit restrictor 54 is also depicted in the drawings.

With specific reference to Figure 2, restrictor 54 is shown as a cone mounted to and fitting 68 and ring support 66, which will be more fully discussed hereinafter. Restrictor 54 forms and annular space 55 which coincides with chamber exit 28, Figure 3. With further reference to Figure 2, it may be observed that a power generator 58 in the form of a conventional bladed turbine is depicted in the drawings.

Turning to Figure 3, it may be seen that power generator 58 includes a plurality of blades 60 which rotate around a central axis 62. A stanchion 64 supports hub 56, Figure 3 to a platform 70. Hub 56 contains the conventional electrical components associated with generator 58. Needless to say, rotation of plurality of blades 50 about axis 62 creates an electrical power source. Support ring 66 connects to platform 70 and also serves as a base for connection of end fitting 68 of chute 20. That is to say, chute 20 is connected to end fitting 68 which is in turn linked to support ring 66. End fitting 68 also serves as a base support for restrictor 54 within chamber 30. Thus, chute 20 is mechanically linked to generator 58 via platform 70. Platform 70 is also depicted in the embodiment shown in the drawings, namely Figures 2 and 3. Platform 70 is supported above ground surface 72 by moving mechanism 74, which is depicted as a plurality of wheels 76, wheels 78 and 80 being depicted in Figure 3. In addition, struts 82 and 84 connect to support ring 60 and the upper surface 86 of platform 70. Thus, platform 70 is free to move in an arcuate direction according to directional arrows 88 and 90, Figure 2. Such arcuate movement centers around the axis 92 of anchor 12, Figures 2 and 4.

Turning to Figure 5, it may be apparent that another embodiment 10A of the AWT is depicted in which a chute 94 is tethered by connector 32 to anchor 12 in the same manner as chute 20 of Figures 2-4. However, chute 94 is of cylindrical configuration, although it is composed of the same flexible and lightweight material as chute 20. A chamber 95 is formed having an entrance 97 and an exit 99. Restrictor 96 is in the form of a cone which is connected to end fitting 98 which is itself connected to support ring 100. Power generator 102 is similar to power generator 58 used with embodiment 10 shown in Figure 2-4. Thus, chute 94 is linked to platform 70 which supports power generator 102.

Referring now to Figure 6-7, it may be observed that another embodiment 112 of the AWT embodiment 112 includes common components to embodiment 10 of Figure 2. A plate 114 is depicted at the exit of chamber 30 which possesses a ring 116. Ring 116 carries a plurality of nozzles 118, which direct wind from exit 28 of chamber 30 to power generator 58.
Although quartets of nozzles are depicted in Figure 7, any number of nozzles 118 may be employed. Figure 7 represents exemplary nozzle 120, passageway 122 through plate 114 leads to nozzle 120. Wind exits nozzle 120 at an angle which is commensurate with the blade system of power generator 58, allowing generator 58 to work in an efficient manner. In other words, the blades of generator 58 may be angulated or curved to directly receive the wind exiting plurality of nozzles 118. In operation, with respect embodiment 10, Figure 2-4, wind is directed into chute 20 via entrance 26.

Wind entering chamber 30 of chute 20 inflates or expands chute 20 which is rotatably held to anchor 12 by connector 32.
Restrictor 54 within chamber 30 concentrates the wind into an annular area 104 between restrictor 54 and end fitting 68 of chute 20. This concentration of the wind within chamber 30 increases the velocity of the wind streaming through chamber 30 toward chamber exit 28 indicated by directional arrows 106 and 108. The wind entering the generator 58 turns blades 60 and produces electrical power in a conventional manner.
Any change in the direction of the wind entering chute 20 will rotate generator 58, and platform 70 according to directional arrows 88 and 90 in an arcuate fashion. Nozzles 118 may aid in this endeavor. Thus, apparatus 10 moves in a generally arcuate or circular path depending on the direction of wind entering chute chamber 30. Rotatable base 16 permits anchor pole 12 to also rotate in this manner according to directional arrow 18.

With respect to the embodiment shown in Figure 5, a similar motion and operation takes place except that chute 94 provides a larger annular area at the exit 99 of chamber 95 allowing wind to hit the blades of generator 102, exemplified by blade 110, Figure 5.While in the foregoing, embodiments of the AWT have been set forth in considerable detail for the purposes of making a complete disclosure of the invention, it may be apparent to those of skill in the art that numerous changes may be made in such detail without departing from the spirit and principles of the invention.

V. DESIGN OF THE WIND TURBINE

The following sections explain the design of the adaptive wind turbine model. Wind turbines are designed to exploit the wind energy that exists at a location. Aerodynamic modelling is used to determine the optimum tower height, control systems, number of blades and blade shape.

Wind turbines convert wind energy to electricity for distribution. Adaptive Wind Turbines can be divided into two components:

The generator component, which is approximately 34% of the wind turbine cost, includes the electrical generator, the control electronics, and most likely a gearbox (e.g. planetary gearbox, adjustable-speed drive or continuously variable transmission) component for converting the low speed incoming rotation to high speed rotation suitable for generating electricity.

