Wireless Power Transmission for Wireless Charging

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***Abstract*- Wireless charging is an emerging technology. It transmits power through an air gap to various electrical devices mainly mobile devices for energy replenishment. Basically, the attempt is to make the charging process easy and user-friendly by removing physical cable connection between the mobile phone and the cable. There has been growing need in wireless field as it has enormous benefits like the user don't have to carry mobile charger with him/her, no need to keep mobile devices near to charging socket as wires have shorter length. The mobile operators have been working to develop methodologies to reduce power consumption in the mobile devices but unfortunately, the reductions were not enough. The early adopters of wireless power are Verizon, AT&T, NTTDocomo, Softbank and KDDI. The purpose of this paper is to present brief idea on wireless power transmission as well as to present its future research scope.**

Index Terms- Wireless Power Transmission (WPT), Inductive Power Transfer (IPT), Inductive Coupling, Energy Replenishment, Mobile Devices, Wireless Energy Transfer.

INTRODUCTION

The technological and theoretical idea behind wireless charging was initially suggested by Nikola Tesla [2] in the 1890s. However, the technology has been harnessed in the last decade to the point where it offers real world applications. Wireless Power is commonly referred by various names like Inductive Power Transfer (IPT), Inductive Coupling and Resonant Power Transfer (RPT). The same fundamental process namely the transmission of energy from a power source to an electrical load without connectors across an air gap is essentially described by these terms. The working of the wireless power system is mentioned in the sections, below.

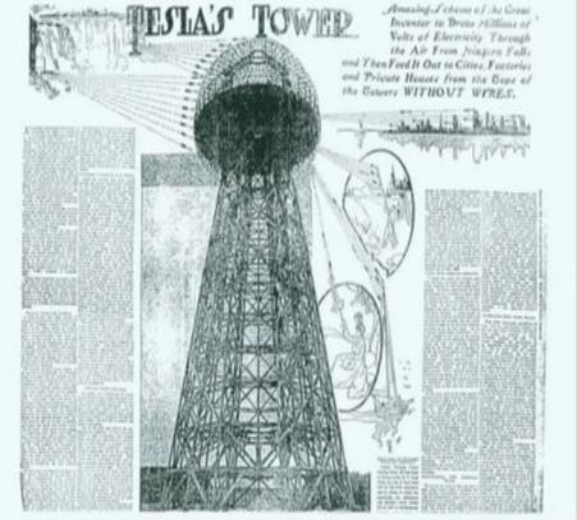

Figure 1 suggests that the technology was advanced at that time as well but the scope and spectrum was limited to some extent. The same legacy continues but with new innovators name

"Wireless power transfer technology is becoming one of the most emerging and promising technology with most highly expected market impacts in mobile and automotive industries. It can be widely applied to commercial products including wireless charging for smart phone, note PC, home appliance, automotive vehicle, and implanted medical device. It will enable us to be free from inconvenient wiring and charging overheads in battery-based operating systems" [1].

WIRELESS POWER TRANSFER SYSTEM

In 1893, Nikola Tesla reinvented the illumination of vacuum bulbs without using wires for power transmission at the World Columbian Exposition in Chicago. Figure 2 shows the Wardenclyffe tower. It was designed and constructed by Tesla mainly for wireless transmission of electrical power [3].

The basic working of wireless power involves transmission of energy from a transmitter to a receiver via an oscillating magnetic field. To achieve this, Direct Current (DC) supplied by a power source is converted into high frequency Alternating Current (AC). The AC energises a copper wire coil in transmitter that generates a magnetic field. Once a second receiver coil is placed within range of the magnetic field, it can induce an AC in the receiving coil. To summarise:

1 The 'mains' voltage is converted in to an AC signal (Alternating Current), which is then sent to the transmitter coil via the electronic transmitter circuit.

2 The AC current flowing through the transmitter coil induces a magnetic field which can extends to the receiver coil (which lies in relative proximity)

3 The magnetic field then generates a current which flows through the coil of the receiving device. The process whereby energy is transmitted between the transmitter and receiver coil is also referred to as magnetic or resonant coupling and is achieved by both coils resonating at the same frequency. Current flowing within the receiver coil is converted into direct current (DC) by the receiver circuit, which can then be used to power the device [4].

BENEFITS OF WIRELESS POWER TRANSFER

The removal of physical connection delivers a numbers of benefits over traditional cable power connectors and is mentioned below:

1. It reduces the cost associated with maintaining direct connectors.
2. It provides greater convenience for charging of everyday electronic devices.
3. It ensures safe power transfer to applications that need to remain sterile or hermetically sealed.
4. It reduces the risk of corrosion as the electronics can be fully enclosed.
5. It provides consistent power delivery to rotating, highly mobile industrial equipment.
6. It delivers reliable power transfer in critical systems like wet, dirty and moving environments.

CONCLUSION

The electrical energy can be economically transmitted without wires to any terrestrial distance are proved by many researchers in their observations, experiments and measurements both quantitatively and qualitatively. The pioneer of Wireless Power Transmission is Nikola Tesla. During my study of several web resources and research papers, I came to know about several limitations of this.

The limitations include:

- The flux condition must satisfy certain conditions and if not, no power supply will take place.
- High capital cost for practical implementation of wireless power transmission.
- There can be interference of microwave with present communication system.
- There is a possibility of "energy-theft".
- Dr. Neville of NASA states "You don't need cables, pipes, or copper wires to receive power.
- We can send it to you like a cell phone call – where you want it, when you want it, in real time". We can expect with certitude that in next few years' wonders will be wrought by its applications if all the conditions are favorable.

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