Wireless power transmission system

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Abstract

Wireless power transmission system is a special type of power transmission process. Wireless power transmission system is used to transmit power from one place to another without any physical contact between the two coils or devices. Wireless Power Transmitter device consists of a transmitter, which takes electric power as input from a power source (either supply or battery), and generates a time-varying electromagnetic field (electromagnetic waves) that carries energy in the form of electric and magnetic waves, and transmits power through free space to a receiver, which extracts power from the field and supplies it to an electrical load. E.g. in the system of charging a phone wirelessly, a transmitter takes in power and generates an electromagnetic field and transmits it which is then received by the receiver and then transformed back into electricity which is used to charge the phone. Transmitter is a set of equipment which is used to generate and transmit electromagnetic waves. The basic working principle of wireless power transfer is: 1. Faraday's law of Electromagnetic theory and 2. Two objects having similar resonant frequency and in magnetic resonance at powerfully coupled tends to exchange the energy in the form of oscillating electromagnetic field. This method of transmitting power is very useful and reliable. The results of various experiments suggest the standardized application method of wireless transmission in utilization of wireless power for implantable sensors.

Keywords: Wireless, Transmission, Electromagnetic, Resonance, Transmitter

1. Introduction

The history of wireless power transmission begins from the 19th century. But, it was invented by Nikola Tesla in 1890, who invented Tesla coil that could emit power upto 16 meters in diameter and could transmit 10,000 watts without any physical contact between the source and the receiver. Nikola Tesla used two coils; primary and secondary coils along with inductive and capacitive coupling using spark excited radio frequency resonant transformers which generates high A.C. voltages.

Wireless power transmission uses an electromagnetic field of certain frequency as a medium of transfer. This frequency depends on the range of transmission. A transmitter (source) and a receiver are required and they must be in resonance condition. This is the basic principle of wireless power transmission electromagnetic induction. In systems when distance between transmitter and receiver is minimum (<3 metres), it is called near-field wireless power transfer system. By using such systems, we cannot transfer more amount of energy. e.g. wireless mobile chargers. And systems in which the distance between transmitter and receiver is more (>3 metres), it is called far-field wireless power transfer system such as

wireless car chargers. Transmission of power depends on the frequencies of the transmitter and receiver. More is the frequency, more is the transmission.

2. Types of power transmission system

Basically, there are three types of wireless power transmission methods: inductive-coupling-power transmission, microwave power transmission and laser-power transmission methods. In microwave transmission, there are two sections; transmission section and receiving section. Transmission section generates microwaves and transmits the power regularly through free space. Receiving section receives the power and converts the power into D.C. power. In inductive coupling power transmission, the power transmission takes place through mutual inductance (the property of two coils by virtue of which each opposes any change in the strength of the current flowing through the other by generating a back electromotive force) between the two coils which we have demonstrated. Also, in laser power transmission, a laser beam is used to transfer power in form of light energy [1]. The types of transmission may be different but the principle behind the transmission is the same in all above cases. The prime difference is being the effective distance of operation. Inductive transmission works only in close range since the two coils must be in proximity of each other for proper coupling. Lasers tend to have longer effective range due to the fact that their beams are highly focused, monochromatic and directional. A new form of transmission which uses magnetic resonance in LC oscillating circuits is under study for providing even longer ranges, and a group of scientists at MIT were able to light up a 60W bulb at a distance of 2 metres [2].

We investigated the variations in magnetic field distributions and power transmission efficiency resulting from the changes in the relative positions of the transmitting and receiving coils, for electromagnetic induction type wireless power transmission using an elliptical receive coil. The calculation showed that the transmission efficiency remains stable even if the alignment between the transmitting and receiving coils is changed to some extent. When the centre of transmitting coil is perfectly aligned with the centre of the receiving coil, the transmission is maximum. However, the degree of transmission efficiency is very small even if the coils are moved a bit apart from their centres and thus it accounts for a proper transmission way and hence the performance of the wireless power transmission system is good.

3. Applications

Wireless power transmission has a wide range of applications starting from wireless sensors to ECG machines, ventilators and in fuel-free electric vehicles. Wireless power transmission is in great demand in the market nowadays, in spite of the field being under development [3].

As far as commercial or home usage is concerned, WPT could be used in various ways. That includes sensor networks that range in radius from that of a small room to an entire town. The sensors would run for years on the wireless power supplied, without the need for maintenance or direct electrical supply. Secondly, it can be used to charge electric vehicles even as they move. Thirdly, universal chargers could be designed to provide power to all mobile electronics in a household.

Inductively coupled wireless power transmission which uses the principle of electromagnetic induction between 2 coils can be used extensively in ECG machines, ventilators, MRI scanners and electric vehicles. With the development of technology, smaller devices with better efficiency are in demand in the medical field. For example the conventional pacemakers can be replaced and devices like micro neural stimulators or

integrated implantable devices for long term acquisitions of cranial nervous systems would come into vogue. As the size of such devices become smaller the size of coils for power transmission must be reduced. Hence the wireless power transmission system finds an application in such devices to be placed at limited area and volume. The most commercially viable application of such transmission arises to counter the effects of global warming and also to control the increasing demand for electricity. This application will supply limitless power to Earth and also open up many new opportunities for space exploration. With WPT, the world can really witness a huge change in technology in future.

4. Conclusion

Wireless power transmission systems have a wide range of applications throughout the world. It has the potential to change this planet's current environment in many different levels. With WPT, the world can really witness a huge change in technology in future.

Wireless power transfer is of contemporary interest to answer the increasing global warming in the planet. It can be predicted that Earth's future could be fully dependent on wireless power transfer. A few examples of this include wireless power in medical science and devices, pollutant free electricity, increased safety for medical procedures, and the mobility of having power anywhere at any time. The efficiency of magnetic coupling, heating and size are the only barriers preventing WPT from becoming ubiquitous. In this paper, we have discussed and reviewed the wireless power transmission system and its applications to change the view of the whole world.

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