The structural support component, which is approximately 15% of the wind turbine cost, includes the cone, wheel, shaft, and blade.

A. Wheel

The wheel is meant for the rotator motion of the blade. Figure 8 explains the design of the wheel.

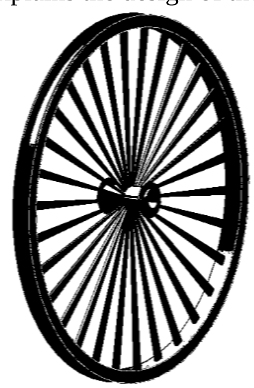

Figure 8 Wheel

B. Blade

A set of 17 cross axial blades are placed over the rim of the wheel. One set of blades facing clockwise direction and another set facing opposite to each other. Two sets of wheel and blade are fixed in a single shaft. Here one wheel is static and another wheel is dynamic.

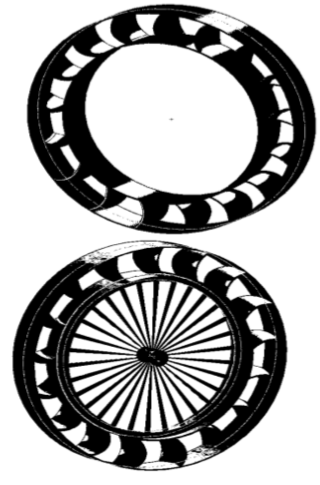

Figure 9 Blade with Static and Dynamic Assembly

C. Compressed Cone

This is the most important design of the model. The inner compression cone technology is achieved using this structure. This cone squeezes the air entering the duct to the blades. This improves the efficiency of the design.

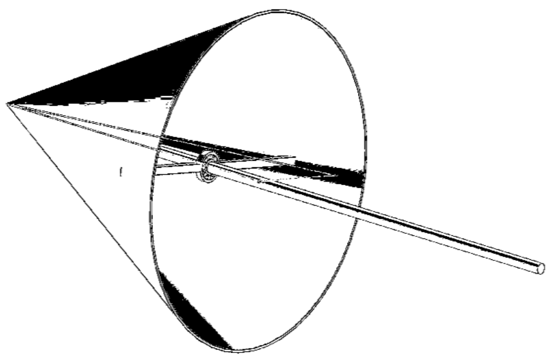

Figure 10 Compressed Cone

This is the whole set up of the Adaptive Wind Turbine. The pressure of air increases as it enters the duct and the speed of the rotating blade increases producing electricity in the generator.

VI. TECHNICAL DESIGN OF AWT

In accordance with the AWT, a novel and useful wind power apparatus usable on a variety of surfaces is herein provided. The apparatus of the AWT utilizes an anchor rotatably fixed to the surface of the ground. The anchor is generally upright and is not intended to be movable relative to an axis in the present application. The anchor preferably includes portions which rotate about the axis of the anchor to allow it to rotate as needed. A chute is also employed in the AWT and is linked to the anchor by a connector.

The chute possesses a chamber which allows the passage of the wind from the chute entrance to the chute exit. The chute may be constructed of relatively light weight and flexible material, such as coated cloth and the like. The chute connector may include a series of lines which are fixed to the anchor and are preferably of equal length. The chute may take a form of a truncated cone, a cylinder, and the like.

A restrictor is also found in the AWT which lies within a chamber formed by the chute. The restrictor is positioned immediately adjacent the chute chamber exit in order to concentrate the flow of air to a peripheral annular portion of the chute exit. For example, the restrictor may take the form of a cone or the like.

The restrictor is mounted to a support or other structure located at the chamber exit. A nozzle or plurality of nozzles may be located at the chute chamber near the extremity of the restrictor. The nozzles are intended to direct wind from the chamber to the turbine. A power generator receives the wind from the chute chamber exit nozzle. The power generator includes a mechanism, which is motivated by the wind received from the chute chamber exit, such as a propeller turbine and the like. The power generator may lie on a platform, linked to the chute, which is supported by a moving mechanism such as a set of wheels, skids, skis, and the like. Thus, the platform supporting the power generator is movable with the chute which tends to swing about the anchor depending on the direction of the wind being captured by the chute.

It may be apparent that a novel and useful wind production apparatus has been heretofore described. It is therefore an object of the AWT to provide a wind power production apparatus which is relatively simple to manufacture and install. Another object of the AWT is to provide a wind power production apparatus which is useable on various types of terrain. A further object of the AWT is to provide a wind power production apparatus in which the velocity of the wind is increased or concentrated for capture by a power generator. Another object of the AWT is to provide a wind power production apparatus which adjusts to a change in direction of the wind being harnessed to provide continual power generation.

A further object of the AWT is to provide a wind power production apparatus which is relatively portable and dependable in generating electrical energy. Yet another object of the AWT is to provide a wind power production apparatus in which at least one nozzle directs wind to a power generator from a chute chamber employed to concentrate wind energy.

