An Experimental Study of Advance Hybrid Savonius With Arm Gear Based Structure For Electric Power Generation

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Abstract- Increasing demand in energy facilitated the need of clean energy such as wind energy. This study was done to investigate the design and development of a micro Vertical Axis Wind Turbine (VAWT) Savonius Type. In regions where wind speed is limited Horizontal Axis Wind Turbines (HAWT) do not have a practical application due to high wind speed requirement. VAWT provide operational abilities at lower speeds and do not require an alignment mechanism. Today, the most commonly used wind turbine is the Horizontal Axis Wind Turbine (HAWT), where the axis of rotation is parallel to the ground. However, there exist other types of wind turbines, one of which will be the primary focus of this paper, the Vertical Axis Wind Turbine (VAWT). These devices can operate in flows coming from any direction, and take up much less space than a traditional HAWT and VAWT are definitely a credible source of energy for the future.

This technique uses a savonius structure which is very advanced and having efficiency greater that other turbines also this structure able to rotate multiple generators so that we can able to handle multiple power stations using that single unit. Since last decade we are using multiple turbines structure so accordingly we have succeed to move only one generator and one station but this structure succeed to rotate multiple generators and according having capability to move multiple stations. This Advanced Hybrid Savonius Multi-Station Structure unit uses 4 units i.e. Advanced Savonius unit, Main Bigger Arm, Sub 8 Arms, Multiple Generators Units so ultimately created Multi-station Structure. This Multi-Station Structure is the demand of developing technology.

Index Terms- Savonius turbine

I. INTRODUCTION

This is not a simple structure like simple turbine. This is advanced technical structure created specially taken vision over multiple natural resources and artificial resources. This structure having natural resources settlement and re-utilization capacity, that means this structure not only uses multiple resources i.e. wind power, water force and other but also settle them to reutilization so that this turbine rotate with more toque and able to create more output so that we can able to charge battery within minimum time.

The Savonius turbine is one of the simplest turbines. Aerodynamically, it is a drag-type device, consisting of two or three scoops. Looking down on the rotor from above, a two-scoop machine would look like an "S" shape in cross section. Because of the curvature, the scoops experience less drag when moving against the wind than when moving with the wind. The differential drag causes the Savonius turbine to spin. Because they are drag-type devices, Savonius turbines extract much less of the wind's power than other similarly-sized lift-type turbines. Much of the swept area of a Savonius rotor may be near the ground, if it has a small mount without an extended post, making the overall energy extraction less effective due to the lower wind speeds found at lower heights.

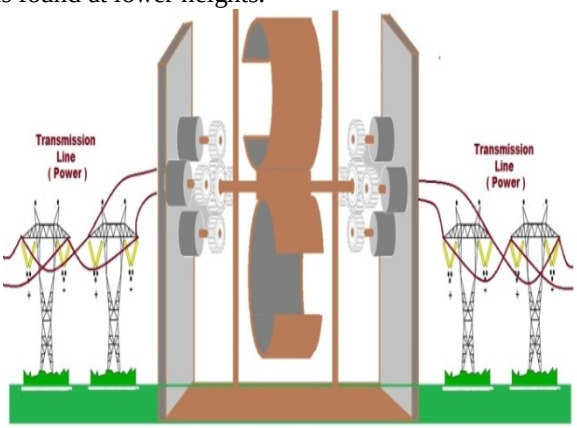

Fig.1 Main Savonius Assembly

Most anemometers are Savonius turbines for this reason, as efficiency is irrelevant to the application of measuring wind speed. Much larger Savonius turbines have been used to generate electric power on deep-water buoys, which need small amounts of power and get very little maintenance. Design is simplified because, unlike with horizontal axis wind turbines (HAWTs), no pointing mechanism is required to allow for shifting wind direction and the turbine is self-starting. Savonius and other vertical-axis machines are good at pumping water and other high torque, low rpm applications and are not usually connected to electric power grids. They can sometimes have long helical scoops, to give smooth torque.

Advanced Hybrid Savonius and arm gear based effective Mechanical Structure for Multi-Station Optimized Power Generation :

As per the technical evolution and technical trends taken into consideration so we have created a “Advanced Hybrid Savonius and arm gear based effective Mechanical Structure for Multi-Station Optimized Power Generation. This system uses an advanced savonius hybrid turbine which will rotate over multiple natural resources water force, wind power and related things having efficiency greater than aerodynamic turbine. The advancement of this turbine is that, this turbine not only rotate over multiple natural resources and artificial resources but also having capability of resources settlement into it according to multiple savonius blade structure. The advantages of this experiment as compared to other system is that, on one single Savonius structure unit we can able to rotate multiple power substation and other power station uses single turbine which will rotate only single generator. So power output is more efficient than that normal. This experiment we can able to implement at industries, factories, agricultural areas, home, airport, hill station and artificial creations.

