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A Review on Wireless Electricity Transmission Techniques

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Abstract – Wireless electricity transmission is one of the emerging fields of engineering. The requirement of such technology is increasing as the applications of mobile devices, because these devices requires frequent recharging and wired connection limits its immovability and adds unconvincing wiring. Since the wireless power transmission combines many theories and explained by many methods, this paper discusses the different methods used for the wireless electricity.

Keywords – Wireless Electricity Transmission.

1. INTRODUCTION

Wireless energy or wireless power transfer is a method of transferring the electric energy from a power source to an electrical load without synthetic conductor. Wireless transmission is useful in cases in which connecting lines are inconvenient, dangerous or impossible. The problem of wireless transmission of energy different from the wireless telecommunication, such as a radio. In the radio, the proportion of energy received becomes critical when it is too low to distinguish the signal from background noise. With wireless power efficiency is the more significant parameter. A large part of the energy required by the production unit arrive and the receiver or receivers at the system economical.

The most common form of wireless power transmission is carried out via direct induction followed by resonant magnetic induction. Other methods are taking into account electromagnetic radiation in the form of microwaves or laser [2] and an electric wire with natural media. [3]. Some of the most common methods used for the wireless transmission of electricity are

1. Electromagnetic induction
2. Electrostatic induction
3. Electromagnetic radiation
4. Microwave method
5. Laser method
6. Electrical conduction

2. ELECTROMAGNETIC INDUCTION

The electrodynamic induction near-field wireless communication technology is used at distances of up to about one-sixth the wavelength. Near field energy it is non-radiative but some radiative losses do occur. Furthermore, there is typically resistive losses. With electrodynamic induction electric current through a primary coil which generates a magnetic field that acts on a secondary coil generating a current therein. Coupling, has to be in order to achieve high efficiency. As the distance is increased from the primary misses more and more of the secondary magnetic field. Even in a relatively short range the inductive coupling is grossly inefficient, wasting much of the transmitted energy. [4]

This action of an electrical transformer is the simplest form of wireless energy transfer. The primary and secondary circuit of a transformer are not directly connected. Energy transfer takes place through a process known as mutual inductance. Main functions are stepping the primary voltage either up or down and electrical isolation. Phone and electric toothbrush chargers and electrical power distribution transformers are examples of how this principle is used. Induction cookers use this method. The main drawback of this basic form of short-range wireless transmission. The receiver needs to transmit directly to the induction unit or to couple efficiently to it.

The application range of the resonance increases slightly. If resonant coupling is used, the transmitter and receiver are tuned to the same resonant frequency inductors. The performance can be further improved by modifying the drive current of a sinusoidal waveform of a sinusoidal transient. [5] can be transferred in this way substantial energy between two mutually tuned LC circuits with a relatively low coupling factor. Transmitting and receiving coils are generally single layer of magnetic coils or flat coils with series capacitors so that the receiving element is tuned to the transmission frequency in combination.

Be charged sharing of resonance-enhanced electrodynamic induction, the batteries of portable devices such as laptops and cell phones, medical implants and electric vehicles. [6] [7] [8] A localized charging technique selects the appropriate transmitting coil in a multilayer winding array structure. [9] Resonance in the wireless charging pad (the transmitter circuit) and the receiver module (embedded in the load) is used to maximize the energy transfer. This approach is suitable for universal wireless charging pads for portable electronic devices such as cell phones. It has been adopted as part of the Qi wireless charging standard.

It is also for the supply of equipment, no batteries, such as RFID patches and contactless smartcards, and to couple electrical energy from the primary coil to the helical resonator Tesla coil wireless power transmitter uses.

3. Electrostatic Induction

An electrostatic induction or capacitive coupling, the passage of electric energy by a dielectric. In practice, an electric field gradient or differential capacitance between two or more insulated blocks, plates, electrodes, or nodes, which are elevated above a conductive ground plane. The electric field is generated by feeding the sheets with a high potential, high-frequency AC power supply. The capacitance between two terminals and a higher powered device form a voltage divider.

The electrical energy which is transmitted through electrostatic induction is used by a receiving device such as a wireless air. [10] [11] [12] Nikola Tesla demonstrated the illumination of wireless lamps by energy that is coupled into them through an alternating electric field. [13] [14] [15]

4. Electromagnetic Radiation

Far-field techniques achieve longer ranges, often several kilometers ranges, wherein the distance is substantially greater than the diameter of the device (s). The main reason for greater distances with radio waves and optical devices is the fact that the electromagnetic radiation can be in the far field to be (with high directivity antennas or well-collimated laser beam) adapted the shape of the reception area, so it provides almost radiated power at long range. The maximum directivity for antennas is physically limited by diffraction.

