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Review for Wireless Power Transmission using Microwave

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***Abstract*— The major issue in power system is the losses occurs during the transmission and distribution of electrical power.This problem can be solved by choose an alternative option for power transmission which could provide much higher efficiency, low transmission cost that is Wireless power transmission.The various technologies available for wireless transmission of electricity resonant coupling method ,inductive coupling and by using microwave. In this framework, several design methodologies are being investigated for the synthesis of transmitting antenna arrays able to maximize the power beaming efficiency of WPT systems. To make the charging process even more user-friendly is to eliminate the physical cable connection between the charger and the mobile phone. To achieve a wireless charging of a mobile phone, a wireless power transfer system must be designed.The microwave signal is transmitted from the transmitter along with the message signal using special kind of antennas called slotted antenna at a frequency is 2.45 GHz.**

***Index Terms*— BE(Beam Efficiency),Nikolas Tesla, Rectenna,WPT(Wireless power transmission)**

I. INTRODUCTION

Wireless Power Transmission (WPT) is useful technology because in *power* system is the losses occurs during the transmission and distribution of electrical power The major amount of power loss occurs during transmission and distribution. The percentage of loss of power during transmission and distribution is approximated as 26%.
The above discussed problem can be solved by choose an alternative option for power transmission which could provide much higher efficiency, low transmission cost and avoid power theft.There are three different techniques for WPT resonant coupling,inductive coupling and using microwave.

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1.1 Resonance Coupling**:-** Macroscopic resonant coupling needs large coils operating at MHz range and proper placement.

Fig.1 Example of Resonant Coupling

1.2 Inductive Coupling:- Inductive coupling relies on magnetic field and current induction between two coils, and has been applied commercially in, for example, electric toothbrushes, and appliance charging mats.
Inductive coupling requires the coils to be very close to the object under charge for successful induction.

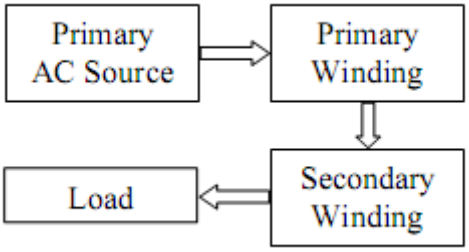


Fig.2 Component of an inductive coupling

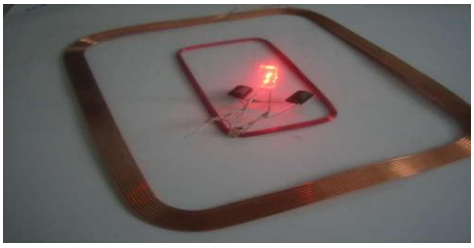


Fig.3 Example of inductive coupling

1.3 Radio wave**:-** Wireless power transfer through radio waves is a three-step process:
(1) Direct current (DC) or alternating current (AC) electrical power is converted into radio frequency (RF) power,
(2) The RF power is transmitted through space to some distant point 8
(3) The power is collected and converted back into DC power at the receiving point.

Characteristics of WPT

	WPT via radio waves	Resonance coupling	Inductive coupling
Field	Electric field	Resonance	Magnetic field
Method	Antenna	Resonator	Coil
Efficiency	Low to high	High	High
Distance	Short to long	Middle	Short
Power	Low to high	High	High
Safety	Electric field	Non (Evanescent)	Magnetic field
Regulation	Radio wave	Under discussion	Under discussion

II. BASICS OF WIRELESS POWER TRANSMISSION

Nikola Tesla is a genius who lit the world. He is the person who defies the efficiency of direct current invented by Thomas Edison. After that, he invented the Alternating current in order to overcome the problem of direct current.When Nikola Tesla discovered alternating current (AC) electricity, he had great difficulty convincing men of his time to believe in it. The method he would use to produce this wireless power was to employ the earth's own resonance with its specific vibrational frequency to conduct AC electricity via a large electric oscillator.

III. COMPONENT OF WPT

The Primary components of Wireless Power Transmission are

1) Microwave Generator
2) Transmitting antenna
3) Receiving antenna (Rectenna).

