

Advanced Trends in Wireless Electricity Transmission using Semiconductor Devices

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Abstract--- in this paper, we describe the advance trends in the system of transmission of electric power without using the actual wires but with the help of conversion of electricity into waves and then transmitting it into the atmosphere with the speed of light i.e. 3×10^8 m/sec. The conversion efficiencies are more than 75% at the transmission distance of 300mm at lab. It is used to transmit electricity at a large distance of high frequency using electromagnetic waves such as microwaves. Such technology is used to transmit electric power from one place to other replacing the old interconnecting mediums called wires. The technology could be more developed by the use electronics that would be described in the paper. The low power could be transmitted using the special microwave or laser devices later on received by distant receivers containing rectenna providing an efficiency of more than 80% and convert back all microwave into electric power. The electronic devices and transducers could be useful in amplifying the power received and later on providing the correct frequency of transmission of 50 Hz in India and sent for domestic purposes. This system takes us to an era of low losses of the electric power by heat or by turbulence and donates an amount of good efficiency. We see the significant improvement in the efficiency and reliability of wireless transmission network. The same experiment is carried out using the present concepts at a ground level up to a few centimetres will be described in paper. The review will also discuss on advantages and short comings of the third generation power transmission system.

Index Terms--- Wireless power transmission, Microwave power transmission, Magnetron, Rectenna, Solar power satellites, Carbon nanotubes.

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1. INTRODUCTION

WIRELESS power transmission has been a topic of continued interests since the last several decades, with an emphasis made initially on long-distance high-power microwave transmission from one place to other place. Firstly we have achieved it in ground level using latest techniques and simple transmission and receiving circuit and using different methodology of induction and microwave transmission. Once it is developed at the ground level it would be easy for the mankind to develop it in the large field also and also in the favour of the mankind.

2. CONCEPT OF WIRELESS ELECTRICITY TRANSMISSION

Wireless power or wireless energy transmission is the transmission of electrical energy from a power source to an electrical load without man-made conductors. Wireless transmission is useful in cases where interconnecting wires are inconvenient, hazardous, or impossible.



Figure I: Ground level transmission

In today's world everything is based on the wireless systems. Communication systems radio and TV signals Walkie talkie system etc. and the wireless system of power transmission is based on same communication system but entirely different from it that we will see further.

Figure II: Solar based transmission

3. WIRELES SPOWERTRANSMISSION SYSTEM

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

The power can be transmitted from one place to other place by three ways called the

3.1. Induction process

In this process whenever a current with a voltage is passed through a inductor coil, it stores the energy and produce electric flux which leads the production of electromagnetic field. These fields carry electric voltage and current with them. When these electric fields link with the other coil produces the voltage in the other coil also. Such thing is called the concept of induction.

Even this process is not suitable for the health and environment as the electromagnetic field causes a type of clotting and cancer among the humans and also causes major health hazardous.

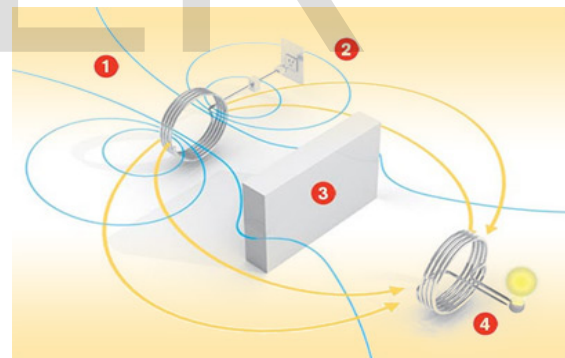


Figure III: Electromagnetic induction

3.2. Microwave transmission method.

Microwave are much developed then the electrostatic and electromagnetic induction. Power transmission via radio waves can be made more directional, allowing longer distance power beaming, with shorter wavelengths of electromagnetic radiation, typically in the microwave range. A rectenna may be used to convert the microwave energy

back into electricity.

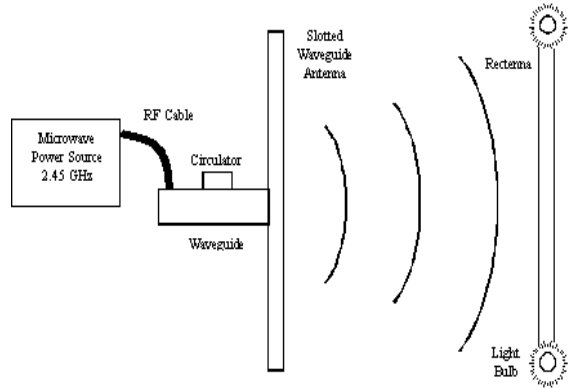


Figure IV: Microwave transmission

So microwaves are proved to be much safe and reliable to transmit electric power over a distance of more than a kilometre.

3.3. Laser transmission method:

LASER (Light Amplification by Stimulated Emission of Radiation) is another method of transferring of electric power by amplification and stimulation method. Power can be transmitted by converting electricity into a laser beam that is then pointed at a solar cell receiver. This mechanism is generally known as "power beaming" because the power is beamed at a receiver that can convert it to usable electrical energy.

