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Vertical Axis Wind Turbine

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ABSTRACT:

Awareness about wind energy is constantly growing in the world as a result demand for small scale wind turbine is increasing. There are mainly two types of wind turbines, horizontal axis wind turbine and vertical axis wind turbines. Horizontal axis wind turbines are suitable for high wind speed whereas vertical axis wind turbines operate relatively low wind speed area. Vertical axis wind turbines are cost-effective and simple in construction. A pitch control linkage mechanism for vertical axis wind turbine is modelled by multi-body approach. Aerodynamic loads are predicted from a mathematical model. An appropriate airfoil which The proposed vertical axis wind turbine is fully automatic and after the battery is fully charged it will divert the supply to dummy load. The design features can full fill all domestic needs

INTRODUCTION:

If the efficiency of a wind turbine is increased, then more power can be generated thus decreasing the need for expensive power generators that cause pollution. This would also reduce the cost of power for the common people. The wind is literally there for the taking and doesn't cost any money. Power can be generated and stored by a wind turbine with little or no pollution. If the efficiency of the common wind turbine is improved and widespread, the common people can cut back on their power costs immensely.

Ever since the Seventh Century people have been utilizing the wind to make their lives easier. The whole concept of windmills originated in Persia. The Persians originally used the wind to irrigate farm land, crush grain and milling. This is probably where the term windmill came from.

Since the widespread use of windmills in Europe, during the Twelfth Century, some areas such as the Netherlands have prospered from creating vast wind farms.

The first windmills, however, were not very reliable or energy efficient. Only half the sail rotation was utilized.

They were usually slow and had a low tip speed ratio but were useful for torque.

Since its creation, man has constantly tried to improve the windmill. As a result, over the years, the number of blades on windmills has decreased. Most modern windmills have 5-6 blades while past windmills have had 4~8 blades. Past windmill also had to be manually directed into the wind, while modern windmills can be automatically turned into the wind. The sail design and materials used to create them have also changed over the years.

In most cases the altitude of the rotor is directly proportional to its efficiency. As a matter of fact, a modern wind turbine should be at least twenty feet above and three hundred feet away from an obstruction, though it is even more ideal for it to be thirty feet above and five hundred feet away from any obstruction.

Different locations have various wind speeds. Some places, such as the British Isles, have few inhabitants because of high wind speeds, yet they are ideal for wind generation. Did you know that the world's largest wind farm is located in California, and the total wind power generated there exceeds 1,400 megawatts of electricity? (A typical nuclear power plant generates 1,000 megawatts.)

Some geographic features such as mountains also have an influence upon wind. Mountains can create mountain breezes at night, because of the cooler air flowing down the mountain and being heated by the warmer valley air causing a convection current. Valleys are affected in much the same way. In the daytime, the cooler air is above the valleys and the hot air is above the mountains. The hot air above the mountain rises above the valleys and cools, thus creating a convection current in the opposite direction and creating a valley wind. The oceans create convection currents, as well as they mountains or valleys. In the day, the hotter air is above the same and the cooler air is above the ocean. The air heats up over the sand and rises above the ocean and then cools, creating the convection current. At night, the cooler air is above the sand and the warmer air is above the ocean, so the air heats up over the ocean and cools over the sand. As you can clearly see, the time of day also affects the wind.

We know that for windmills to operate there must be wind, but how do they work? Actually there are two types of windmills -- the horizontal axis windmills and the vertical axis windmills. The horizontal axis windmills have a horizontal rotor much like the classic Dutch four- arm windmill. The horizontal axis windmills primarily rely on lift from the wind. As stated in Bernoulli's Principle, "a fluid will travel from an area of higher pressure to an area of lower pressure." It also states, "as the velocity of a fluid increases, its density decreases." Based upon this principle, horizontal axis windmill blades have been designed much like the wings of an airplane, with a curved top. This design increases the velocity of the air on top of the blade thus decreasing its density and causing the air on the bottom of the blade to go towards the top ... creating lift. The blades are angled on the axis as to utilize the lift in the rotation. The blades on modern wind turbines are designed for maximum lift and minimal drag.

Vertical axis windmills, such as the Durries (built in 1930) use drag instead of lift. Drag is resistance to the wind, like a brick wall. The blades on vertical axis windmills are designed to give resistance to the wind and are as a result pushed by the wind. Windmills, both vertical and horizontal axis, have many uses. Some of them are: hydraulic pump, motor, air pump, oil pump, churning, creating friction, heat director, electric generator, Freon pump, and can also be used as a centrifugal pump.

