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Windbelt

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***Abstract* – As there is increase on pressure on our non renewable resources people now are shifting to non renewable resources of energy like wind, air, light which is somewhat reducing our dependency on traditional energy sources. The present non renewable ways of harnessing energy is less efficient. In this context, we focused on developing a product that can generate electricity using the kinetic energy of the wind. A typical wind mill has a rotating device called "turbine" which rotates when wind flows over it. The shaft is coupled to a dynamo and thus electricity is generated. This process is good at small scale but if we talk on it more there are problems which reduces the efficiency like rotatory based turbines many time rotate less due to friction. So, there is a need to develop a new innovation which does not use rotary equipment, to achieve the required targets at the small scale. By applying TRIZ techniques (TRIZ is a theory of inventive problem solving), one can easily say that turbine is the part that is causing all the trouble, so we need to remove it and find some alternative way. Let there be a membrane vibrating due to the wind. If we place magnets at its ends and make them oscillate in and out of a copper coil, electricity can be produced.**

***Keywords* – Wind Mill, Air, Light, Turbine, TRIZ Techniques.**

I. Components

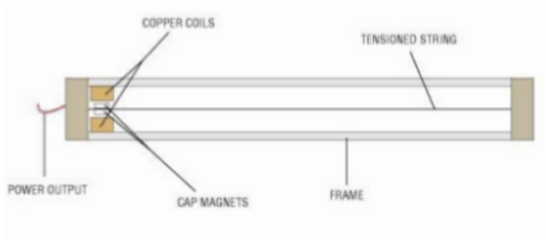

Fig.1.Windbelt components

The windbelt is a very simple design that can be self modified and enhanced to suit the needs of the user. The main components are a containing bracket, two copper coils, two strong button magnets, a ribbon and some bolts and nuts to piece together the entire system.

1.1 Bracket

The bracket holds together the entire unit. It can be fabricated from any available material such as treated timber, aluminum or plastic. The bracket requires a top and bottom piece and four spacer pieces. (See drawings for dimensions). It is important to consider the lifespan of the material since exposure to the elements is imminent. Weather treatment and protection will need to be applied, or else the windbelt can be sheltered in an environment that channels wind through the capture zone.

1.2 Copper Coils

The copper coils provide the medium for electromagnetic induction, as explained in the concepts section. According to Faraday's law of induction, the induced Electromotive Force (EMF) is directly influenced by 'N', the number of turns in a coil. We plan to use coils that have the maximum number of turns to fit in the available space between the bracket and the ribbon. To reduce the cost of the unit, we hope to make use of available electronic waste. There are copper coils in almost all appliances such as televisions and speakers. Any of these coils will potentially work in the Windbelt.

1.3 The Ribbon

The ribbon is the platform for the entire functionality of the Windbelt. When exposed to wind above 4m/s the ribbon in our Windbelt will experience aeroelastic flutter. Wind will cause the ribbon to move up and down with high frequency oscillating motion. It can be pictured to be similar to the flutter of a tarp on the back of a ute, or the vibration of a piece of grass stretched between your fingers. The material for the ribbon can be anything durable enough to withstand monsoon weather and high wind forces. It is key for the ribbon to be as light as possible so that the cut in wind speed for flutter is minimised. The ribbon also needs to be torsionally strong so that the oscillation is as linear as possible, with little twist during the motion.

1.4 Magnets

Two button magnets are attached to the ribbon in line with the centre of the copper coils. Joining the magnets on either side of the ribbon means they naturally attract, and using strong magnets will prevent movement over time. The stronger the magnetic field, the greater the magnetic flux and thus the larger induced current. As the magnets move up and down with the flutter of the ribbon the polarity of the field through the copper coils reverses. This change in polarity results in an alternating current best represented by the sine wave in figure. To capture the power output from the Windbelt, we plan to connect the wires from the copper coil into a rectifier for AC to DC conversion, and then plug the DC power into a appropriate applicant.

II. Procedure

2.1 Attach one large washer to a 4 inch screws Attach one large washer to a 4 inch screws Attach the 10 inch piece of ribbon with a small piece of electrical tape and wrap it all of the way around the screw in the space between the washers. This piece of ribbon should be a big enough that its diameter is bigger than the size of the magnets you're going to use to produce electricity

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2.2 Slip the other 2.5 inch washer onto the screw leaving about 1.5 inches of space between the two washers. (You can adjust the size of the space between them based on how big you want to roll your coil.)

2.3 Carefully take the end of the copper coil and wrap it around the end of the screw that is on the outside of the 2.5 inch washer. Make sure it's firmly wrapped so that its stays in place.

2.4 Now wrap the rest of the coil around the ribbon that is on the screw. Keep a balanced amount of tension on the wire while guiding it onto the screw. Make sure that the coil does not go off of the ribbon. Keep a finger on the wire as you guide it onto the spool. Watch for imperfections like ridges or loops in the coil as you roll it. If you mess up, then you can go back easily enough and find your mistake and fix it. Be careful, this kind of mistake can ruin your coil.

2.5 Drill two holes into the PVC pipe one inch from one end of the pipe. The holes should be parallel to each other and approximately the diameter of the screw.

