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A Novel Approach of Electricity Generation by Placing Turbine over Train

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ABSTRACT: A method of generating electrical energy from wind by mounting specially designed wind turbines on the roof of moving train. The specially designed wind turbine converts the energy of wind into mechanical energy and then converting that generated mechanical energy into electrical energy by using generating device. Nowadays it is widely accepted fact that we need to switch on to the non–conventional energy sources. The aim of this paper is to used of the kinetic energy of air for generation of electrical energy which is created due to the motion of the train. Wind energy is a renewable source of energy.
This paper brings a new possibility for the utilization of the wind generated electrical energy for various electrical appliances of the train coaches. This technology will help to reduce the cost of fuel as well as the pollution.
KEYWORDS: Locomotive, Non-conventional, Wind energy, Wind turbine.

I. INTRODUCTION

We all know that food, shelter and cloths these are the basic needs of human beings but nowadays electricity is playing one of the important role in human life. The sources and quantum of fossil energy are decreasing day by day and getting exhausted at very fast rate, so to prevent these non-renewable sources for future generation. Renewable energy from wind and solar is capable and does not increase carbon dioxide emissions.

The wind is one of the most copious natural renewable sources of energy. The idea of train being able to utilize is very infrastructure to generate electricity is very fascinating. However, the potential of harnessing wind energy through large moving vehicles for generation of electricity has remained unexploited. This work proposes an idea in which motion of trains can be used to exploit wind energy for production of electricity. When train is running, the relative speed between wind and train is enough for production of electricity by wind turbine arrangement. This process does not involve any sophisticated mechanism and it is economical therefore we have generated hope. The proposed idea deals with the wind flow and the speed of the train. In this modern age more and more energy is required for daily consumption in all walks of life. In India 70% of electricity generated in thermal power plant .But this power plant is not stable one. Because after twenty years, coal will completely decade. So thermal power plant can not capable to generate the electricity. At the time, India will definitely depend on renewable energy like solar, wind, hydro power plant. Wind presents a vast source of renewable energy. So, gift of this wind should be utilized. The wind on earth surface is caused primarily by the unequal heating of the land and water by the sun. The differences in temperature gradients induce the circulation of air from one to another. It has been estimated that roughly 10 million MWs of energy are continuously available in the earth's winds. The utilization of some of this energy through various mechanical conversion devices has played an important role in the economic development of many countries where windare strong and steady.

In the early 1980's, the Department of Non-conventional Energy Sources (DNES) came into pitcure with the aim to reduce the dependence of primary energy sources like coal, oil etc in view of the Country's energy security. The DNES begin to be Ministry of Non-conventional Energy Sources (MNES) in the year 1992 and now from 2006,DNES was renamed as Ministry of New &

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Renewable Energy (MNRE). The growth of Renewable Energy in India is expand and Wind Energy proves to be the most effective solution to the problem of depleting fossil fuels, importing of coal, greenhouse gas emission, environmental pollution etc. Wind energy as a renewable, non-polluting and cost effective source directly avoids dependency of fuel and transport, can leading green and clean electricity.

India has installed capacity of 35625.97MW (March 2019) of wind energy. Renewable Energy Sources (excluding large Hydro) currently gives the 22% of India's overall installed power capacity of 356100.19MW. Wind Energy carry the major portion of 45.5% of total RE capacity (78316.39MW) among renewable and continued as the largest supplier of clean energy.

The Government of India has target of 175GW by 2022 out of which 60GW will be coming from wind power. The biggest advantage with Overall the future of Wind Energy in India is bright as energy security and self-sufficiency is identified as the major driver. wind energy is that the fuel is free, and also it doesn't produce CO2 emission. Wind farm can be built very fast, the wind farm land can be used for farming as well thus serving dual purpose, and it is cost-effective as compare to other forms of renewable energy.

II. BLOCK DIAGRAM OF PROPOSED MODEL

The above fig-2 shows the block diagram of proposed system. The system which will generate the electricity from the rotational energy of the turbine shaft i.e. the mechanical energy is converted into electrical energy.