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This experiment Consists of 4 different Units:

[1] Savonius Unit
[2] Main Arm.
[3] Sub Arm
[4] Multi-station Generator Unit

Fig.2 Savonius balde

Here we will discuss the blade material,size and shape.In this experiment we decided to use Aluminum for Material but u can use steel, Puck Board, or even a simple 5gal pale cut into 2 or 45gal drum cut into 2, so many options you have for the blades.The size for blade is 12.5 width, 6.25 depth, .125"thick, 20" circumference and 18" high.Savonius wind turbines are a type of vertical-axis wind turbine (VAWT), used for converting the force of the wind into torque on a rotating shaft. The turbine consists of a number of aerofoils, usually but not always vertically mounted on a rotating shaft or framework, either ground stationed or tethered in airborne systems.

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Stepwise Creation of Assembly:

This experiment uses main arm having large diameter with some thickness. This main arm is link with the savonius unit, that means according to the rotation of savonius unit, the main arm rotates. the main arm is smallest in size that of savonius unit. The main arm having major gear/wheel whose RPM will be greater than that of savonius unit that means for single rotation of savonius unit the main arm rotates multiple times. This advantage which is useful to increase the RPM of main arm accordingly sub arm,via savonius unit**.**

Fig.3 Gear Mechanism (Main arm)

Fig.4 Chromium alloy sheet

In this experiment, here used 4 sub arms, these 4 arm are nothing but the 4 gears which is link with main arm gear. Ultimately the rotation savonius unit, main arm rotates and accordingly sub 4 arm rotates. The gear assembly of 4 arm are created according to increase maximum RPM stepwise from savonius unit to main arm and main arm to sub arm. The diameter thickness and teeth of gear i.e. sub arm is less than main arm and savonius unit so according we will get maximum RPM through the savonius unit and main arm and main arm o sub arm. This advance structure helps to generate maximum RPM at the sub arm. This sub arm present in a multistation structure form, so according we can able to connect multiple generator unit .

Fig.5 Advance Hybrid Savonius With Arm Gear Based Structure model

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This experiment used multistation structure that means over one savonius unit and single main arm, here used multiple sub arm and accordingly multiple generator. This assembly works from savonius unit to generator with increase in RPM form that means with minimum natural or artificial resources i.e, wind power, water force and etc.

The savonius structure rotates with minimum amount of energy. This rotation helps to rotate main arm with greater RPM than that of savonius turbine. The main arm helps to rotate sub multiple arms .the RPM of sub arm is greater than main arm and accordingly the generator i.e, 4 multiple generator rotates with greater RPM .

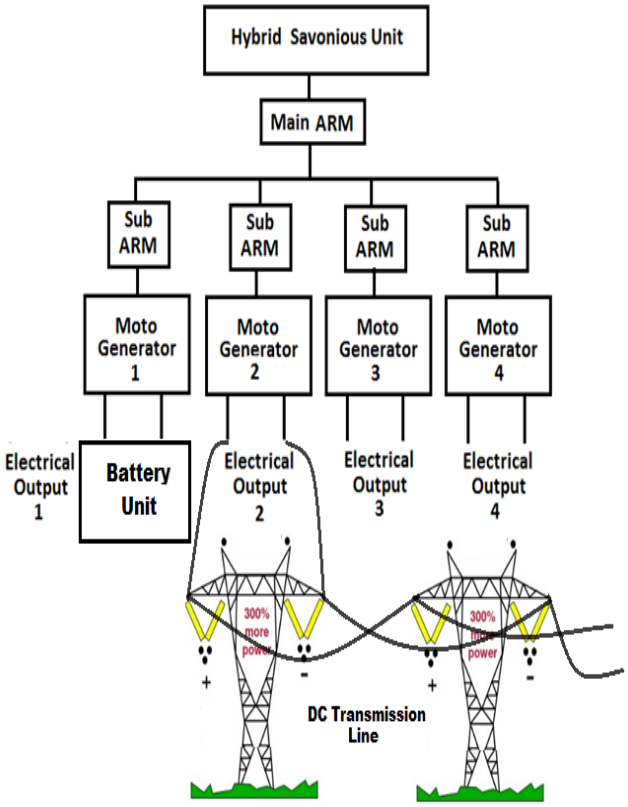

Fig.6 Savonius Unit with DC Transmission

Experiment Model tested Output for Single Generator :
TABLE I

Savnious Rotor speed (N) rpm)	Driver gear speed (N_1) rpm	Driven gear speed (N_2) rpm	Voltage (V)	Current (mA)	Power (W)
20	180	720	8.12	0.200	1.6
30	270	1080	10.02	0.371	3.71
40	360	1440	11.22	0.565	6.33
50	450	1800	18.24	0.769	14.02
60	540	2160	20.10	0.980	19.69

Therefore Output for four DC Generator:

