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WIRELESS BATTERY CHARGING USING TESLA COIL

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Abstract

Tesla coil is one of the oldest and fundamentally easiest devices that could transmit electricity through the air. The Tesla coil is an electrical resonant transformer circuit which is used to produce high voltage, low current, and high frequency alternating current electricity. This high voltage power supply can be used to charge and store the electricity in capacitors, which can later be used to transfer the electricity to the primary and secondary coils. In this paper, we have used a distinctive method which combines the use of 'Inductive coupling' or 'induction' with the capacitor. The capacitor used is attached to each of the two inducting coils which are place in the magnetic field produced by the Tesla coils. The setup helps in the conversion of high AC voltage to DC voltage which can be regulated with the help of regulators and later used for the battery charging. At last, we have tried to review some of its advantages and disadvantages of wireless battery charging using Tesla coil (using inductive coupling) with future directives.

Index Terms: Tesla coil, transformer, induction, magnetic field, battery charging

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1. INTRODUCTION

In 1891 Nikola Tesla, a pioneer in the field wireless electric transfer conducted his first experiments in wireless power transfer and investigated the wireless transmission of electrical energy. Tesla coil is a result of those experiments which are used to supply electricity without the use of wires. All Tesla coils generate radio frequency electrical and magnetic fields which are comparably as strong as an operating coil. The Tesla coils are a loosely-coupled, dual resonant step-up transformer that typically operated at the low radio frequencies and it is used to generate a very high voltage. A Tesla coil consists of two inductive resonance circuits when the primary coil resonates with the secondary at the high resonance frequency.

In the recent years, development in the state of art technologies such as mobile phones, tablets, and laptops has been driving the need for the development of an alternative way for powering and charging technology and the wireless charging is one the end result of such attempts. Wireless energy harvesting is a useful method of powering electrical devices in cases where interconnecting wires are inconvenient, hazardous, or not possible. The goal of this project is to design a prototype wireless energy charger for low power devices with specific emphasis on mobile phones

1.1 Theoretical Background of a Wireless Power System

- Fundamental Working Principles:-

Wireless Electricity uses the principle which involves the usage of inductively coupled objects with same resonant frequency. The principle Electromagnetic Induction states that a coil generating magnetic field induces a current in another coil as it is being placed in the field of the former coil.First, we employ a pre-made high voltage iron core transformer to go from 120 V wall current to roughly 10,000V. The wire with 10,000 volts is wrapped into one very large (primary) coil with only a handful of turns. The secondary coil contains thousands of turns of thin wire. This steps up the voltage to between 100,000 and one million volts. This potential is so strong that the iron core of a normal transformer cannot contain it. Instead, there is only air between the coils.

2. WORKING OF WIRELESS BATTERY CHARGING

2.1 COMPONENTS REQUIRED

1. Inductors:

The tesla coil's primary and secondary coils are both inductive in nature. As the current flows through the inductor, it creates a reverse voltage

2. Spark-gaps:

A sparking plug in a car is basic spark gap, and the breakdown voltage depends upon the electrode spark gap size. As it conducts, the ionized hot air in the spark gap gives the ability to carry on, so long as a current is flowing.

3. Capacitor:

A good analogy for capacitor is to think of a sponge then placed it on a spilled water and left it to slowly soak it up. If it is left for a minute and if it is squeeze hard, one minute's worth of soaking-up is instantly released in a fraction of second. In a tesla coil circuit, this is so-called 'soaking-up' stage lasts only a few milliseconds, while the 'squeezing-out' can be a thousand times quicker in a few micro second.

4.Resonant-Circuit:

If a capacitor is placed across an inductor and voltage applied, you will have a resonant circuit. As the capacitor discharges, it sends current into the inductor that stores this as energy in its magnetic field. But as the capacitor discharges, the current into the inductor also diminishes. This causes its magnetic field to collapse and generate an opposing voltage back into the capacitor, allowing the cycle to start all over again. The number of times that this 'back and forwards' cycle happens per second, is the circuit's resonant frequency, expressed in Hertz (Hz).

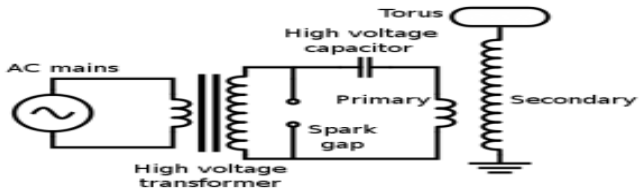

Figure 1. The working of Tesla coil circuit.

2.2 WORKING

By referring to the figure 1, here we have used the AC power supply. When we provide the AC voltage the air resistance in spark gap drops quickly and become conductive. This complete circuit in the presence of capacitor and inductor acts as a high-frequency oscillator in the primary winding generating an electromagnetic field (EMF) around the primary coil. By Faraday's Law of electromagnet induction, the flux then cut by secondary coil and EMF is generated in the secondary coil. The EMF is then fed to a capacitor where it filters the voltage and provides it to the regulator. The regulator regulates the voltage and converts it into useable DC supply(6v) which can be later used for battery charging.

Classification of wireless charging technologies:-

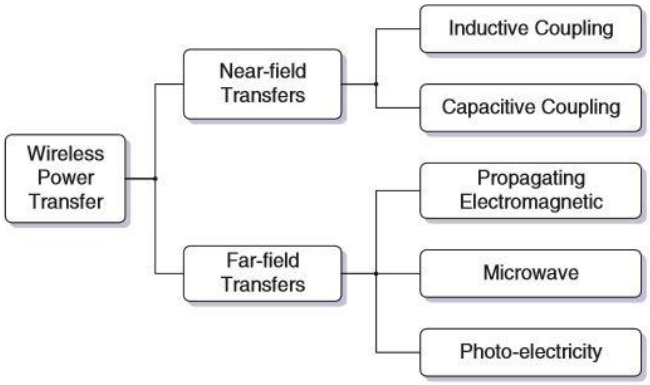

Figure 2. Flowchart for the classification of wireless charging technology

The transmitter is usually connected to a source of power such as a mains power line. The transmitter changes this power to a time-varying electromagnetic field. The receiver converts intercept the magnetic field and convert it back to the required output ready for use by an electrical load. Depending on the working principle wireless charging can be categorized as shown in figure 2 above, namely near-field transfers and the far-field transfers.

The main difference between the two is the frequency range and transfer distance. When the resonant frequency of the changing electromagnetic field is relatively low around one megahertz and the transfer distance is only a few centimeters that belong to the near-field power transfer. Higher frequencies in the range of gigahertz employ longer distances which fall in the Far-field transfers. Due to the low charging efficiency and safety issues far field is not employed in low power portable devices.

3. ADVANTAGES:

Compared to traditional charging with cord, wireless charging introduces many benefits as follows.

1. The hassle of connecting cables is eliminated. Different models of devices can also use the same charger.
2. It makes the design and manufacture of much smaller devices without the at-attachments of batteries.
3. A waterproof and dustproof property gives these devices a longer lifespan.
4. The technology makes it easy to charge body implanted sensors.
5. Power can regulate and supplied only when on required.

4. DISADVANTAGES:

1. Higher implementation cost since from the current situation receiver circuitry have to be introduced during the manufacture of mobile gadgets.
2. Produces more heat while charging
3. Slower and less efficient

5. CONCLUSION

The main objective was to demonstrate wireless battery charging using Tesla coils. Tesla coils are remarkable devices able to generate high voltage, high-frequency waveforms with little control circuitry. Delivery of electric power wirelessly to the device using resonant inductive coupling promises a greater level of convenience to users of portable devices.

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