

Wireless Power Transmission

S. Leema Rose
Dept of EEE.

Star Lion College of Engineering and Technology.

P. Subha
Dept .of EEE

Star Lion College of Engineering and Technology.

Abstract:- Power is very important to modern systems. The purpose of this paper is to discuss concept of transmitting power without wires. Wireless Power Transmission (WPT) is the efficient transmission of electric power from one point to another through vacuum or an atmosphere without the use of wire or any other substance. The methods applied for wireless power transmission like Induction, Electromagnetic transmission, Electrodynamic induction, Radio and microwave ,are discussed.. We have also discussed the technological developments in Wireless Power Transmission (WPT). The advantages, disadvantages, biological impacts and applications of WPT are also presented.

Keywords - Wireless transmission power, magnetic coupling, micro wave etc.

I. INTRODUCTION

The requirement of power transmission is basically to transmit power from generating point to the consumer. There are two major modes of power transmission:-

- (A) Present mode i.e. with conductors
- (B) Another mode is new that is WPT (wireless power transmission)

One of the major lagging phenomenon in current power distribution system is the losses during the transmission of electrical energy. It is an established fact that line losses are always in proportion to the power supply. In case of wireless transmission, since there is no transmission by physical conductor, these losses are bare minimum.

WPT is defined as „The power transmitted from one point to the other point without use of physical conductor, i.e power is transmitted with the use of vacuum or an atmosphere, i.e. without the use of wire or any other substance“

Now we will discuss two types of WPT viz,

- 1) Ground based power transmission
- 2) Space based power transmission

If we compare both the above, obviously Space-based power transmission has got the major under mentioned plus points “Input power availability is round the clock, hence obviously. No storage required for night time power”.

II. POSSIBLE METHODS OF WIRELESS TRANSMISSION OF ELECTRICAL POWER

- A. Inductive coupling
- B. Microwave
- C. Radio frequency
- D. Laser

A. INDUCTIVE COUPLING

The basic concept behind electromagnetic approach of WPT is magnetic induction between two coil say transmitting and receiving coil. When transmitter coil is excited then it generates flux and when receiver coil receives this flux a potential difference is developed across its terminals. The potential difference developed in receiver is directly related to distance between transmitter and receiver coil. Fig.1 shows the basic model for WPT [1].

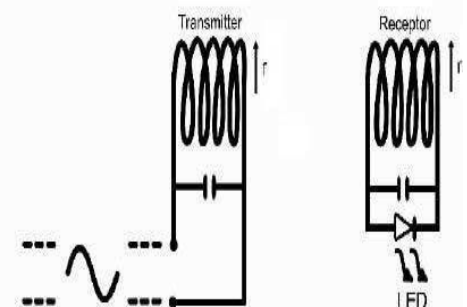


Fig.1 Basic WPT model with inductive coupling

This is the basic model and its efficiency is very poor hence cannot be used for large distance transmission. We can enhance its efficiency by inductive coupling as shown in fig.2. But with this also we cannot use it for long distance transmission

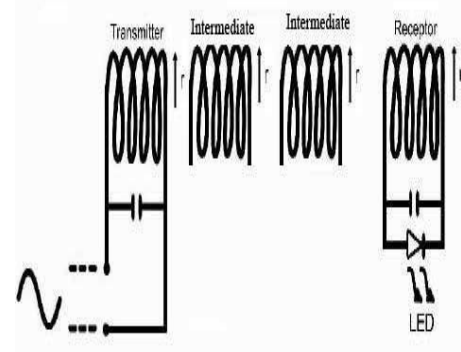


Fig.2 WPT model with intermediate

In general term these intermediate coils is called repeaters. These repeaters increase efficiency of transmission



Fig.3 Demonstration of WPT with intermediate

B. MICROWAVE

The Primary components of Wireless Power Transmission are Microwave Generator, Transmitting antenna and Receiving antenna (Rectenna)

- **Microwave Generator:-** The microwave transmitting devices are classified as Microwave Vacuum Tubes and Microwave Power Module and Semiconductor Microwave transmitters
- **Transmitting Antenna:** - The slotted wave guide antenna, micro strip patch antenna, and parabolic dish antenna are the most popular type of transmitting antenna. The slotted waveguide antenna is ideal for power transmission because of its high aperture efficiency (> 95%) and high power handling capability
- **Rectenna:-** The rectenna is a passive element consists of antenna, rectifying circuit with a low pass filter between the antenna and rectifying diode. The antenna used in rectenna may be dipole, micro strip or parabolic dish antenna

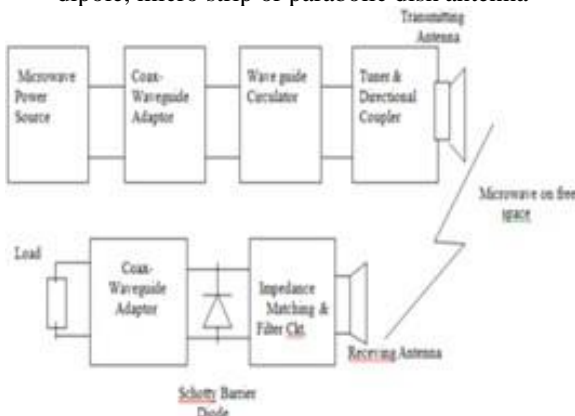


Fig.4 Functional block diagram of WPT Steps involved are-

- Conversion of electrical energy into microwave energy.
- Receiving microwave energy using rectenna.
- Conversion of microwave energy to electrical energy.

