Review on Wireless Power Transmission

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Abstract— Wireless power transmission has been widely used it has the advantage of high transmission efficiency, long transmission distance. Now a days through wire connection we are getting many problems ex: shocks etc.., to minimizing the problems like from preventing shocks, This paper explains good appearance, easily transferring the energy from power source to the load and to improving the efficiency. The intent of this paper is to present review on wireless power transmission. There are two ways of electrical energy transmission one is wired and another is wireless. Wired electric transmission is complicated in design, easy way to overcome this disadvantage we are using wireless transmission. This paper explain how the electrical energy is transferred from a source to load, without any wired connection.

Keywords: Wireless Power Transmission, Microwave transmission, WPT System

I. INTRODUCTION

The common way of transferring electric energy is by using cables and wires. However this way is difficult. The Use of electronic appliances increases the use of cables which creates complicated and difficult in design the solution of this problem is wireless energy transfer. In WPT we are not using any wires to transfer the energy here through air gap only the energy will transfer. It is efficient and safe when operated carefully.

By using wires we will get less efficiency, power loss will be more. Losses occurring during the transmission and allocation of electrical power. Our existing transmission system is 70% to 74% .As the demand increases day by day, the power generation and power loss are also increased. To transmit the power in high mountains and seabed, which greatly reduces the safety and reliability of its use, Therefore, with the development of technology, the wireless power transmission has made people look on it. It has the advantage of low wear rate, high reliability safety, convenient and flexible. This paper contains concept of wireless electricity power transmission, types, application, advantages, disadvantages and future scope of WPT.

II. CONCEPT OF WIRELESS ELECTRICITY TRANSMISSION

Wireless power transmission is the transmission of electrical energy from a power source to a load without wire connection and man-made use. Wireless power transmission is useful in cases where inter connecting wires are inconvenient, hazardous. In todaty's world everything is based on the wireless systems communication systems radio and tv signals walkie system and the wireless system of power transmission is based on the same communication system but entirely different from it that we will see further.

A. Wireless Power Transmission System:

It includes the system by which the transmission of power takes place and defines the concept of transmission channel and receiving module.

1) Induction process:

An inductor coil carries a current with some voltage. Then the coil stores the energy and produces electric Flux which leads the production of electromagnetic Field these fields carry electric voltage and current with them. These electric fields link with the other Coil produces the voltage in the other coil such thing is called concept of induction.

By these process we will get health and environment. As the electromagnetic field causes a type of clotting and cancer among the humans and also causes major health hazardous.

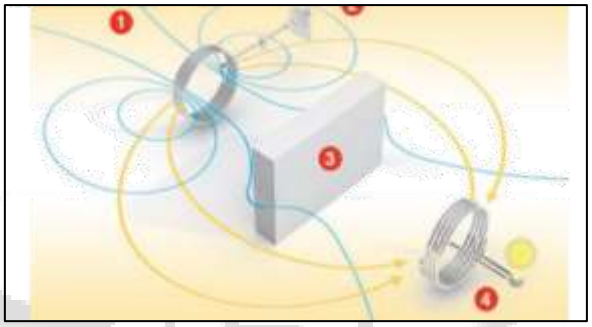


Fig. 1: Electromagnetic induction

2) Microwave transmission method:

Microwave transmission is the transmission of information by microwave radio waves .It is used for point-to-point communications because their small Wavelength allows conveniently-sized antennas to direct them in narrow beams, which can be pointed directly at the receiving antenna .A rectenna may be used to convert the microwave energy back into Electricity.

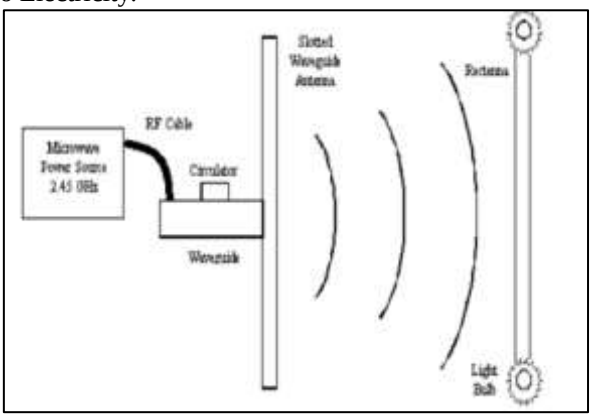


Fig. 2: Microwave transmission

So microwaves are provided to be much safe and reliable to transmitt electric power over a distance of more than a km

3) Laser transmission method:

The technique used for WPT is based on laser beam .Which acts as a source .The laser beam of high intensity is thrown

from some specific distance to the load end .Depending on the range and intensity of the beam this method is used for small distance applications.