The system consists of

1. Wind turbine
2. DC generator
3. Battery
4. Inverter

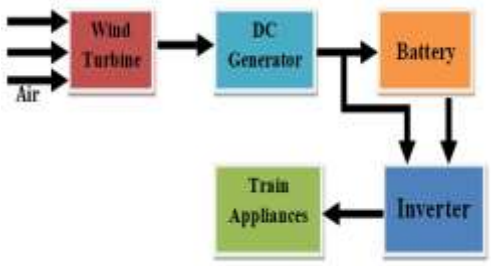

Fig-2: block diagram of proposed model

II.1 Wind Turbine

A wind turbine is a machine for converting kinetic energy of wind into mechanical energy. A wind turbine can be separated into two types based on axis about which turbine rotates. A wind turbine is a device that converts kinetic energy from wind into electrical power. A wind turbine is used for charging the batteries may be referred as a wind charger.

There are normally two types of wind turbines:

(i)HAWT (Horizontal Axis Wind Turbines)

(ii) VAWT (Vertical Axis Wind Turbines)

In this project we are using VAWT, Vertical axis wind turbines (or VAWTs) have the main rotor shaft arranged vertically. One advantage of this arrangement is that the turbine does not need to be pointed into the wind to be effective, which is an advantage on a site where the wind direction is highly variable. It is also an advantage when the turbine is integrated into a building because it is inherently less steerable. Also, the generator and gearbox can be placed near the ground, using a direct drive from the rotor assembly to the ground-based gearbox, improving accessibility for maintenance. However, these designs produce much less energy averaged over time, which is a major drawback. The key disadvantages include the relatively low rotational speed with the consequential higher torque and hence higher cost of the drive train, the inherently lower power coefficient, the 360-degree rotation of the aero foil within the wind flow during each cycle and hence the highly dynamic loading on the blade, the pulsating torque generated by some rotor designs on the drive train, and the difficulty of modeling the wind flow accurately and hence the challenges of analyzing and designing the rotor prior to fabricating a prototype.

When a turbine is mounted on a rooftop the building generally redirects wind over the roof and this can double the wind speed at the turbine. If the height of a rooftop mounted turbine tower is approximately 50% of the building height it is near the optimum for maximum wind energy and minimum wind turbulence. While wind speeds within the built environment are generally much lower than at exposed rural sites, noise may be a concern and an existing structure may not adequately resist the additional stress.

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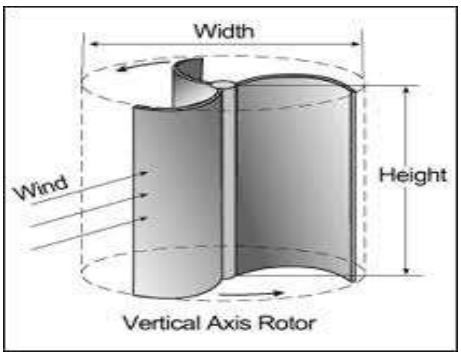

Fig-2.1: vertical axis wind turbine arrangement

II.2 DC Generator

Wind generator converts the mechanical energy generated due to the pressure of wind and speed of the train into electrical energy. For this purpose, permanent magnet DC generator is proposed. The DC generator has constant torque with respect to load. It can easily vary its speed. There is no problem of frequency in DC system so that DC generator plays an important role.

Fig-2.2: DC generator

DC generators give out a direct current, which means the current only flows one way, unlike AC which alternates. The main principle is to convert mechanical energy into electrical energy. The way it produces this energy is that it is based on the fundamental principles of Faraday's Law of electromagnetic induction, in which when a conductor moves in a magnetic field of any strength it cuts magnetic lines of force, due to which an EMF is induced in the conductor. The EMF will cause the current to flow if the conductor circuit is closed. This means the magnitude of this induced EMF depends upon the rate of change of flux linkage. This means the essential parts of the generator are a magnetic field and conductors which move inside the magnetic field. In the case of a "wind turbine generator", the wind pushes directly against the blades of the turbine, which converts the linear motion of the wind into the rotary motion necessary to spin the generators rotor and the harder the wind pushes, the more electrical energy can be generated.