5. Microwave Methods

Taken directional transmission using radio waves are so long distance power transmission at shorter wavelengths of the electromagnetic radiation, typically in the microwave range. A rectenna is used to convert the microwave energy into electricity. Rectenna efficiencies have been realized in excess of 95%. Power beaming using microwaves has been for the transfer of energy from solar power satellites orbiting the earth and leave the beaming of power to spacecraft orbit has been considered. [2] [16] proposed

Power beaming by microwaves has the difficulty that for most space applications the required aperture sizes are very large due to the diffraction limited antenna directivity. For example, the 1978 NASA Study of solar energy requires satellite a 1-km diameter transmitting antenna, and a 10-km diameter receiving rectenna for a microwave beam at 2.45 GHz. [17] These sizes can be reduced to something shorter wavelengths, although short wavelengths may have difficulties with atmospheric absorption and beam blockage by rain or water droplets. Because of the "thinned array curse," it is not possible, a narrow beam which make by combining the beams of several smaller satellites.

For earthbound applications a large area 10 km diameter receiving array allows large total power levels are used as proposed in the low power density for human electromagnetic exposure safety. A person certainly distributed power density of 1 mW/cm2 over a 10-km diameter corresponds to a total of 750 megawatts. This is the power found in many modern power plants.

6. Laser Methods

When electromagnetic radiation in detail the visible spectrum (10s microns (um) to 10s nm) capable of transmitting power through the conversion of current into a laser beam, which is then at a solar cell receiver [39] it This mechanism is usually called "power beaming "because the power at a receiver, convert it into usable electrical energy radiated can be known.

The laser "powerbeaming" technology has been studied primarily in military weapons and space and applications will be developed for commercial and consumer electronics Low-Power applications. Wireless energy transfer system using laser for consumer space has to satisfy Laser safety requirements.

7. Electrical Conduction

7.1 Disturbed charge of ground and air method. The wireless transmission of alternating current through the earth with an equivalent electrical displacement obtained by the air above long areas that are higher than the resonant electrical induction methods and low compared with the electromagnetic radiation methods. Electrical energy can be transmitted through inhomogeneous earth with low loss because the net resistance between earth antipodes is less than 1 ohm. [3], the electrical adjustment takes place predominantly by electrical conduction through the oceans, and metallic ore bodies and similar subsurface structures. The electric displacement by electrostatic induction through the more dielectric regions such as quartz deposits and other non-conductive minerals. Recipients are attracted by currents through the earth while an equivalent electric displacement is carried out in the atmosphere.

This energy transfer process is suitable for the transmission of electric energy in industrial quantities and also for wireless broadband telecommunications. The Wardenclyffe Tower project was an early commercial venture for trans-Atlantic wireless telephony and proof-of-concept demonstrations of global wireless power transmission using this method. The plant was not completed due to insufficient funding.

7.2 Terrestrial transmission line with atmospheric return

Single wire with Earth return electrical power transmission device systems rely on electricity, which is insulated by the earth and a single line from the earth to complete the circuit. In emergencies high-voltage direct current power transmission systems can also operate in the 'single wire with earth return' mode. Removal of the increased insulated wire, and the transmission of alternating high potential through the earth with an atmospheric return line is the base of this method for the wireless transmission of electrical energy.

The method depends on the atmospheric line passage of electric current through the earth and through the upper troposphere and the stratosphere. This flow is caused by electrostatic induction up to a height of about 3 miles

(4.8 km) induced on the surface. Electrical Conduction and the current flow through the upper air layers starting at a barometric pressure of approximately 130 mm Hg is possible by the process of the atmospheric ionization by creating capacitively coupled plasma discharge. In this way, illuminated electric lamps and electric motors can be rotated at moderate distances. The transferred energy can be found in greater distances.

A global system for "the transmission of electrical energy without wires" called the World Wireless System, dependent upon the high electrical conductivity of the plasma and the high electrical conductivity of the earth was proposed already in 1904.

8. Conclusion

This paper presented a short review of the techniques used for the wireless transmission of electricity and each has their own advantages and disadvantages. Hence the selection of the technology is depends upon the number of parameters such required power, distance, medium, application, complexity and cost.

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