Pumping of Water by using Wind Turbine

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Abstract -*This paper describes about the Pumping of water by using small scale wind turbine .To utilizes kinetic energy of wind for pumping the water for remotely located inhabitants not connected with national power grid. The time immemorial, The main source of energy has been, wood, inorganic substance like petrol, coal ,nuclear energy, biogas ,natural gas, all these source are limited and this has produce more environmental pollution.Wind power, a green energy, has become another primary renewable resource of great value in economic utility. Wind energy can generated using windmills that provide mechanical energy that is used directly on machinery e.g. positive displacement water pump.*

In our design the wind created aerodynamic action and turns three or five blades around the rotor of wind mill. The rotor is connected to the main shaft which is connected to gear box. The gear box converts rotary motion in to reciprocating motion to piston in the cylinder. When the crank moves from inner dead centre to outer dead centre vacuum is created in cylinder and piston force the water at delivery valve or outlet

***Key Words*: windmill turbine, wind energy, aerodynamics, gear box, positive displacement pump etc.**

1. INTRODUCTION

The wind is the clean and plentiful source of energy. In India data quoted by some scientists that wind speed value lies between 5km/hr to 15-20km/hr. Wind power is the used of winds force to generate some form measurable power and work. Water pumping is very important, most basic wide-spread energy needs in rural areas of the world. It has been found that more than half the world's rural population does not have approach to clean water supply. The need for the optimum utilization of water and energy resources has become a vital issue during the last decade, and it will become more essential in the future. The availability of RESs such as solar photovoltaic, solar thermal, wind, biomass and various hybrid forms of energy sources provides good solutions for energy related problems in India.

To meet the energy demands and reduce the environmental impact, the idea of pumping of water by utilizing wind power in a such way that the without any loss wind power is directly couple to the positive displacement pump such as piston cylinder pump. The use of wind mills is one of the most popular methods of using the energy from natural sources. Windmills were used in earlier days to run the pump & pumping the water from the well. Wind mills are not used because they mostly depend on the wind blowing. However, a small scale wind mills can be used to power small home appliances by decreasing the electricity cost and quantity of fuel burnt to produce equal amount of electricity.

1.1. Objectives

1. To design & develop water pump which will cope up with ordinary pump.
2. Lifting the water without using electricity and fossil fuel.
3. To design small scale wind turbine and to see the feasibility of it. The main advantage helical wind turbine is, it rotates in minimum wind speed also.
4. Setup cost should be less and maintenance free, one time investment is preferable.
5. Improved torque characteristics on the current designs.

2. Experimental Procedure

The experimental analysis of this project started with a detailed study of various mechanisms and component that are used in our project. The wind turbine are used to generate power but in certain application we are used as prime movers to pump water. As per our data the tower was first fabricated based on the requirements with standard parts (Input of pump) keeping in mind various frictional losses. Testing and then the basic designing of the parts followed this. If any of the parts was found to possess strength lesser than the required, it was replaced by a standard part of greater strength. Initially this project had a nature air area and tower with a fly wheel leaf reciprocating pump arrangement. The rotation of the flywheel was not found to be continuous, so it reducing the efficiency of the leaf. This flywheel and leaf has a same rpm. Leaf is attached to the flywheel. Windmills generally consist of two basic types.

1) Horizontal axis windmill

In horizonal shaft windmill the orientation of axis of their rotor are kept along the horizontal axis which can be adjusted so that it is parallel to the direction of wind stream. Blades of propeller type wind mill turbine are made of aerofoil section. The rotational speed of propeller are in the range of 300-400 rpm. While the speed of multiblade type wind mills are 60-80 rpm.

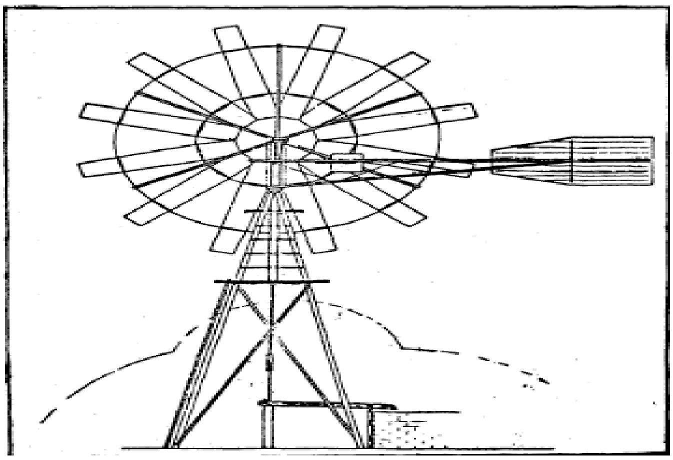

Fig-1: Horizontal Axis Wind Turbine (Source: Wind power Workshop, Hugh Piggott, 1982).

