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Kite Generation System

MR. Omkar Pandole, MR. Aniket Sathe, MR. Rushikesh Wable,
MR. Rameshwar Doiphode, Mr. P. R. Chaugule

1234Student, Department of Electrical Engineering, SKN Sinhgad Institute of Technology and Science, Kusgaon (Bk.), Lonavala

5Prof, Department of Electrical Engineering, SKN Sinhgad Institute of Technology and Science, Kusgaon (Bk.), Lonavala

ABSTRACT

The main objective of this project was to make a simulation and design of a one kilowatt scale system. Kite power has the potential to be more economical than using wind turbines because kites can fly higher than turbines can operate. At higher altitudes, wind speeds and available power are increased. In the developed system, a large wind boarding kite pulls the end of a long rocking arm which turns a generator and creates electricity. This motion is repeated using a mechanism that changes the angle of attack of the kite during each cycle, thus varying its lift force and allowing a rocking motion of the arm. The end of the arm turns a shaft with a flywheel attached and spins a mounted generator, whose output then gets stored in batteries for later use. A future application for this system will be in a developing nation without access to a power grid.

Keywords: Kite Power, Turbine, Electricity Generate, Generator, Batteries.

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I. INTRODUCTION

As we all know, by increasing use of Electricity ,we have to increase the generation of electricity by renewable ways or somewhat we have to adopt some new ideas or technologies of generation of electricity, the generation of electricity whatever we have been using ,we have to reduce its losses or somewhat we have to improve that technologies by using various new ideas & techniques.

Fiscal	Year-End Cumulative Capacity (in MW)
2017	34,046
2018	35,626
2019	37,669
2020	38,785

India presently has an installed wind energy capacity of approximately 37-38 GW. Also, it has a target of reaching 60GW by the year 2022;and an ambitious goal of 450 GW by the year 2030.In terms of potential, it is 695GW at a hub-height of 120 meters. In the May2020 issue of the Electrical India magazine, Singh stated that KGS is the future of the renewable energy market. There is already a heavy demand as well as tough competition in the international market of KGS technology.

On the top is the kite in the shape of a parachute. The natural path followed by this kite is upward with the wind in an eight-shaped orbit. The tether is a cheap rope made of fiber having good mechanical strength. The one end of the tether is connected to the kite and the other end is wounded on a drum. The drum rotates to unroll the tether and the kite goes upwards. An electromechanical energy conversion (EMEC) device is connected on the same shaft as the drum through a gearbox. Hence, the linear kinetic motion of the kite is converted in rotational motion of the drum and is used to generate electricity using an EMEC device.

To convert this concept into the action we are going to use mixture of Mechanical and Electrical concepts. For e.g. The following mechanism we are using in this project. 1)Power Conversion Mechanism. 2)Kite Control Mechanism. 3)Angle Of Attack.

Power conversion mechanism are totally based on the electrical mechanism and the kite control mechanism and the angle of attack is dependent upon the mechanical design. Above concepts are discussed in the Design part briefly.

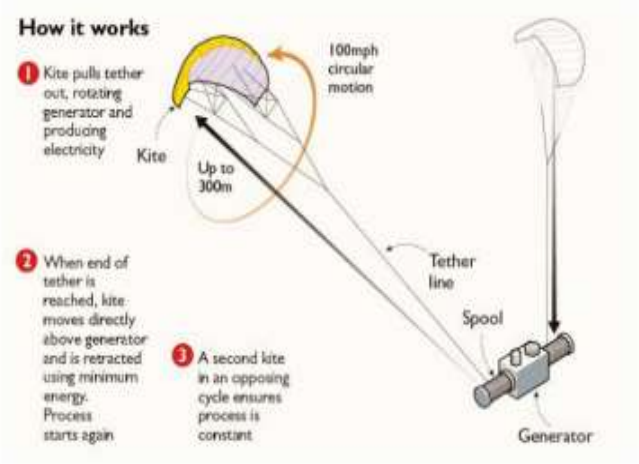


Fig 1. Basic Structure Of KGS

II. LITERATURE SURVEY

Makani Power : Saul Griffith, Donald Montague Makani power, a google X company, has developed a unique type of air-bone wind energy which is called as air-bone wind turbine(AWT).

EnerKite : Enerkite was founded in 2010 in Germany. After the establishment of enerkite this company drive on its experiences from cyber kite to develop a new prototype 'EK30'.

SkySails : Skysails was established in 2001 to develop airborne wind energy devices for ship propulsion augmentation. Between 2001 and 2006, they tested small scale proto-types on various vessels.

Ampyx Power: Ampyx Power is a Dutch company that is developing a pumping mode AWE sys-tem with a tethered rigid wing glider called Power Plane.

WindLift : WindLift was founded in 2006 and developed a ground actuated kite control sys-tem. This American company developed an AWE prototype which utilized a 40m2 inflatable kite as the prime mover.

TwingTec : The Swiss company Twingtec is developing a 100 kW GG-AWES. After having tried several concepts including soft wings and rigid wings, the team is now tackling the problem of automating take-off and landing with an innovative concept: a glider with embedded rotors having rotational axis perpendicular to the wing plane. The rotors are used during take-off and landing. The company plans to have the generator and power conversion hardware inside a standard 20-foot shipping container in order to easily target off-grid and remote markets.