4. Components of wireless transmission:

Components refer to the different stages and equipment which are used to carry out a particular technology. The Primary components of Wireless Power Transmission are Microwave Generator, Transmitting antenna and Receiving antenna (Rectenna). The components are described below:

4.1 Microwave Generator:

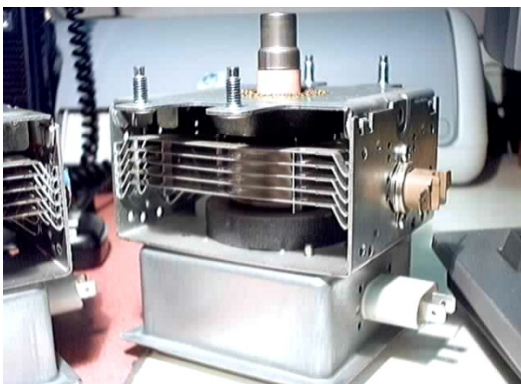


Figure V: Magnetron

The devices which are used to produce the microwaves by using some electric source or oscillator are called microwave generators. These are high efficiency generators which produces microwave at a constant frequency. The microwave transmitting devices are classified as Microwave Vacuum Tubes (magnetron, klystron, Travelling Wave Tube (TWT), and Microwave Power Module (MPM)). The other choices of frequencies are 8.5 GHz, 10 GHz and 35 GHz. The highest efficiency over 90% is achieved at 2.45 GHz among all the frequencies.

4.2 Transmitting Antenna (horn antenna or parabolic):

An antenna is a device which is used to transmit electrical signal by converting them to electrical signals. The height of the antenna is kept to one fourth of the wavelength of the microwave. The slotted waveguide antenna is ideal for power transmission because of its high aperture efficiency (> 95%) and high power handling capability. The same antenna can also be used for the receiving side also which is also used to receive signals at the receiver module to receive and work out on the signal received.

4.3 Rectenna:

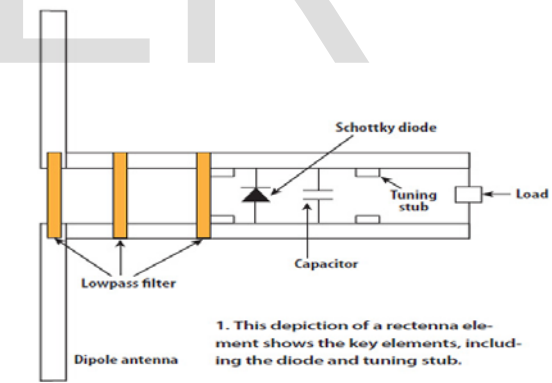


Figure VI: Rectenna circuit

RECTENNA as the name suggests denotes the rectifying antenna which is used to convert the microwave back to electricity. The rectenna is a passive element consists of antenna, rectifying circuit with a low pass filter between the antennas and rectifying diode. Scotty barrier diodes (GA As-W, Si, and GA As) are usually used in the rectifying circuit due to the faster reverse recovery time and much lower forward voltage drop and good RF characteristics. The diameter of rectenna would be in miles. Deploying in the earth surface in a diameter would allow it to receive

more and more microwave and thus converting it to electric power.

5. GROUND LEVEL TRANSMISSION

The transmission of electricity at the ground level is achieved using the different instruments developed and processed. It is carried by using a transmission module and a receiver module. It also displays the transmission of AC supply using microwaves at a shorter distance of 15 to 20 cm. The voltage of the transmitting wave and frequency is maintained and then sent. Some waves are received at the receivers end and then falls on the rectenna. The rectenna converts the microwaves to the electricity and thus we can use it for domestic power. The output we can also see on the oscilloscope also which displays the respective waveforms of the receivers end. The complete setup of the receiver and the transmitting module is presented below.

5.1. Transmitting Circuit:

The transmitting circuit consists of:

5.1.1 AC 220V: It is the supply coming from the port which should be getting converted to microwave and then transmitting it.

5.1.2 cycloconvertor: A Cycloconvertor (CCV) or a cyclo converter converts a constant voltage, constant frequency AC waveform to another AC waveform of a lower frequency .it is a device whose work is to reduce the frequency of the incoming AC power and it increase the voltage. Due to this we get a very short range frequency of the AC signal and a high voltage.

5.1.3 Step down transformer. It is a device which is used to decrease the voltage of the above got AC signal which has a low frequency and high voltage. The step down transformer provides us with a low voltage and low frequency.

5.1.4 Magnetron:

The cavity magnetron is a high-powered vacuum tube that generates microwaves using the interaction of a stream of electrons with a magnetic field. The devices used to convert electricity to the microwaves. This device will convert the coming A C power coming from step down transformer to the microwaves for transmitting through the waveguide or helical antenna which are two basic methods for the transmission of the microwave produced. The main work of

this device is just to convert the coming electric power to the microwaves whose frequency and voltages are predefined by the step down transformer.