The material used for blades mainly in glass fibers reinforced plastic and aluminum, cast iron, carbon fiber. The multiblade rotor consists of number of curved sheet metal with increasing chord length away from the center. The number of blade used are 12 to20 which having inner side is fixed. Diameter of rotor generally varies from 1to 3m and cut of speed of 16km/hr. the automatic brake are provided for controlling the speed of shaft. The Yow mechanism is provided on wind mill the nacelle around the vertical axis to keep facing the wind.

2) Vertical axis windmill

Vertical axis turbine windmill used the blade either Savonius type or Darrieus type.

The advantage is no orientation is required according to direction of wind. These can produced torque with the wind coming any direction. It has cut in speed as low as 8kmph

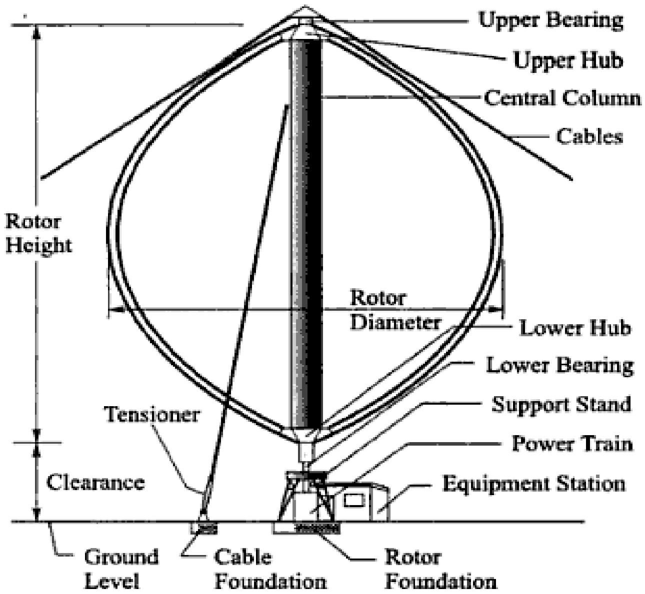

Fig- 2: Darrieus Wind Turbine (Source: Green energy technology, Wortman, 1983).

3. Definitions

3.1. Power Coefficient, Cp

The power coefficient is the ratio of the actual power deliver by the turbine rotor output (Pt) to the theoretical maximum power available in the wind (Pw). So that,

Turbine output power =0.5*ρ* A * v^3* Cp

The Betz Limit is the maximum possible value for *Cp* which is equal to (16/27) but the optimum possible for a multi-blade windmill is 30%.

3.2. Swept Area, As

Swept area is the section of air that encloses the wind turbine or windmill in its movement and interacts with the rotors to produce the rotation motion. For HAWM the swept area is circular in shape and VAWM the swept area is with straight blade, the swept area is rectangular in shape.

The swept area for the HAWT is calculated by:

A=((π/4)*D^2)

3.3. Tip speed ratio, λ

Tip Speed ratio is ratio of the speed of the windmill rotor tip, at radius R when rotating at ω radians per second to the speed of the wind *V* m/s. It is numerically represented as:

λ =(ωR/U)

3.4. Specific speed of wind mill

This is the angular velocity in revolutions per minute at which a turbine will operate if scaled down in geometrical proportion to such a size that it will develop unit power under unit head.

3.5. Thrust coefficient, Ct

This is non-dimensional measure of the force that falls on the windmill. It given as the ratio of the actual thrust force on the windmill to the average force from the wind. Thrust Force on the windmill, FT;

FT=(0.5*Ct* ρ*As*U^2)

3.6. Solidity, ϒ

Solidity is the ratio of the blade area to the swept frontal area of the wind turbine. In case of horizontal machine if n is the number of blade, C is the mean chord length and R is the radius of rotor blade then,

Solidity, ϒ =(nC/R)

3.7. Water pump output power

Power required to pump water is normally determined by the flow rate and the total head generated. This is shown below;

Water Horsepower Pw = ρw*g*Q*H Watts

Where: ρ- Density of water (kg/m^3)

g- Acceleration due to gravity (m/sec^2)

Q- Flow rate (m^3/s)

H- Total pumping head in meter of water(m)

4. Design specification of windmill

Rated wind speed	3.5 m/s
Starting wind speed	2.4 m/s
Power Output	51.09048 W
Maximum Torque Output	106.4572 Nm
Rotor diameter	4 m
Number of blades	24
Standard tower height	7.5 m
Maximum head of water	30 m
Maximum water flow rate	0.1736*10-3 m3/s
Solidity	0.8
Area of blades	0.5585 m2

5. CONCLUSION

The aim of this project to utilize wind kinetic energy is converted in to required pumping torque. This torque is to utilizes to pumping of water. To accomplish the goals, wind speed data measured at different heights and area and to calculate the flow rate of water.

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