II.3 Battery

Battery is as storing device which store the energy generated by DC generator. A battery is a device consisting of one or more electrochemical cells with external connections for powering electrical devices such as flashlights, mobile phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy. Historically the term "battery" specifically referred to a device composed of multiple cells; however, the usage has evolved to include devices composed of a single cell.

Fig-**2.3:** Battery

II.4 Inverter

An inverter can be appliances defined as it is a electrical equipment used to convert direct current (DC) voltage to alternating current (AC) voltage in common appliances. The **a**pplication of DC involves several small types of equipment like solar power systems. Direct current is used in many of the small electrical equipment such as solar power systems, power batteries, power-sources, fuel cells because these are simply produced direct current. The basic role of an inverter is to change DC power into AC power. The AC power can be supplied to homes, and industries using the public utility otherwise power grid, the alternating-power systems of the batteries can store only DC power. In addition, almost all the household, as well as other electrical equipment can be functioned by depending on AC power. In some cases, generally, the input voltage is lesser whenever the output voltage is equivalent to the grid supply voltage of either 120 V otherwise 240 V based on the country. These devices are

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standalone devices for some applications like solar power. There are different types of inverters available in the market based on the switching waveform shape. An inverter uses DC power sources to provide an AC voltage to giving the supply to the electronic as well as electrical equipment.

III. WORKING OF PROPOSED MODEL

In this proposed system axis of rotor rotation of wind turbine is perpendicular to wind stream. The pressure is generated between the blades due to the movement of wind and aerodynamic lift is developed which causes the rotation of the blades. Fig.3.2 shows the basic flow diagram of proposed system. The shaft of the turbine is directly coupled with a DC generator so as the shaft of the turbine rotates due to the rotation of blade, the generator generates power which is sent to the battery through bus bar arrangement. The generator generates output between 10.5 – 12V DC. The output of the generator can be fed to a chopper with an appropriate control strategy to feed the load in the train coaches which requires DC input. For the coaches which requires AC as an input, the generator output is passed through the inverter with proper control strategy.

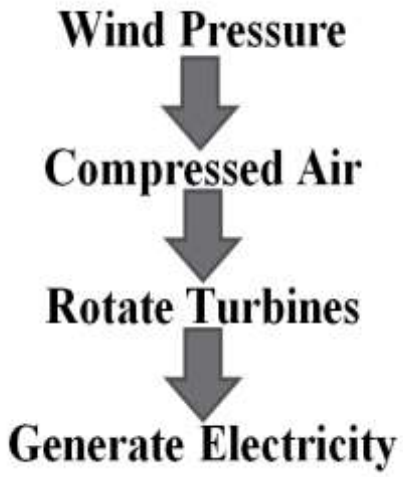

Fig-4: Basic Flow Diagram

IV. GENERAL CALCULATION

Let E= kinetic energy m=mass (kg)
v=wind speed (m/s)
P=power (W)
dm/dt =mass flow rate (kg/s)
dE/dt =Energy flow rate (J/s)
ρ=Density of air (kg/m^2)
A=swept area (m^2)
Cp=power coefficient
R=radius (m)
x=distance (m)
T=time(s)
a=acceleration (m/s^2)

Now, work done (W) on an object is equal to the product of the force & displacement of the object i.e.

$W=E=F*x$ (1)

Newton's law states that

$F= m*a$

Putting in equation (1)

$E=W=m*a*x$

Now using third equation of motion,

$a= (v^2-u^2)/2x$ (2)

Since, initial velocity (u) of the object is taken as zero, we have:

$a=v^2/2x$ (3)

Now, kinetic energy of a body in motion is

$E= (1/2)\ mv^2$

Considering wind as the object, Power in the wind can be computed as rate of change in wind energy: -

[for steady wind speed]

$P=dE/dt= (1/2).\ v^2.(dm/dt)$ (4) Mass flow rate (dm/dt) is:

$dm/dt= \rho*A.(dx/dt)$

And rate of change of displacement is the velocity of the body

$dx/dt=v$

Hence, mass flow rate is

$dm/dt= \rho*A*v$ (5)