5.1.5 Waveguide:

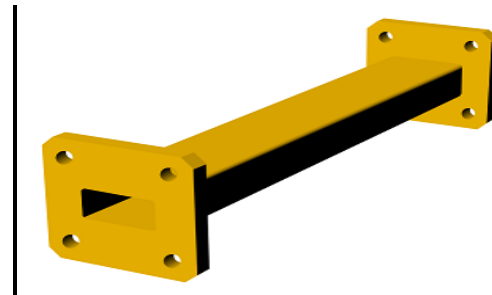


Figure VII: Waveguide

A waveguide is a structure that guides waves, such as electromagnetic waves or sound waves. The original and most common meaning is a hollow conductive metal pipe used to carry high frequency radio waves, particularly microwaves. Waveguides are the devices which works as a microwave travel line for the travel of the microwave in which the attenuation of the microwave is done to make it ready for the transmission through the transmission props.

5.2. Receiving module:

The receiving module is the module which consists of the receiving circuit which is used to receive the transmitted microwave from transmitting module. It consists of the following components:

5.2.1 Rectenna: A rectenna is a rectifying antenna, a special type of antenna that is used to convert microwave energy into direct current electricity. They are used in wireless power transmission systems that transmit power by radio waves. A simple rectenna element consists of a dipole antenna with an RF diode connected across the dipole elements. The diode rectifies the AC current induced in the antenna by the microwaves, to produce DC power, which powers a load connected across the diode. Scotty diodes are usually used because they have the lowest voltage drop and highest speed and therefore have the lowest power losses due to conduction and switching. Large rectenna consist of an array of many such dipole elements. Here rectenna will be used as a receiver which will collect

the microwave coming from the transmitting module and thus convert the microwaves back to electric power.

5.2.2 Step up transformer It is a device which is used to step up the coming voltage from the rectenna. The output of the voltage provided by the transformer is much larger than the input voltage. So its main work is to increase the level of the voltage received by the rectenna. The rectenna provides a dc output with a low voltage. Therefore this device used to increase the voltage as per the Indian standards level required voltage is 220v which is provided by the transformer.

6. OUTPUT:

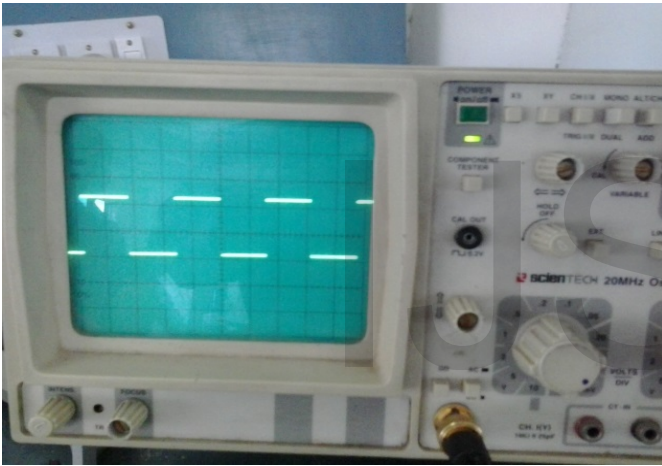


Figure VIII: Transmitting microwave

The microwave received at the receive end can be seen at the cathode ray oscilloscope determining its different properties like voltage current frequency which can be calculated easily by it. The microwave received has some amount of voltage and current which we need to be received. Such calculations can be performed by the oscilloscope for determining the different parameters.

The above procedure of transmission of electricity can be carried out by using a special evolved technique called the technique of the carbon nano tubes or the grapheme technology in which the special semiconductor materials like solar cells diodes and other materials are manufactured

by using carbon grapheme technology. By using such technology the size of the components can be reduced to large extent and their efficiency can be increased. Such technology is proved to be a boon for nature and mankind.



7. ADVANTAGES:

1. Energy delivered anywhere in the world
2. Zero fuel cost
3. Less losses
4. Less use of copper wires
5. More efficiency
6. Minimum long-range environmental impact

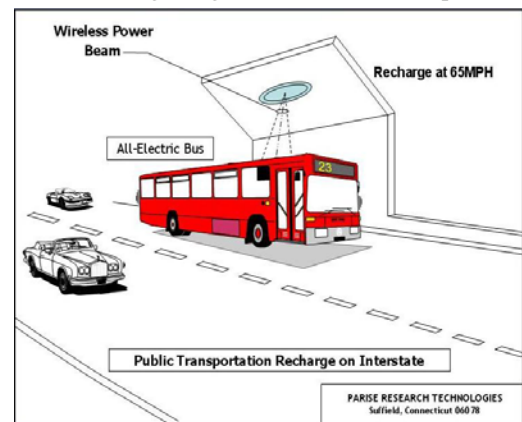


Figure IX: charging by Witricity

8. DISADVANTAGES:

1. Possible health hazards
2. Huge capita investment in the deployment system.
3. Unbearable change of the existing transmission system.

9. CONCLUSION

The applications of the long-distance high-power wireless transmissions are primarily applied to the space solar power satellites and the far-distance remote site power supplies, the short-range low-power wireless transmissions are applied to the power grid system to form a wireless power supply, the wireless charging system and also the medical sensor network and imaging systems. The carbon nanotubes will be proved as a boon for the research and industries. 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.

10. REFERENCES

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