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PIEZOELECTRIC EFFECT BASED WIND ENERGY CONVERSION SYSTEM

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Abstract- *This paper deals that the concepts of harnessing electrical energy from wind energy with piezoelectric crystals. In recent years, invention and development of power electronics devices have been increasing rapidly at a constant rate and these devices have been used in daily lives of people to ease their work and to make them comfort. The feasibility of piezoelectric power generation system for electric power system, with conventional wind mill is discussed in this paper. Design and implementation of piezoelectric windmill which consists of conventional windmill, piezoelectric flag, step up converters and filter circuits. The windmill of our design consists of two main components: 1.The blades connected to the axis of the tower by which normal operation of the windmill can be achieved and 2. The piezoelectric (flag or sheet) component attached to the top of the tower from which the additional energy can be achieved. As the wind blows the pressure of the wind helps to produce the electric energy which is by the way the principle of piezoelectric component.. Therefore a suitable converter is used to achieve the constant frequency AC output which is then given to a suitable load for test run.*

Key Words: **piezoelectricity, wind energy, renewable energy, energy harvesting, load. etc.**

1. INTRODUCTION

In today's world energy is the most important especially electricity is important. Renewable energy sources are expected to be the apt solution to solve the energy crisis problem. As natural resources and fossils fuels are on its verge of extinction, the researchers are striving hard to find an alternative energy sources from nature. Due to the depletion of fossil fuels and drastic changes in climatic conditions, the use of natural renewable energy for production of power has become essential. Fossils fuels are depleted for generation of electric power and scientist predicts that fossils fuels will be exhausted in near future. The alternatives should not be harmful to the environment. Human being on this Planet has started use energy harvesting technology in the form of windmill, geothermal and solar energy. Now renewable energy resources are focused more and researchers are currently involved with use of piezoelectric crystals. After solar power wind energy is the most effective power since Wind is a clean and renewable energy source which has been used to produce electrical power and in addition to it piezoelectric transducers is used which converts vibrational energy to electrical energy. Piezoelectric crystals are typically low cost and easy to maintain and are available in abundance. Piezoelectric crystals used are ceramic quartz crystals and are one of small scale energy sources. The piezoelectric crystals are generate voltage when exposed to mechanical vibration. The proposed windmills could also be used in environments where reach of electricity is poor. The proposed system consists of conventional wind mill with piezoelectric component boost circuits and filter circuits.

1.1 PRINCIPLE

The piezoelectric windmill topology employs two systems for power generation so which two principles are employed. The first one is windmill which operates on a simple principle that converts kinetic energy of air into mechanical energy and which in turn is converted into electricity. The second process or latter is described as i.e. the piezoelectric crystal converts the mechanical energy or vibrational energy of air into electrical energy. The piezoelectric effect converts mechanical strain into electric current or voltage. It is based on the fundamental structure of a crystal lattice. Certain crystalline structures have a charge balance with negative and positive polarization, which neutralize along the imaginary polar axis. When this charge balance is perturbed with external stress onto the crystal mesh, the energy is transferred by electric charge carriers creating a current in the crystal. Conversely, with the piezoelectric effect an external input change will cause an unbalance in the neutral charge state causing mechanical stress.

1.2 OBJECTIVE

The main aim of the project is to produce considerable amount of power from wind energy with piezoelectric crystals .The system consists performs the operation of wind mill which harnesses wind energy with minimum pickup speed to produce electrical power in addition to the

electrical energy is obtained by using piezoelectric transducers which converts the vibrational energy or pressure of air to electrical energy which is used to operate the suitable light load.

2. BLOCK DIAGRAM

Fig.1. shows the block diagram of piezoelectric windmill and Fig 1.1.shows its circuit diagram.

