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Wireless Transfer of Electricity

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Abstract - This paper deals with the experiment of transmitting electrical power wirelessly i.e. to transfer power without wires. Wireless Power Transfer or ***"Witricity" as it is*** *named is an innovative idea which deals with generating electric power by using piezoelectric material and then transit this power wirelessly. In future this technology if used on large scale will definitely put an end to the hazardous usage of electrical wires involving initial financial investment like installing power grid and also the risk of short circuit that arises out of damaged wires or faulty installation process. The results obtained during the testing of the set up are reported..*

Key Words:Witricity, Near field, far field

1. INTRODUCTION

Electricity has become an essential to life. It has led to several technological developments since its first applications dating back to the late 16th century. However records show that nearly 50% of all electrical plants are high polluting coal plants [1]. Major changes in the environment have occurred over the last 30 years that are detrimental to the future of this planet. This has led to the development of sustainable technology using piezoelectric material [2] for generation of electricity. Also conventionally the power is transmitted through wires. Unorganized or improper tie wrap results in tangled wires around home or office. This resulted in the development of Wireless Power Transfer (WPT) technique [3] – [5].

2. WPT BASICS

The Piezoelectric effect is the ability of certain materials to generate electric charge in response to applied mechanical stress. The most common piezoelectric material is quartz and certain ceramics, Rochelle salts, and various other solids also exhibit this effect. In this experiment the electricity is generated using piezoelectric crystals.

Wireless power transmission is useful to power electrical devices where interconnecting wires are inconvenient, hazardous or are not possible. Wireless power techniques are of two type viz. Non – Radiative and Radiative [6].

In near field or non – radiative techniques, power is transferred over short distances by magnetic fields using inductive coupling between coils of wire or electric fields using capacitive coupling between electrodes.

In radiative or far-field techniques, also called power beaming, power is transmitted by beams of electromagnetic radiation like microwaves or laser beams. In this experiment near field or non – radiative technique is used for power transmission.

Wireless power transfer uses the concept of "Resonant Inductive Coupling". It is the near field wireless transmission of electrical energy between two magnetically coupled coils that are part of resonant circuits tuned to resonate at the same frequency. Resonant transmission works by making a coil ring with an oscillating current. This generates an oscillating magnetic field because the coil is highly resonant, any energy placed in the coil dies away relatively slowly over every cycle but if a second coil is brought near it, the coil can pick up most of the energy before it is lost, even if it is some distance away [7]

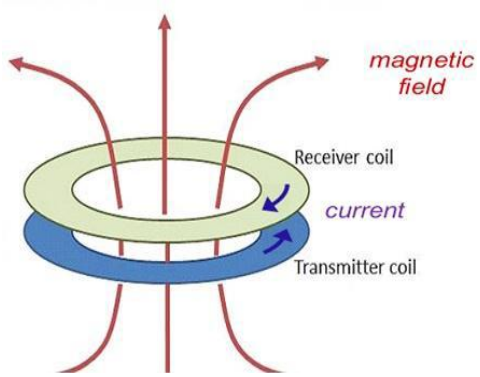

Fig. 1

Efficiency can be improved using resonance. If resonant inductive coupling is used, each coil is capacitively loaded so as to form a tuned LC circuit. If the primary and secondary coils are resonant at common frequency, it turns out that the significant power may be transmitted between the coils over a range of few times the coil diameter at good efficiency.

A piezoelectric substance produces an electric charge when a mechanical stress is applied (the substance is squeezed or stretched). In order to produce the piezoelectric effect, the polycrystal is heated under the application of a strong electric field. The heat allows the molecules to move more freely and the electric field forces all of the dipoles in the crystal to line up and face in nearly the same direction as shown in Fig.2 [8].

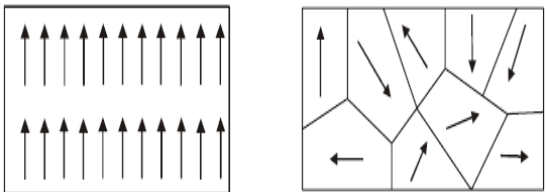

Fig. 2

3.WPT SYSTEM AND WORKING

The block diagrams viz fig.3 and fig. 4 represent the WPT system.