VII. SIMULATION

The whole design is simulated using Solid Works. Based on the design calculation, the power converted from the wind into mechanical energy in the turbine is calculated as below. Let's assume the blade length as l, Wind speed as v, Air density as ρ, Power Coefficient as C_p and Area as A.

The Power produced P_{avail}, from the adaptive wind turbine is calculated as given below.

$$P_{avail} = \frac{1}{2}\rho A v^3 C_p$$

A. Real Time Simulation

The adaptive wind turbine is designed using the readily available materials like cycle wheel, sheet metal, ball bearings, shafts, and generator. The working model of Adaptive Wind Turbine (AWT)

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was tested for its efficiency and compared to the Traditional Horizontal Wind Turbine (THWT).

The parts which are designed and mentioned in the section III are fixed and the complete structure of the Adaptive Wind Turbine is given in the Figure 12.

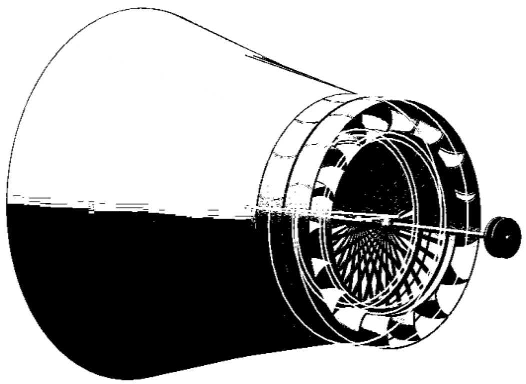

Figure 12 Adaptive Bladeless Wind Turbine

This whole set up is connected to the generator and based on the speed of the rotation, electric energy is produced. The pressure of air increases as it enters the duct and the speed of the rotating blade increases, producing electricity in the generator.

VIII. ADVANTAGES OF AWT OVER TRADITIONAL DESIGN

In this section, the common disadvantages of the traditional wind turbines are discussed.

Wind doesn't always blow consistently, and turbines typically operate at only 30 percent capacity. If the weather is not in your favour, you may end up without electricity (or at least you'll have to rely on the utility company). Severe storms or extremely high winds might cause damage to your wind turbine, especially when they are struck by lightning.

The blades of wind turbines can sometimes be dangerous to wildlife, particularly birds. Wind turbines create a sound that averages around 60 decibels, and if you don't have enough space to locate it away from your house it may prove to be a nuisance. Some people believe that wind turbines are unattractive, so your neighbours may complain.

Compliance with city codes and ordinances may be bothersome when you are trying to install a wind turbine. In some cases, height restrictions may prevent you from installing one. Wind turbines and other equipment required to create wind energy can be very expensive up front, and depending on where you live, it may be difficult to find a vendor and someone who can maintain the equipment.

It requires a lot of open land to set up wind turbines, and cutting down trees sort of defeats the green purpose. Desirable areas to install them are often located far from dense urban areas that could benefit the most from their power.Wind turbines may interfere with reception for televisions or other equipment.

Now the advantages of the Adaptive Wind Turbines are discussed.

It emits hardly any noise in operation, has few moving parts, and since it doesn't use spinning blades it's much less of a hazard to bats and birds. The whole assembly is inside an enclosed housing; with screened inlets and outlets to keep animals safely out. It also can be installed on sensitive locations such as radar installations or sites under surveillance where the rotating blades cause detrimental effects.

The lack of blades and other rotating gears means that there is very little aerodynamic energy and this result in improved power generation. It also reduces mechanical losses.

These units are extremely light weighted when compared to the traditional wind turbines. Hence it can be used as portables in home and offices. Large wind farm can be set in city.

Multiple smaller units can be mounted to the existing blade turbine poles, running two rows of units up each side. These units are environmental safe for the birds, as birds will not fly into these holes. They can be used to replace the existing blade turbine wind farm that are injuring the birds, are expensive to manufacture, erect and replace.

Figure 13 explains the replacement will look like.

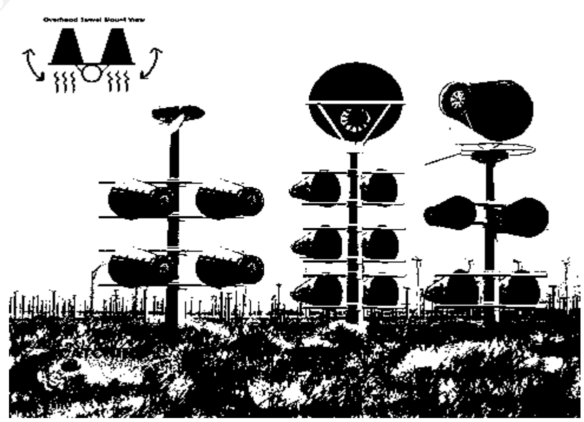

Figure 13 Replacement of Blade Turbine with AWT

IX. CONCLUSION

As discussed above, the Adaptive Wind Turbine is more efficient in terms of operation, power produced and safety. The manufacture and instalment cost is also so low. This can be used widely from household purposes to larger wind farms. Towards the prospect of the greener environment, the new innovative technology like Adaptive Wind Turbine will save birds and also make a good usage of plentiful renewable energy.