There are many types of windmills, such as: the tower mill, sock mill, sail windmill, water pump, spring mill, multi-blade, Darrieus, savonis, cyclo-turbine, and the classic four-arm windmill. All of the above windmills have their advantages. Some windmills, like the sail windmill, are relatively slow moving, have a low tip speed ratio and are not very energy efficient compared to the cyclo-turbine, but are much cheaper and money is the great equalizer.

There have been many improvements to the windmill over the years. Windmills have been equipped with air breaks, to control speed in strong winds. Some vertical axis windmills have even been equipped with hinged blades to avoid the stresses at high wind speeds. Some windmills, like the cyclo-turbine, have been equipped with a vane that senses wind direction and causes the rotor to rotate into the wind. Wind turbine generators have been equipped with gearboxes to control [shaft] speeds. Wind turbines have also been equipped with generators which convert shaft power into electrical power. Many of the sails on windmills have also been replaced with propeller-like airfoils. Some windmills can also stall in the wind to control wind speed. But above all of these improvements, the most important improvement to the windmill was made in 1745 when the fantail was invented. The fantail automatically rotates the sails into the wind.

Most wind turbines start to generate power at 11 m/s and shut down at speeds near 32m/s. Another variable of the windmill's efficiency is its swept area. The swept area of a disk--shaped wind wheel is calculated as: Area equals pi times diameter squared divided by four (pi equals 3.14).

Another variable in the productivity of a windmill is the wind speed. The wind speed is measured by an anemometer.

Another necessity for a windmill is the tower. There are many types of towers. Some towers have guy wire to support them and others don't. The towers without guy wires are called freestanding towers. Something to take into consideration about a tower is that it must support the weight of the windmill along with the weight of the tower. Towers are also subject to drag.

Scientists estimate that, by the 21st Century, ten percent of the world's electricity will come from windmills.

Central Power Research Institute

ABOUT

Central Power Research Institute (CPRI) is the power house of the Indian electrical industry. Set up in 1960 by the Government of India, it functions as a centre for applied research in electrical power engineering assisting the electrical industry in product development and quality assurance. CPRI also serves as an independent authority for testing and certification of power equipment.

CPRI's governing body includes eminent professionals from industries & utilities, prestigious academic and research institutions & the government. It employs over 300 highly qualified and experienced engineers & scientists besides other supporting staff.

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With its head office located at Bangalore, the Institute has seven state-of-the-art infra-structural facilities in different parts of India to cater to the needs of power equipment manufacturers and user industries.

OVERVIEW OF WIND ENERGY

India’s Market Overview of Wind Energy

Overview

India has a vast supply of renewable energy resources. India has one of the world’s largest programs for deployment of renewable energy products and systems 3,700 MW from renewable energy sources installed.

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States with strong potential	Potential MW	Installed MW
Andhra Pradesh	8285	93
Gujarat	9675	173
Karnataka	6620	124
Madhya Pradesh	5500	23
Maharashtra	3650	401
Orissa	1700	1
Rajasthan	5400	61
Tamil Nadu	3050	990
West Bengal	450	1

POWER & SOURCES

The power in the Wind

The power in the wind can be computed by using the concepts of kinetics. The wind mill works on the principle of converting kinetic energy of the wind to mechanical energy. The kinetic energy of any particle is equal to one half its mass times the square of its velocity, or ½ mv^2. The amount of air passing in unit time through an area A, with velocity V, is A. V, & its mass M is equal to its Volume multiplied by its density ρ of air, or

$m = \rho AV$ ……………………..(1)

(m is the mass of air transversing the area A swept by the rotating blades of a wind mill type generator)

Substituting this value of the mass in expression of

K.E.=½ $\rho AV.V^2$ watts

$= ½\ \rho AV^3$ watts ………………… (2)

Second equation tells us that the power available is proportional to air density (~~1.225~~ kg/m^3) & is proportional to the intercept area. Since the area is normally circular of diameter D in horizontal axis aero turbines, the A = π D^2 4 (Sq. m)

Put this quantity in equation second then

Available wind power $Pa = ½\ \rho\ \pi D^2 V^3$ / 4

$= 1/8\ \rho\ \pi D^2 V^3$ watt

" wind machines intended for generating substantial amounts of power should have large rotors and be located in areas of high wind Speed".

The Source of Winds

In a macro-meteorological sense, winds are movements of air masses in the atmosphere mainly originated by temperature differences. The temperature gradients are due to uneven solar heating. In fact, the equatorial region is more irradiated than the polar ones.