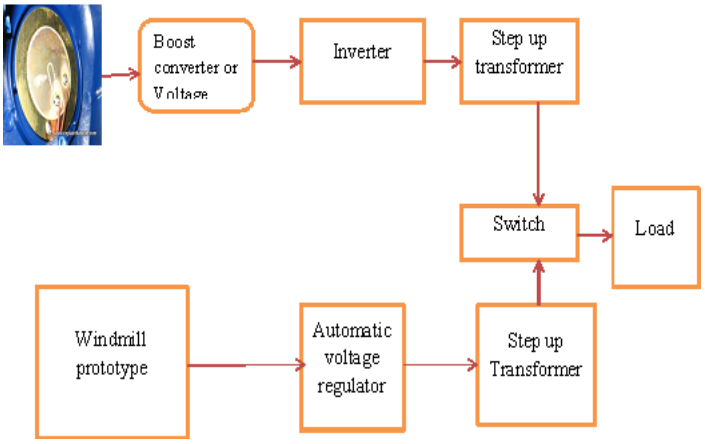

Fig.1. Block Diagram

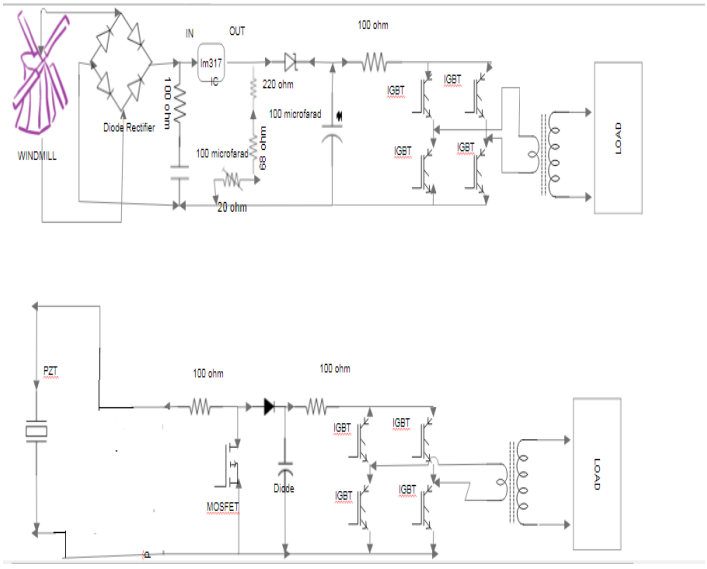

Fig.1.1.Circuit Diagram

The following Apparatus required for designing the piezoelectric windmill.

- Windmill prototype
- Piezoelectric crystals
- Inverters
- Step up transformers
- Load (e.g. Bulb, fan etc.)

PIEZOELECTRIC TRANSDUCERS

The piezoelectric material described above in the block diagram is mechanical energy or vibrational energy of air into electrical energy as name indicates piezoelectric means electricity caused by pressure.

Today most commonly used piezoelectric transducers are lead zirconate titanate compositions and also piezo-polymers has also gained importance as well as acceptance in today's market. The advantage of piezoelectric transducers is that it is available in low cost and is flexible as well as it can be obtained in any desired shape.

BOOST CONVERTER

A boost converter (step-up converter) is a power converter which is used to steps up voltage from its input supply to its output (load). The advantage of this boost converter is that it is able to step up the voltage at its lowest as possible and the input is continuous and desirable. Boost converters or regulators are used in places where higher voltages may be needed to much higher power requirements.

AUTOMATIC VOLTAGE REGULATOR

A voltage regulator is designed to automatically maintain a constant voltage level. The automatic voltage regulator is used to regulate the voltage. It avoids fluctuation in voltage and converts them into constant voltage. The fluctuation in the voltage mainly occurs due to the variation in load on the supply system and automatic voltage regulators are commonly used.

STEP UP TRANSFORMERS:

The step up transformer is used in the above circuit to step up the 12v or 24v ac output of the inverter to 230v or required level so as to run the suitable load. The step up transformers are normally used in power systems so as to minimize the power losses as power is normally transmitted at high voltages.

2.2 WORKING

The method showcased here is the electrical energy harvesting using piezoelectric effect in addition to conversion of wind power to electrical power using

conventional windmill with a slight modification in its characteristics design. The power obtained from windmill as well as the power of piezoelectric crystal to operate load or stored in battery for later use with an inverter. The power obtained from the windmill is stepped up with a step up transformer to a required level in order to operate the load. The intermediate process also consists of automatic voltage regulator and filter circuits to filter the harmonics, stray inductance and to obtain smooth fundamental output. The electrical power obtained from piezoelectric crystal is then stepped to 230v to operate the light load.

