EXPERIMENTAL ANALYSIS OF VERTICAL AXIS WIND TURBINE BY USING SPINNIG TOP PRINCIPLE

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Abstract – *The principle of rotating spinning top is applied in vertical axis wind turbine. In this principle the whole mass of the body is concentrated at the centre axis. It reduces the friction between the rotating object and the bearing element to almost zero and gives maximum kinetic energy. All the mass is acting towards the centre vertical axis and gives the opposite force to rotate the axis. Continuous blades are fitted at the centre at 90 degree to each blade. One side it acts like a plane surface give the force for rotation of the blade and other side it acts as line and deviate the air. This special arrangement gives no change in direction of blades respected to wind direction. The shaft rotates all the direction of wind flow.*

Key Words: Wind turbine, Vertical Axis, Spinning Top, Concentrated mass, Centre load.

1. INTRODUCTION

The surge in fossil fuel creates a big gap for power generation. There is plenty of wind energy were not used in the coastal areas. In wind mill the wind energy is used to produce electric power.

1.1 Wind Energy and Wind Turbine

Uneven heating of atmosphere by the sun produces the wind energy. Wind turbine is the device used to produce electricity by means of kinetic energy present in the air. It takes the energy from the atmospheric air and restricts the air speed and converts this energy to shaft rotation.

1.2 Classification of Wind Turbine

i.   Horizontal Axis Wind Turbine (HAWT)

ii. Vertical Axis Wind Turbine (VAWT)

HAWT is the common type of wind mill and mostly used. The blades and transmission systems are mounted at some altitude from the ground. During service requirements it is difficult to servicing the wind turbine setup and it requires the rotation of blades through the wind direction. These are the major disadvantages by using HAWT.

In VAWT not requires changing direction of the blade to the wind direction. The transmission parts are easily accessible. The drawback in the VAWT is self start. But in our arrangement of VAWT the wind blade easily effected by the wind and rotates at lower wind speeds.

2. SPINNING TOP PRINCIPLE

Most sophisticated spinning tops are span by holding the axis steadily by pulled by a string or m twisting a stick or pushing an auger. In the kinds with an auger, an internal weight rotates, producing an overall circular motion. It is a well-known that frictional load is a factor of area of contact between two member in contact by reducing area of contact we can able to reduce the frictional loss. By concentrating load of a rotating system at a point, the friction can be minimized.

Table – 1: Wind Turbine Component Specification

DESCIPTION	DIMENSIONS
Column	Length = 2m
Hub	Length = 0.2m
Blade	Length = 1.5m Breath = 0.3m
Bottom frame	Top side = 0.2 × 0.2 m Bottom side = 0.4 × 0.4 m

3. WORKING PRINCIPLE OF VERTICAL AXIS WIND TURBINE

It is well known that the working principles of vertical axis wind mill turbine. Working principle of this turbine is also same to the vertical axis wind mill turbine's working principle. The flowing of air passes through the blades. One side of the blade the area contact will occur, and other side of the blade will be occur line contact. So area contacted blade tends to move the blade. When the blade moves along the air flowing direction the column which is connected to the blades also revolve to that direction. It drives the differential gear. In this type the blades with reduced length can added more in bottom of the shaft to achieve the spinning top principle.

The differential gear connected to the step up gear box to raising the speed. This may connect with the electrical power

generator, which converts the mechanical (rotation of the shaft) into electrical energy (electric power). The electrical power generated by the generator is stored by a battery which is used for various applications. At the bottom, to minimize the static friction by using the spinning top principle which will enable the wind turbine to start without the aid of external forces even at lower wind speed. In added advantage the system will have very lower dynamic friction. So it will also reduce the overall friction.

4. DESIGN CALCULATIONS:

Available wind power $Pa = \frac{1}{2} \rho \times b \times l \times v^3$

Kinetic energy $K.E = \frac{1}{2} m v^2$

ρ = air density = 1.225 kg / m³

Mass = Density × Volume

Volume = Area ×Length

From above triangle $\sin \theta$ = h / hyp

     Sin 60 = h / 0.30

     h=0.26m.

Area of the triangle = $\frac{1}{2} \times b \times h = \frac{1}{2} \times 0.15 \times 0.26$

     = 0.0195 m².

Volume = 0.039 ×1.5 = 0.0585 m³

Air mass = 1.225 × 0.0585

     = 0.07166 kg.

b= 0.3 m, l= 1.5 m

Normal wind speed, v=6 km/hr

= 6 ×1000/3600 = 1.667m/s.

P_a=12×1.225×0.3×1.5× (1.667)³

P_a= 1.26 Watts.

P_a=2 πNT/60

Force = m × g = 0.07166×9.81= 0.70298 N

The blades are acted as cantilever beam.

Effective force acted on blades = (force × length)/2

= (0.70298×1.5)/2 = 0.5272 N

0.5272 N force acted on the blades by the in the wind.

Torque = force ×distance = 0.52722×0.75 = 0.3954 N-m.

∴ N = 1.2602/ 2π×0.3954

= 0.5073 rev/sec.

The shaft rotates half revolution per second in normal wind speed.

For 1s = 0.5073 rev/sec and for 2s = 1.014 rev/sec .

This is only for shaft, it transported into pinion it can changed into two and half revolution per second.

5. PHOTOGRAPHY

Fig -1: Prototype of vertical axis wind turbine by using spinning top principle
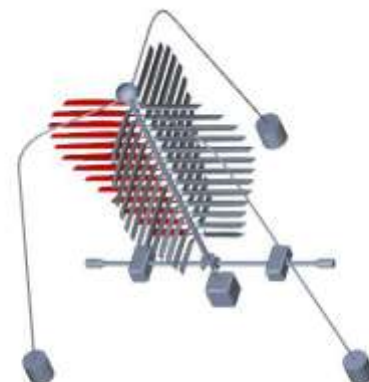

Fig -2: Ansys design of vertical axis wind tubine using spinning top principle.

6. CONCLUSION

From our research in vertical axis wind turbine using the spinning top principle remove the challenges of establishing the vertical axis wind turbines. Among the four blades only two blades are in the wind direction. One blade makes the area contact and the opposite blade makes line contact. Also number of blades can be increased in the lower portion of the shafts by reduced lengths. The design of wind turbine encourages the shaft to rotates the in the normal wind speeds. This type of wind turbines may install in the coastal areas for the high utilization of wind energy as well as electrical power production at lower wind speeds. Among the four blades only one blade is make area contact with the air. Because of line contact in the opposite side blade air is easily flew with lower resistant to the blade.

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