TABLE II

Savnious Rotor speed (N) rpm)	Driver gear speed (N_1) rpm	Driven gear speed (N_2) rpm	Voltage (V)	Current (mA)	Power (W)
20	180	720	32.48	0.200	6.49
30	270	1080	40.08	0.371	14.86
40	360	1440	44.88	0.565	25.35
50	450	1800	72.96	0.769	56.10
60	540	2160	80.4	0.980	78.79

Comparison between this experiment output with existing system by graph :-

1) Voltage vs Voltage

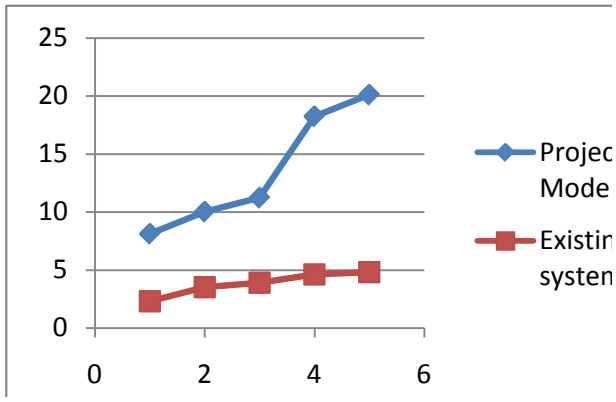

Fig.7 Voltage vs Voltage graph

As seen in scatter chart plotted above, it can be easy to conclude that the experiment model outputs for voltage is more better and much higher as compare existing system result. As the speed of turbine rotor increases then it is seen that the voltage production increases. That's why the experiment model voltage graph is goes to higher side.

2)Current vs Current

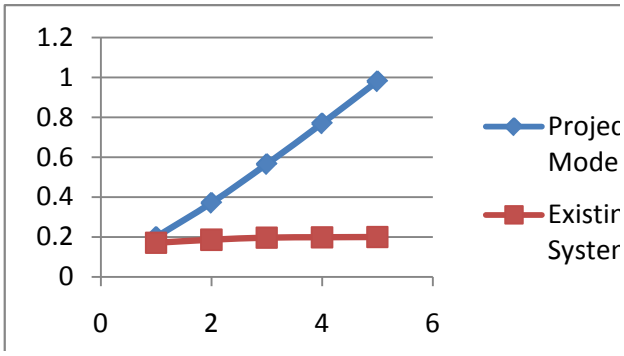

Fig.8 Current vs Current graph

As seen in chart plotted above, it can be easy to conclude that the experiment model outputs for current is more better and much higher as compare existing system result. As the speed of turbine rotor increases then it is seen that the voltage production increases. This result directly relate to current. So alternately current is increases. That's why the experiment model graph is goes to higher side.

3)Power vs Power

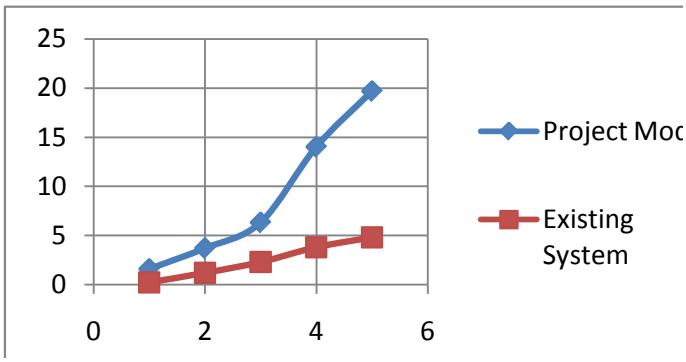

Fig.9 Voltage vs Voltage graph

As seen in chart plotted above, it can be easy to conclude that the experiment model outputs for power is better and much higher as compare existing system result. As the speed of turbine rotor increases then it is seen that the voltage production increases. This result directly relate to current. So alternately current is also goes on increasing state. So by this V and I it is easy to calculate power for different rpm of turbine and hence that's why the experiment model graph is goes to higher side.

Advantages :

- ☐ Highly Efficient and optimized.
- ☐ Effective utilization with of resources
- ☐ Artificial Resources also possible.
- ☐ Easy to create and adopt.
- ☐ Life time generation capacity.

Applications:

- ☐ Agricultural Area where power availability is less .
- ☐ Hills Stations generator.
- ☐ School.
- ☐ Colleges.
- ☐ Hospitals.
- ☐ Restaurants and Hotels.
- ☐ Home .

II. Conclusion

The rotation of 4 generator units is based on main arm followed by savonius unit with geared coupling. This structure i.e. single savonius with multiple generating stations over single arm not only provides efficiency to the system but also increases utility with multiple power stations. As per the result shown in tables having power output almost six times than conventional

system. And system having four generators, combinely able to become more effective wind power plant which will able to handle large load. We can use this system in industrial region where large power is required also we can use this system in agricultural area where there is no availability of power so that we can able to cover larger geographical area for power distribution.

In the advancement of this experiment if we will increase the generator capacity and large savonius unit with increase number of generators units so we can be able to create biggest power plan with optimized cost and suitable power.

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