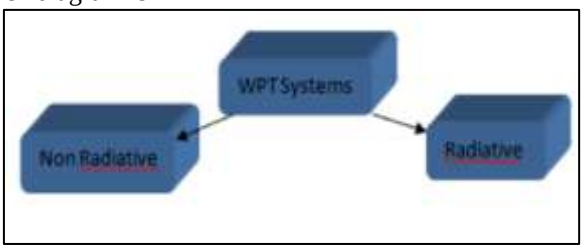
This Process is similar to the solar cells photovoltaic generation which uses the solar energy of the sun light and converts it to electricity .At the load end highly efficient photovoltaic cells are used which receive the laser beam ,energize laser light and finally convert laser light energy to electrical energy.

B. Comparison of different methods:

Induction process	Microwave Transmission method	Laser Transmission method
It is economical as the equipment used is cheap and easily available.	Relatively expensive as compared to other methods.	Implies same economic conditions of mutual induction.
Useful for implementation of the small distance application	This method implies for long distance applications.	Used for small distance but could be used for longer distances
Range: short	Range: long	Range: long
Frequency: Hz-MHz	Frequency: GHz	Frequency: >=THz
Future application: Electric tooth brush, Industrial heaters, Razor battery charging etc..,	Future application: Solar power satellite, Powering done aircraft, charging wireless devices etc..,	Future application: Charging portable devices, Powering drone aircraft etc.,

III. CLASSIFICATION OF WPT SYSTEM

Wireless power transmission system can be classified mainly into 2types based on radiative pattern.
They are:
1) Far-Field technique or Radiative pattern.
2) Near field technique or non-radiative pattern.
Block diagram is



A. Far-Field technique (Radiative pattern):

The far-field technique is also called power beaming. Power is transferred by beams of electromagnetic radiation, like microwaves. These technique can transport energy longer distance but must be aimed at the receiver. Proposed applications for this type are solar power satellites and wireless powered drone aircraft. The far-field techniques are measuring the electrical load far from the power source.

These techniques aim at high power transfer and need line of sight. It can be separated into two categories, which are microwave power transmission and laser power transmission

1) Microwave Power Transmission (MPT):

This technology transfers high power from the base station to the receiving station or mobile devices with two places being in line of sight. With the help of geosynchronous receiving and transmitting satellites, this technology enables the objects to acquire power from the base station with using the magnetron. MPT provides the efficiency in energy conversion but it is slightly difficult to focus the beam in a small region. Besides, this technology could pass through the atmosphere easily. The first step of power transmission is initiated with converting electrical energy to be microwaves energy and then microwaves energy will be captured with using retina.

In this technology, Alternating Current (AC) cannot be directly converted to microwaves energy. Therefore, AC needs to be converted to Direct Current (DC) first and then DC is converted to microwaves by using magnetron. Transmitted waves are received at retina and then rectify microwaves into electricity with more efficiently. It will give DC as the output. In the final step, DC will be converted back to AC.

2) Laser Power Transmission: This technology is slightly different with MPT where it enables the power concentrated in a small area by utilizing the mirror.

This technology also produces high powers that are coherent and not dispersed. However, laser technology gets attenuated when it propagates through atmosphere. In addition, this technology has been used to apply to a rover to explore the presence of ice in the bottom of craters of the moon where no sunlight is available. On the other hand, the solar energy generated by the radiation is converted into the electric energy. This energy next will be converted to the laser light and then transmitted to the rover working at the bottom of the crater.

B. Near-Field technique (Non-Radiative Pattern):

The near-field techniques are measuring with appliance near from the power source. It can be broken down into three categories, which are electromagnetic radiation, inductive coupling, and magnetic resonant coupling. These techniques can be used to eliminate problem due to weather and security concerns

1) Electromagnetic (EM) Radiation:

Energy from the transmission antenna of a power source to the receiver antenna through radioactive EM waves is the process of emission by EM radiation. Omnidirectional radiation and unidirectional radiation, this two section classified in the sense of the direction of emitting energy. Through omnidirectional radiation process, broadcasting EM waves via transmitter in an assigned ISM band for example 850–950 MHz or 902–928 MHz which can be varies with the different region both with 915 MHz center frequency, and a receiver for example RFID tags tunes to the same frequency band to harvest radio power. In omnidirectional radiation though information transfer is more easy and suitable but also

suffers from a serious efficiency problem in energy transfer because when the distance is going large there is quick decay of EM waves. By the experiment it was found that when receiver is 30 cm away from the RF transmitter, power transfer efficiency is only 1.5%.In addition, to protect potential health hazards of humans from EM radiation, only appropriate process is omnidirectional radiation for ultra-low-power sensor nodes for example up to 10 maw with very low sensing activities like temperature, moisture and light. If there is a clear line-of-sight (LOS) path exists in the process of unidirectional radiation, it can gain high power transmission over a much longer distance for example by using a microwave or laser beam the range can be in kilometer. In the microwave-based system mostly, wireless power is transmitted on microwave frequencies of either 2.45 or 5.8 GHz, both in the ISM frequency band. In the Laser-based system, it is still considered less mature than microwave-based system, transmit power under the visible or near infrared frequency spectrum as an example from several THz to several hundred THz.

