

# WIND ENERGY CONVERSION SYSTEM

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**ABSTRACT:** A study has been made on conversion of kinetic energy of the wind to the useful mechanical energy. The theory behind the working of the energy conversion system is well explained with the help of the conservation of mass, Newton’s second law, conservation of energy and the electromagnetic induction principle. A pressure difference is created between two sections by varying the area and hence a magnet placed is moved two and forth in between the coils. The magnetic flux hence generated will produce the useful current.

KeyWords: C-Dduct, magnet, solenoid, Power

## INTRODUCTION

Wind energy is one of the renewable sources of energy which has been used for generating the electricity using the wind energy conversion system named wind turbines. All renewable energy ultimately comes from the sun. The Earth receives  $1.74 \times 10^{17}$  watts of power from the sun. About 2 percent of this energy is converted to wind energy. The efficiency of a system lies in how effectively we can convert the wind energy to the useful power. Wind is a form of kinetic energy. A study is made to state that the wind possess kinetic energy.

energy, The mass of air has been considered in a control volume V, where the study has been made.

Heat supply = internal energy + work done

Heat supply = heat from the sun

But in the above system the only visible energy is kinetic energy which excited the air particle to move from one point to the other till it collide with another air particle.

But each masses can move in any direction i.e. xyz

$$Q = \frac{1}{2}mv^2 + \text{waste heat}$$

$$m = \rho \times v$$

v = average velocity of the air in the system

m = mass of air in the system

The direction of the control volume is based on the magnitude of velocity of each molecule. This can be well illustrated with the following study. Consider the two masses  $m_1$  &  $m_2$  of air molecules which absorb the heat energy and move in the opposite direction with velocity  $v_1$  &  $v_2$ .

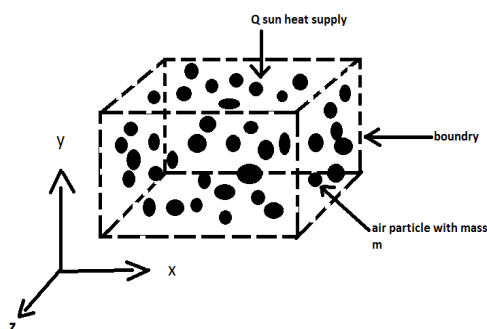


Figure 1

Let us consider a system as shown above in the figure with ‘Q’ as heat supply from the sun and m the masses of air absorbing the heat

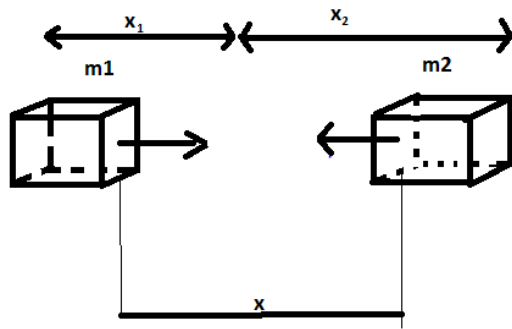


Figure2

If  $x_1$  &  $x_2$  are the distance travelled by each masses respectively and  $x$  is the mean free path when they collide at a particular point.

let us assume  $m_1 = m_2$

The main explanation here is about the velocity and its direction. let the velocity of each masses be  $v_1$  &  $v_2$  respectively

When both the masses collide and if  $v_1 > v_2$  then  $m_2$  will move in the direction of  $m_1$  but their velocity will reduce. The velocity after collision will be lesser than  $v_1$  &  $v_2$ .

The energy after collision  $= 1/2 m(v_1^2 - v_2^2) + \text{heat loss due to friction.}$

Here we see that  $m_2$  start to move in the direction of  $m_1$  but the heat supply from the sun  $Q$  is constant hence increase again the kinetic energy of these two masses which are now in the direction of  $m_1$  when they collide with other masses again there will be a change in direction or continue in the same direction if one or more masses have higher than the other then a collective of masses in the system will start to move in one particular direction.

From the above discussion the wind occurs due to a collective masses of air in the system moved in the direction of mass of high velocity. Therefore wind energy is a kinetic energy.

### WIND ENERGY CONVERSION SYSTEM

A Conceptual system has been developed to convert the wind energy to the useful power. Conventional turbine though efficient to extract 60 percent of wind power is having the drawbacks of

structural complexity, vibrational effects. An attempt has been made to minimize these losses by developing a new system which purely works on the principle of conservation of the conservation of energy.

let us consider the above figure a duct of convergent then a convergent divergent and divergent with a constant area at the entry and exit and in between the duct. let the area at section 1 2 3 4 5 be  $A_1 A_2 A_3 A_4 A_5$ .