Kitenergy : Another Italian company, Kitenergy, was founded by a former KiteGen partner and is also developing a similar concept by controlling a foil kite with two ropes.

TU Delft : At Delft University of Technology, the first research in Airborne Wind Energy was started by the former astronaut, Professor Ockels, in 1996 . A dedicated research group was initiated by Ockels in 2004 with the aim to advance the technology to the prototype stage.

KiteGen Research : The first moving-ground-station architecture which is based on a vertical axis generator has been proposed back in 2004 by Sequoia Automation and acquired by KGR .

Electrical Magzine(May-2020): HAWE technology and the limitations to its adoption Michael Perlberger, Founder, Brainwhere GmbH, speaks on High Altitude Wind Energy Systems (HAWE).

III. DESIGN OF PROJECT

KGS consist of the following components. 1) kite-boarding kite and tethers 2) A wooden A-frame, an aluminum rocking arm mounted at a series of pillow blocks. 3) An angle of attack mechanism 4)a roll stability mechanism 5) The power conversion system.

The kite is attached to the end of a rocking arm at . A roll stability mechanism autonomously ensures that the kite flies in a stable cycle. This mechanism works by rotating the kite's control bar as a reaction to lateral motion. As the rocking arm is lifted up, it in turn pulls a spring loaded rope. The rope turns a shaft and a system of gears and belts transmit this energy to another shaft. The second shaft attaches to an electrical generator and also contains a flywheel to maintain its motion while on the down-stroke . Once the rocking arm has rotated to a given angle, a weight in the angle of attack mechanism slides down, pulling the kite's trailing edge controls and stalling the kite. As the kite stalls and stops producing lift, the arm falls due to gravity and the angle of attack mechanism resets the trailing edge lines to their original tension. The kite again produces lift, restarting the cycle again.

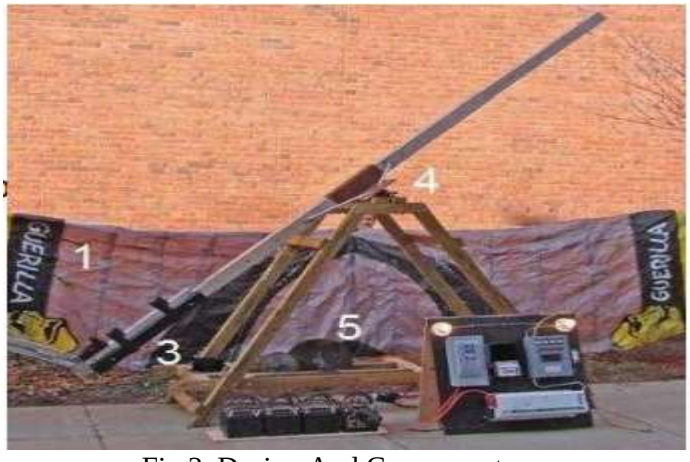


Fig 2. Design And Components

IV. FORMULA AND CALCULATION OF POWER

• Wind Power Availability:

Most available wind studies have been from ground level to approximately 100 m.The power available in the wind is

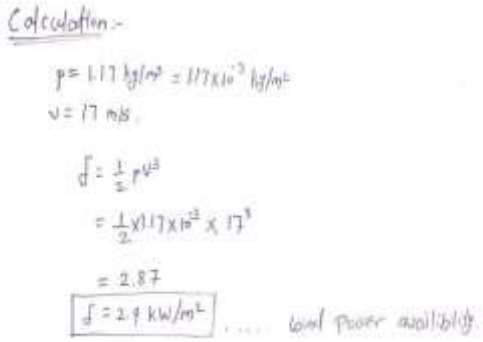
$\delta = ½ \rho v3$

Where,

δ is the wind power density (kW/m2)

ρ is the air mass density (kg/m 2) and

v is the wind velocity.



At the average altitude of the kite, the air density is approx. 1.17 kg/m3 , and they assume windspeeds of 17 m/s. According to the power density equation above, this leads to a wind power density of 2.9 kW/m2

• Power Generation:

We can estimate the maximum amount of power that the kite could extract from the air. This maximum power is:

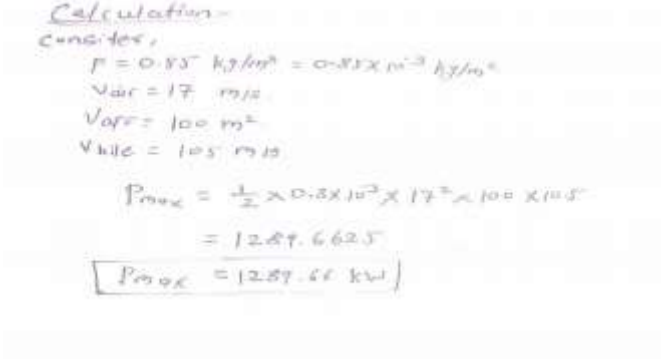
Pmax =½ *ρ *vair 2 *Aeff *vkite

where ρ is the air density,

vair is the wind velocity,

vkite is the velocity of the kite with respect to the air,

and Aeff is the effective area of the kite.



Using a kite speed of 105 m/s and a lift coefficient of 0.85 in addition to the same wind speed and air density as above, the maximum available power for a 100 m2 kite with 17 m/s winds is 1290 kW

V. CONCLUSION

In this project, our main purpose was to make the new inventions and methodologies for power generation from the renewable energy sources.

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