C. RADIO FREQUENCY

Nikola Tesla he is who invented radio and shown us he is indeed the “Father of Wireless”. Nikola Tesla is the one who first conceived the concept of Radio frequency.



Fig.5 Wardencliff tower

The Wardencliff tower shown in Figure was designed and constructed by Tesla mainly for wireless transmission of electrical power rather than telegraphy. RF signals to DC electrical current powered from either an international or ambient power sources. e.g. – Wi Fi, mobile networks, laptops, remote sensors. This method provides a continuous power source up-to a distance of 30 meters.

D. LASER

A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. A laser differs from other sources of light because it emits light coherently. Spatial coherence allows a laser to be focused to a tight spot. The mechanism of producing radiation in a laser relies on stimulated emission, where energy is extracted from a transition in an atom or molecule. Power can be transmitted by converting electricity into a laser beam that is then pointed at a photovoltaic cell. This mechanism is generally known as "power beaming" because the power is beamed at a receiver that can convert it to electrical energy. There are lot of advantages in this system It allows narrow beam cross- section area for transmission over large distances; Compact size; No radiofrequency interference to existing radio communication. There are various disadvantages too. Laser radiation is hazardous. Conversion between electricity and light is inefficient. Photovoltaic cells achieve only 40%–50% efficiency. Atmospheric absorption, and absorption and scattering by clouds, fog, rain, etc. It requires a direct line of sight with the target. This method has been used in military and aerospace applications



Fig.6 EADS developed fully laser power autonomous rove

III CONCLUSION

From the above it is more than clear that presently we are in the process of switching over (partly or fully) from Wire Power Transmission to Wireless Power Transmission by the method {Microwave}, Because of the following plus points

- This concept offers greater possibilities for transmitting power with negligible losses.
- It will be useful for long distance also.
- can be transmitted to anywhere in the globe and eliminate the need for an inefficient, costly, and capital intensive grid of cables, towers, and substations.
- It is space based power transmission there are no storage required for night time.

REFERENCES

- [1] Sourabh Pawade, Tushar Nimje, Dipti Diwase Student Goodbye Wires: Approach to Wireless Power Transmission, Electronics & Telecommunication, G.H. Raisoni College of Engineering, Nagpur. (INDIA) Student, Electronics & Telecommunication, G.H. Raisoni College Of Engineering, Nagpur. (INDIA) Lecturer, Department of Information Technology, G.H. Raisoni College of Engineering, Nagpur. (INDIA)
- [2] Matsumoto, H.N. Kaya, I. Kimura, S. Miyatake, M. Nagatomo, and T. Obayashi, MINIX Project toward the Solar Power Satellites --- Rocket Experiment of microwave energy transmission and associated plasma physics in the ionosphere, ISAS space energy symposium, pp 69-76, 1986. (references)
- [3] J.J Schelesak, A. Alden and T. Ohno, A microwave powered high altitude platform, IEEE MTT-S Int. Symp. Digest, pp – 283-286, 1998.
- [4] R. Bryan Erb, "Space-Based Solar Power - How Soon and How Much", 49th Congress of the International Astronautical Federation, Paper IAF-98-R.2.02, Melbourne, Australia, September 28 - October 2, 1998.
- [5] Nikola Tesla Tesla's Tower of Power. Information available at the following link, <http://www.damninteresting.com/teslas-tower-of-power/>
- [6] Nikola Tesla, —The Transmission of Electrical Energy Without Wires as a Means for Furthering Peace, Electrical World and Engineer. Jan. 7, p. 21, 1905
- [7] Rakesh K. Goyal, Utsav Gautam and Ranjan K. A Novel Design of Magnetically Coupled Circuits for Wireless Power Transfer with Improved Waveforms Behera Department of Electrical Engineering, Indian Institution of Technology Patna
- [8] L. W. Epp, A. R. Khan, H. K. Smith, and R.P.Smith, "A compact dual- polarized 8.51-GHz rectenna for high-voltage (50V)actuator applications," IEEE Trans. Microwave Theory Tech., vol. 48, pp. 111-120, 2000 .
- [9] Franklin Hadley "Goodbye wires" MIT News, 2007-06-07, <http://web.mit.edu/newsoffice/2007/wireless-0607.html>.
- [10]P. Koert and J.T. Cha, "35 GHz rectenna development," in Proc. St 1993, pp. 457-466.
- [11] Benjamin L. Cannon, James F. Hoburg, Dabiel D. Stancill, Seth Copen Goldstein, Magnetic Resonant Coupling as a Potential Means for Wireless Power Transfer to Multiple Small Receivers, IEEE Transactions on Power Electronics, Vol. 24, No.7, July 2009.
- [12]Joe T. Howell Advanced receiver/converter experiments for laser wireless power transmission, , 5th Wireless power transmission conference, pp 1-8, Granada Spain 2004