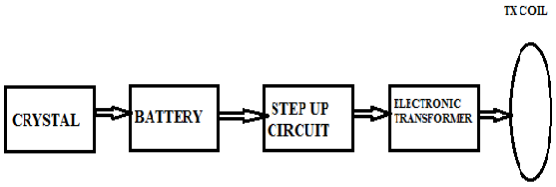

Fig. 3

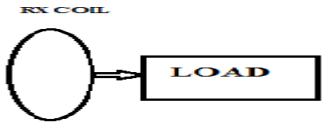

Fig. 4

This experiment uses piezoelectric crystal having capacity of generating maximum 1V instantaneous voltage under continuous vibrations. The crystal used is as shown in the Fig.5. Such crystals are commercially cheap and abundantly available in numerous electronic stores everywhere.

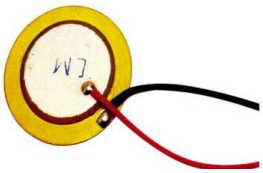

Fig. 5

For the crystal shown in fig.5 the inner circle (cream white colour) acts as the positive electrode and the outer circle (yellow colour) is the negative electrode. To increase the output voltage such crystals have to be connected in series.

The series connected crystals are mounted on the metal board of size 29 x 27cm as shown in Fig.6

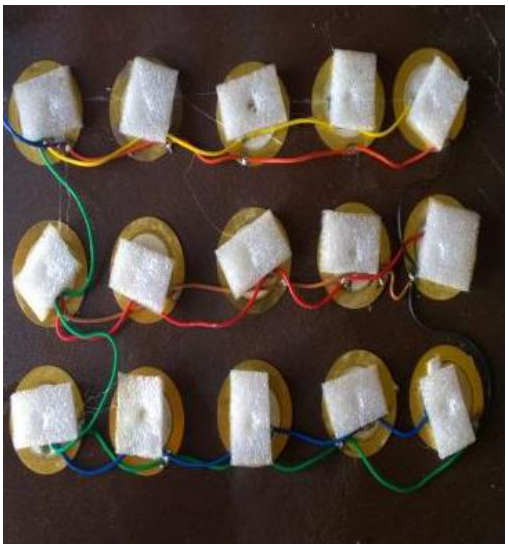

Fig.6 Top View of Board

Four springs (not shown in Fig.6 above) are used at the four corners of the board so that the board touches crystal only when pressure is applied on it.

Fig. 7 Front View of Board

Equal amount of pressure should be applied on every crystal whenever foot is placed on the upper board. Nut bolts are used on the upper board to tap on the crystals. A soft rubber bush as shown in fig. 7 is used on the surface

of the crystals to prevent damage due to bolt hitting crystal surface.

This assembly generates DC voltage which is of very small amplitude. Since very less power is generated which cannot be transmitted directly, it is stored into a rechargeable battery of 12V.

Push-pull is type of electronic circuit that uses a pair of active devices that alternatively supply current to or absorb current from a connected load. These are better than buck-boost converters in which the input current is supplied by a single tranSistor which is switched on and off, so current is only drawn from the line during half the switching cycle. During other half the output power is supplied by energy stored in inductors or capacitors in the power supply.

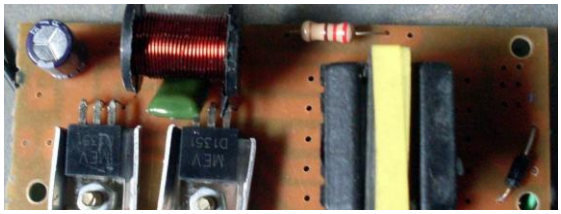

Fig. 8

The step up circuit shown in Fig. 8 has a push-pull converter, with two switching power transistors, whose base feedback is collected from the transformer itself.

The copper coil used in Power transmission circuit as a Transmitter and receiver is 45 Gauge copper wire having 15 of turns with radius 22cm.

4. RESULTS

The following results were obtained when the set up was tested

i. Voltage generated from piezo tile for pressure applied = 8V DC

ii. Current generated from piezo tile = 150mA

iii. Frequency at the output of electronic transformer = 35kHz

iv. Voltage and Current at step up circuit =150VAC,1.5A, 50Hz

v. Transmitting voltage and current =12V AC, 1A, 35kHz

The set up was also tested for different values of distance between the transmitter and receiver coils and the following results were obtained

i. 22cm - 2V AC - 150mA

ii. 14cm - 4V AC - 500mA

iii. 6cm - 9V AC - 900mA

5. CONCLUSION AND FUTURE SCOPE

This experiment proves that WPT can become the technology of future and can be successfully used for applications like charging of mobile batteries.

Instead of small discs if large sheets of piezoelectric materials are installed underneath foot mats on public places like railway station or bus stands the sufficient electrical power can be generated and stored to provide uninterrupted supply to devices like ATM, Wi-Fi transmitters etc.

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