Consequently, the warmer and lighter air of the equatorial region rises to the outer layers of the atmosphere and moves towards the poles, being replaced at the lower layers by a return flow of cooler air coming from the polar regions. This air circulation is also affected by the Coriolis forces associated with the rotation of the Earth.

In fact, these forces deflect the upper flow towards the east and the lower flow towards the west. Actually, the effects of differential heating dwindle for latitudes greater than 30oN and 30oS, where westerly winds predominate due to the rotation of the Earth. These large-scale air flows that take place in the entire atmosphere constitute the geostrophic winds.

The lower layer of the atmosphere is known as surface layer and extends to a height of 100 m. In this layer, winds are delayed by frictional forces and obstacles altering not only their speed but also their direction. This is the origin of turbulent flows, which cause wind speed variations over a wide range of amplitudes and frequencies.

Additionally, the presence of seas and large lakes causes air masses circulation similar in nature to the geostrophic winds. All these air movements are called local winds

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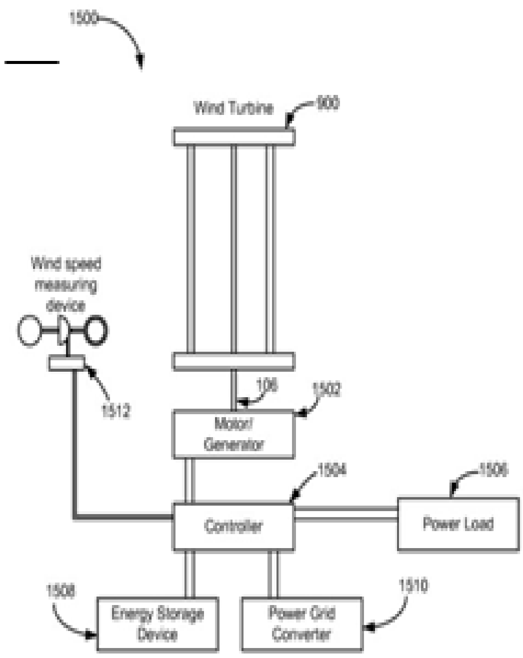

MATERIALS & PROPERTIES COMPONENTS USED

1. CHANNELS
2. ANGLES
3. BLADES
4. SHAFT
5. BEARINGS
6. PULLEY
7. BELT

MATERIALS USED FOR COMPONENTS

CHANNELS	MILD STEEL
ANGLES	MILD STEEL
SHAFT	MILD STEEL
BLADES	MILD STEEL
PULLEY	MILD STEEL
BEARINGS	STAINLESS STEEL

WORKING PRINCIPLE:

Wind turbines operate on a simple principle. The energy in the wind turns two or three propeller-like blades around a rotor. The rotor is connected to the main shaft, which spins a generator to create electricity. Click on the image to see an animation of wind at work. Wind is a form of solar energy and is a result of the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and the rotation of the earth ,The terms wind energy or wind power describe the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water) or a generator can convert this mechanical power into electricity.

CONCLUSION

Our work and the results obtained so far are very encouraging and reinforces the conviction that vertical axis wind energy conversion systems are practical and potentially very contributive to the production of clean renewable electricity from the wind even under less than ideal sitting conditions. It is hoped that they may be constructed used high-strength, low- weight materials for deployment in more developed nations and settings or with very low tech local materials and local skills in less developed countries.

Advantages

- It is a renewable source of energy.
- Wind power system are non-polluting so it has no adverse influence on the environment.
- Wind energy system avoid fuel provision and transport.
- On a small scale up to a few kilowatt system is less costly.
- On a large scale costs can be competitive conventional electricity and lower costs could be achieved by mass production.
- They are always facing the wind - no need for steering into the wind.

- Have greater surface area for energy capture - can be many times greater.
- Are more efficient in gusty winds – already facing the gust.
- Can be installed i more locations-on roofs, along highways, in parking lots.
- Can be scaled more easily - from milliwatts to megawatts.
- Can have low maintenance downtime - mechanisms at or near ground level.
- Produce less noise - low speed means less noise
- The rotor can take wind from every direction.

FUTURE SCOPE

To develop high-altitude wind turbines capable of harnessing stronger and more consistent winds higher in the atmosphere. Although different models are either in the design or testing stage, there are significant feasibility, and particularly, viability issues associated with their development. Laddermills, which are like giant kites, are composed of a series of kiteplanes on a long string that use wind energy at an altitude of 9,000 meters, where wind speed can be 20 times higher than at sea level. Other projects feature helium balloons or flying wing turbines.

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