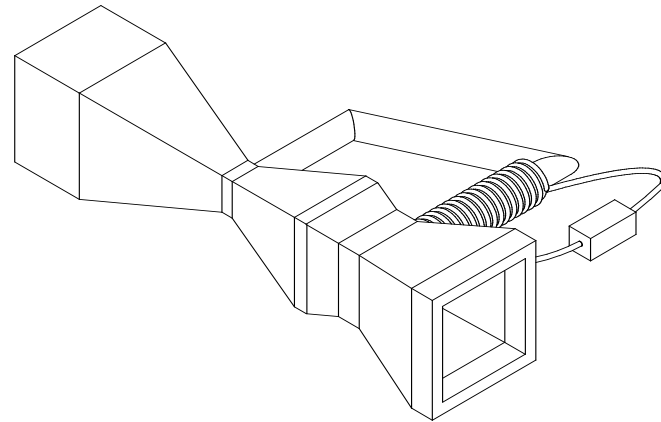


Figure 3

The kinetic energy possessed by wind is converted to the pressure force, which enables the magnetic mass which is embedded inside the section 6-7 to move two and forth. The working of the system is well described as follows, The velocity is made to increase and decrease by varying the area of the duct by providing the convergent, convergent-divergent and divergent nozzle within the system correspondingly varying the pressure. The pressure has to be decreased at section 1 in order to move the magnetic mass from section 6 to 7 or from a higher pressure to a lower pressure on applying the principle of conservation of energy and mass. The velocity at section 2 is more than at section 1 due to the convergence of area and the corresponding pressure  $P_2$  less than  $P_1$ . Bernoulli's equation can be well used to find the pressure at the section 2 using instruments like pitot static tubes connected to a manometer. The axis of any section in the duct are same without any inclination therefore  $Z_1 = Z_2 = Z_3 = Z_4 = Z_5$  so the consideration are only taken for velocity and pressure

The cross section at entry is constant therefore

we can find the mass of air by

$$PV=MRT \quad (1)$$

Where P ,V, R ,T are the pressure ,volume, gas constant and temperature at the entry. And also the area at section 2 can be found using the continuity equation

### THE WORKING PRINCIPLE

Let the atmospheric density pressure temperature be  $\rho$  P T and the volume of the inlet straight section of the duct be v then we can find the mass m using gas equation (1)

$$\text{From continuity } A_1 V_1 = A_2 V_2 = m/t \quad (2)$$

At section 2 the velocity is  $V_2$  so we can find

$$\text{Time } t_2 = m/A_2 V_2, d_2 = V_2 t_2 \quad (3)$$

And  $d_2$  is the length of the section 2 of horizontal axis.  $P_2$  can be find by using the Bernoulli's equation:-

$$(P_1/\rho g + V_1^2/2g) = (P_2/\rho g + V_1^2/2g) \quad (4)$$

We know that if there is pressure difference between two section then there will be flow from higher pressure region to lower pressure region.

Let us consider that  $P_6$  at section 6 is greater than  $P_2$  base on the requirement.

$$nP_2 = P_6, nP_2 = F/A = mg/A$$

$$nP_2/g = m_m/A_m, m_m = \text{mass of magnet}$$

$A_m$  = area of the magnet

Let the distance from the 6 to 7 be x.

$$m_m * x/t^2 = F$$

but the force acting on the body is the upward force due to net pressure force

$$m * x/t^2 = (P_6 - P_2) A_m$$

the effective distance in which the mass of air will move without the effect of pressure difference in section between 2 and 3

$$\frac{1}{2} \frac{mv_n^2}{P_n A_n} = d \quad (5)$$

for section between 4 and 5 .The length of the nozzle in other section is again calculated using  $v * t = d$  (6)

The pressure at section 4 is lesser than section 2, which enhances the magnet mass to move downward.

### CONCLUSION

Electricity is the key component to modern technology and without it most of the things that we use everyday simply could not work, and would never have been created. Hence an effort is made to design a new conversion system which is simple and reliable. The system purely works on the principle of conservation of energy. Working model of this system will be developed in future to study the efficiency. The successful implementation of this system will revolutionize the power generation system.

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