2) Inductive Coupling:

Inductive coupling generally defined as coupling between to LC circuits where resonant frequency is same. It works by using magnetic field induction that is the natural part of current's movement through wire, as an example alternating current in a primary coil that is connected to a source can produce a varying magnetic field that induces a voltage across the terminals of a secondary coil at the receiver. Primary and secondary coils are two distinct coils in inductive coupling. Each of these connected wirelessly and the reason of its simplicity, convenience, and safety, inductive coupling has been an important and popular technology to transfer power without wires. With this technological application various kinds of electronic devices has been already made. Therefore, it has been successfully commercialized to a number of products, including electric toothbrush, charging pad for cell phone or laptop, and medical implants. In inductive coupling, power transfer gradually decreases when the two coils are being separate slowly from each other or when the alignment of two coils is not perfect. These kinds of problems are generally occurred when it's not carefully used. It works best when the charging node of the device and power receiving node are close in contact usually less than a coil diameter, for example the range can be in centimeter and the direction of the charging must have to be aligned.

3) Magnetic Resonant Coupling:

The last and most important category of WPT technology under the section of near field techniques is magnetic resonant coupling. This technology was developed by Kursk et al., which enable to make the interactions between two different objects very strongly because of the combination of inductive coupling and resonance. In addition, energy will be shifting back and forth between magnetic field surrounding the coil and electric field around the capacitor. To the classical mechanical resonance the effect of magnetic resonance is analogous, under which a string when tuned to a certain tone it can be excited to vibration by a faraway sound generator if there is a match between their resonance frequencies. In this technology, energy can be transferred efficiently from a source coil to a receiver coil with little loss of energy to alternating current in a primary coil (connected to a source) generates a varying magnetic field that induces a voltage across the terminals of a secondary coil at the receiver. An electrical transformer is a good extraneous off-resonant object. There are several advantages of this technology namely highly efficient, radiation loss will be negligible, provides much greater range and directional as compared to inductive coupling.

IV. ADVANTAGES

1) Can transfer electricity anywhere without wires i.e. Reduction of E-waste by eliminating the need of power cords.
2) More reliable, flexible & convenient.
3) Short circuit and fault on cables would never exist in transmission.
4) Automatic wireless charging for cord less for instruments.

V. DISADVANTAGES

1) The particle implementation of WPT system cost seems very high.
2) If proper flux linkage not possible, no power supply takes place. WPT systems can cause interference communication systems which using microwaves or radio waves.
3) This approach is good but up to certain level transmitter and receiver antenna is high in gain so that is too much dangerous for human life may be generated radiation will create cancer
4) Less efficiency compared to traditional charging.

VI. APPLICATIONS OF WPT

Most wide application of WPT by using satellites with giant solar arrays placed in Geosynchronous:

1) Earth Orbit. These satellites used to generate and transmit the power as microwaves to the earth known as Solar Power Satellites (SPS).
2) Application of wt Ubiquitous Power Source (or)Wireless Power Source, Wireless sensors and RF Power Adaptive Rectifying Circuits (PARC).
3) Mobility -. Moving targets such as fuel free airplanes, Electric vehicles, moving robots etc.
4) Used in remote controls, computer headsets sensors, wireless thermostats, smoke detectors, smart phone accessories, laptops etc.

VII. FUTURE SCOPE OF WPT

Some of the following Issue which needs for making WPT system more general and effective are

1) Reduce Radiation Issue.
2) Improve Distance Issue.
3) Improve voltage Issue.
4) To develop Multiple Transmitters and Receivers System.

VIII. CONCLUSION

WPT is most wide area of research area. Wireless power transmission offers greater possibilities for transmitting power with negligible losses, There recent technological applications that make the human life more beneficial in the

present world have been discussed. Presently it is being used in the solar cell application to improve the efficiency and reduce the weight and cost. By this method we can refine the method of solar power and witricity transmission and hence can achieve greater efficiency.

REFERENCES

[1] Goodbye Wires: Approach to Wireless Power Transmission Sourabh Pawade, Tushar Nimje, Dipti Diwase Student, Electronics & Telecommunication, Lecturer, Department of Information Technology, G.H. Raisoni college of Engineering, Nagpur.
[2] "Experimental Thin-Film, Etched-Circuit Rectenna", W.C. Brown, J.F. Triner, (1982) International Microwave Symposium Digest, IEEE Cat. No.82CH1705-S