2.3 SIMULATIONS

Chart-1 shows the simulation diagram of piezoelectric windmill and chart-2 shows the output of the simulation in scope

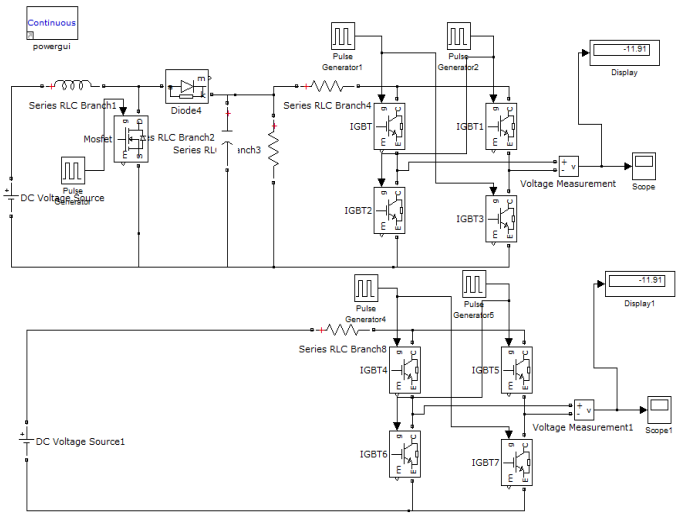

Chart -1: Simulation

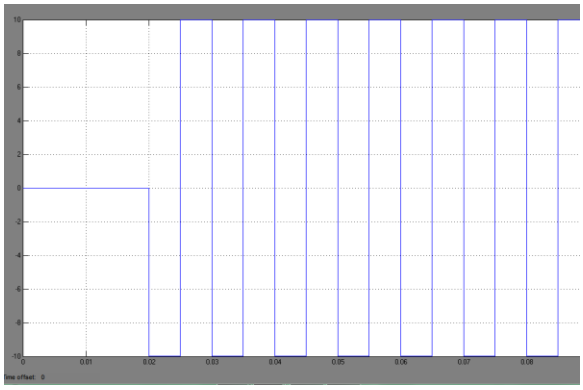

Chart-2 : Simulation Result

2.4 HARDWARE IMPLEMENTATION

Hardware implementation setup consists windmill prototype, piezoelectric flag, boost converter, inverter, battery and load as shown in fig 5.6 hardware implementation. In order to prevent continuous discharge of the battery, a switch is provided which produces where load is operated only when the switch is pressed.

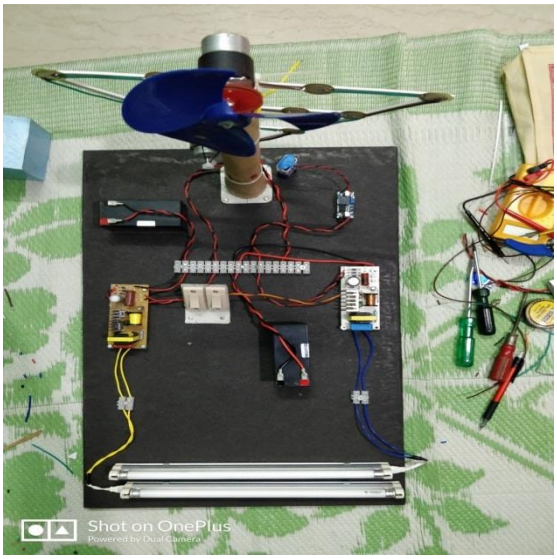

Fig .2.Hardware implementation

The windmill is designed to provide 12v at its output with DC geared motor. The Piezo-electric is designed to produce 3-4 volts at its output which is given to boost converter which step up the voltage and give its output to the inverter which in turn to the load. A consequent service should be done in order to avoid the damage caused to the electronic equipment's. Hardware is implemented as shown in the above figure.2.

3. CONCLUSIONS

This project is developed which could be economical and an affordable solution to the people. It can be used in remote places where more power is required and there is no other choice of electric power available to them. Effective wind energy harvesting is realized and obtained by this method. The piezoelectric transducers are used since it is of low cost and easy to maintain and in today scenario it has gathered a huge response among the scientist for its developments in near future. As a whole piezoelectric windmill, an emerging alternative for renewable power production which does not harm the environment as well as additional power can be produced when does not depend on climatic conditions.

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