2.6 Now attach the end of your 4 inch screw to the PVC pipe through the holes that you just drilled.

2.7 Attach the drill to the 4 inch screw.

2.8 While one person holds the drill and PVC pipe horizontally between them, the other person holds the big spool of copper coil by putting the lollipop into the spool to steady it.

2.9 With the drill, very slowly begin to wind the copper coil from the big coil onto the 4 inch screw. try to keep it as evenly distributed as possible as you wind it.

2.10 Stop winding when your coil is approximately 5 cm thick .

2.11 Cut the copper coil and leave approximately 5 inches hanging off,

2.12 Unhook the drill from the screw that is connected to the PVC pipe, we taped the coil into place with strips of black electrical tape

2.13 Carefully remove the washer from the end of the screw

2.14 Without unwinding any of the coil, remove the newly wound copper coil from the screw. We taped the coil into place with strips of black electrical tape and used a knife to pulled it off. This is a delicate process so don't rush getting the coil off, you could ruin it if you don't remove it in a balanced way.

III. Cost Analysis

Table 1: Cost analysis of the project

Rough cost of the project we carried out:

Object	Quantity	Dimensions	Cost (₹)
Belt	1	1 meter long	15
Wooden frame	1	Slightly longer than belt	25
Magnets	2	1cm diameter	60
Stator coils	2	-	20
Miscellaneous (Nails, adhesives etc.)	-	Different sizes	20
Total			140

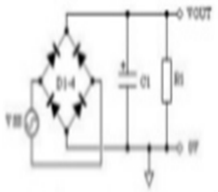
Rough cost estimates of a final useful product:

Object	Quantity	Dimensions	Cost (₹)
Frame	1	1m x 5cm x 2cm	25
Belt	1	1m x 2cm	30
Magnets	4		80
Stator coils	4		30
Rectifier	1	-	15
Nails, Nuts and Bolts	-	Different sizes	10
Total			190

Thus, a basic model of wind belt costs less than to ₹ 200 manufacture.

IV. Calculations

Windbelt consists of two cap magnets, which move in and out of two copper coils connected in series. So there is change in magnetic flux which produces electricity in the coil. The output from the coil is AC, can be converted DC through a rectifier circuit attached between two terminals of copper coil.



- Rectifier circuit

Voltage output from WindBelt V=20.19mV and current output I=0.04A (measured using Multimeter)

Threrefore power output from Windbelt prototype

P=V*I=0.81mV ……………………..(1)

Approximating vibrations of the membrane (belt) to a parabolic shape

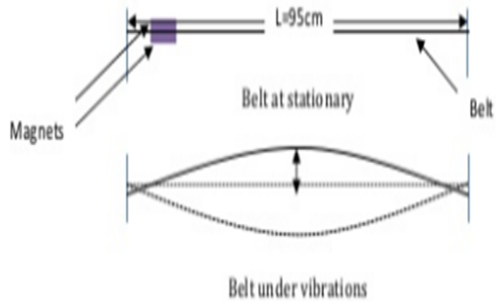


Fig.2. Efficiency of windbelt

Here ρ=1.0cm , equation of the parabola passing through 3 points (0,0),(47.5,1),(95,0)

$$y = -4.432 \times 10^{-6}x^2 + 0.0421x$$

So area swept by belt (under vibrations) across wind flow is

$A=2\int_0^L y\,dx = 126.63cm^2$

Power contained in the wind can be found by $P=\frac{1}{z}\rho A\pi v^3$

Here density of air $\rho = 1.23\frac{kg}{m^3}$

Swept area A=126.63 cm^2

Velocity of the wind , $v=2\frac{m}{s}$

Therefore power P=15.57mW………………(2)

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Efficiency of wind belt =

$$\frac{P_{wind}}{P_{windbelt}} \times 100 = \frac{0.81}{15.57} \times 100 = 5.20\%$$

V. Advantages

5.1 The windbelt is a light weight, low cost, portable, easy-to-use device.

5.2 The 1 meter windbelts are designed to work alone or in groups to provide power to or any situation demanding 0.1 kWh to 1 kWh of lighting, WiFi nodes, micro-base stations, energy per month.

5.3 It can also be used for lighting bed lamps.

5.4 A windbelt can be kept on a moving car and the output can be used to charge phone while travelling.

5.5 A Windbelt can be placed on poles in high wind zones and used for street lighting.

5.6 An array of Windbelts placed side by side can form a "Windcell" and it may be used to light up an entire room!

5.7 The Windcell have a form factor similar to Solar panels and are designed for larger installations, targeting applications with 5 kWh to several MWh of energy demand per month, with particular attention to cost.

5.8 On larger installations, the Windcell panels have an initial projected production cost of Rs. 2.5 per kWh (at 6m/s average wind speed). Cost combined with modularity, safety and form factor gives the variation of the technology access of many of the places that wind and solar cannot presently go.

VI. Conclutions

By this technology we can think of another alternate source of electricity in the field of wind energy , this is one of the latest technologies in which more research is being done.The best thing about it is that it is cheap. In future it is hoped to remove the inefficiency problems of wind mills.

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