Putting in equation (4) we get,

$P= (1/2).\ P*A*v^3$ (6)

Where, $A=\pi r^2$

r=length of the blade, V=relative velocity of the train and wind ρ= 1.2754 kg.m-3 (at STP)

In proposed model, rotor diameter is taken as 0.04 meter, i.e. length of blade is 0.05 meter. Now, we take an average train velocity of 80km/h (22.2222m/s). Putting the values in equation (6),

$P=1/2x1.2754x3.14x0.05x0.05x\ (22.2222)^3$

P=54.9347 Watt

According to Betz law, It calculates the maximum power which can be taken out from wind irrespective of the wind turbine design. The theory was published in 1919 by a German physicist, Albert Betz. He found that the theoretical maximum power extractable from wind is 16/27 (59.3%) times the power contained in the wind. Today, commercial wind turbine efficiency (Cpg, efficiency of generator is also taken into account) is ranging from 15% to 35%. In our calculations 25% efficient wind turbine is considered.

Actual Power (P_{actual}) = P x (16/27) x 0.25
= 8.1384 Watt

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V. RESULT

The proposed model shows the output depend on the speed of train as the speed of train increases the power generation also increases. Theoretical value obtained from calculation is P = 8.1384 Watt And proposed model gives the output of 16 Volt i.e. 24 Watt.

Fig- 5: Proposed Model of Project

Fig- 6: Output of Project

VI. ADVANTAGES

i. The main advantage of the wind energy generated electricity without polluting environment.
ii. Wind energy also be used directly mechanical energy form.
iii. The luxury train is also be the comfortable in high speed then also be generate the useful energy.
iv. Like as solar energy & hydropower, wind power taps of the natural physical resource.
v. Wind energy is an inexhaustible of energy &it‟ s limitless sources.
vi. It is not very costly in generate use full energy.
vii. It generates electricity very easily in the environment.

REFERENCES

[1]. Betz, A. (1966), " Introduction to the Theory of Flow Machines" (D. G. Randall, Trans.) Oxford: Pergamon Press.
[2]. Chen, Z., Spooner, E., "Wind Turbine Power Converters: A Comparative Study", 7th International Conference on Power Electronics and Variable Speed Drives, No. 456, pp. 471-476, Sept. 1998.
[3]. G. Prasanth, "A Renewable Energy Approach By Fast Moving Vehicles", Proceedings of the National Seminar & Exhibition on Non-Destructive Evaluation NDE 2011, December 8-10, 2011.
[4]. Kostyantyn Protsenko, "Modelling and Control of Brushless Doubly-Fed Induction Generators in Wind Energy Applications", IEEE Trans. On Power Electronics, 2008, 23(3): 1191-1197.
[5]. Menaka.S, Archana Adarsh Rao. "Production of Electricity using the Wind turbine Mounted on a Moving Vehicle", Proceedings of the National Seminar & Exhibition on Non- Destructive Evaluation NDE 2011, December 8-10, 2011.
[6]. S.Bharathi (2010), "An Approach to Electricity Generation from Vehicles", International Joint Journal Conference on Engg. & Tech Vol.1 pp.39
[7]. Stephane Sanquer, Christian Barre, Marc Dufresne de Virel and Louis-Marie Cleon (2004), "Effect of cross winds on high-speed trains: development of new experimental methodology", Journal of Wind Engineering and Industrial Aerodynamics, 92(2004), 535-545.
[8]. Suresh Mashyal, "Design and Analysis of Highway Windmill Electric Generation", American Journal of Engineering Research (AJER) e-ISSN : 2320-0847 p-ISSN : 2320-0936 Volume-03, Issue-07, pp-28-32, 2014.
[9]. Venkatesh Kumar Sharma, "Production of electricity by using turbine mounted on train", International Journal Conceptions on Electrical & Electronics Engineering Vol. 1, Issue. 2, December 2013; ISSN: 2345 – 9603
[10]. http://airfoiltools.com/airfoil/details?airfoil=naca6412-il
[11]. https://www.princeton.edu/~asmits/Bicycle_web/blunt.html