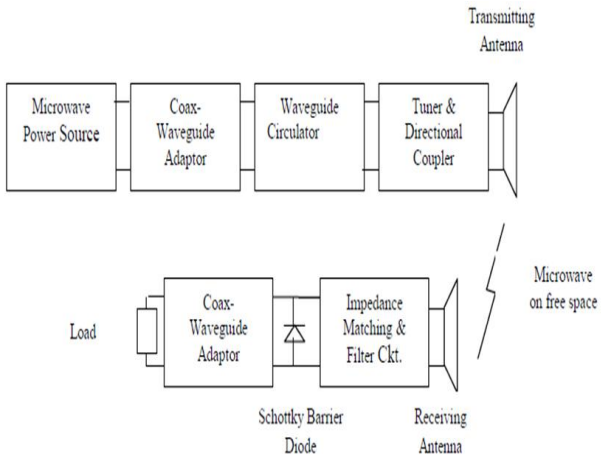


Fig.4 Components of wireless power

1) Microwave Generator:- The microwave transmitting devices are classified as Microwave Vacuum Tubes (magnetron, klystron, Travelling Wave Tube (TWT), and Microwave Power Module. The microwave transmission often uses 2.45GHz or 5.8GHz of ISM band.

2) Transmitting antenna:- The slotted waveguide antenna is ideal for power transmission because of its high aperture efficiency (> 95%) and high power handling capability. Designed frequency is 2.45 GHz.They are enough to transmit or to receive 2.45 GHz microwave power.

3) Receiving antenna (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, Yagi – Uda,microstrip or parabolic dish antenna.

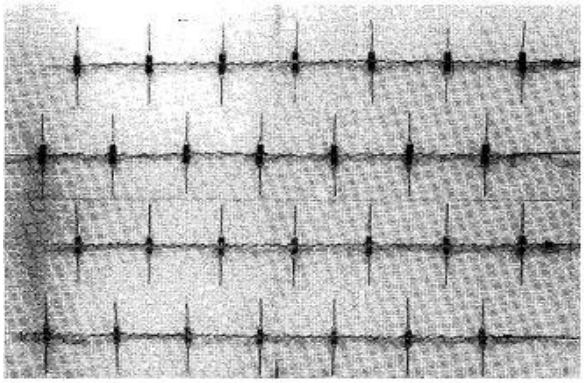


Fig.5 Rectenna

IV. DEVELOPED SYSTEM

4.1 Short Range WPT Experiment of Wireless Charging of EV:-

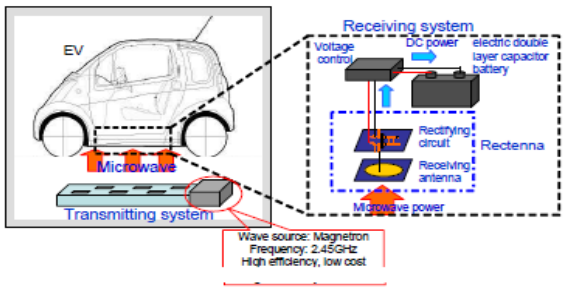


Fig.6 Proposed wireless charging system for EV from road[1]

We need to increase thenBE of the system. The BE includes the T/R antenna efficiency. Except the BE, we have to consider both efficiency of the magnetron which is approximately 72 % and efficiency of rectennas which is approximately 80 %.

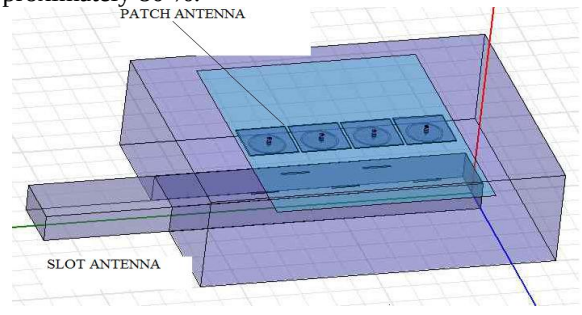


Fig.7 Antenna positioning in HFSS simulation.[1]

The wireless power charging system is used in short distance. There are receiving antennas in front of transmitting antennas as shown in Fig. 7. Distance between the transmitting antennas and the receiving antennas is only 9 cm, <λ.

4.2 Advantages of wireless power transmission

It would completely eliminates the existing high-tension power transmission line cables, towers,sub stations between the generating station and consumers.

It has more choice of both receiver and transmitters.

The cost of transmission and distribution become less is negligible level in the Wireless Power Transmission

The efficiency of this method is very much higher than the wired transmission.

4.3 Disadvantages of wireless power transmission

The Capital Cost for practical implementation of WPT seems to be very high.

Interference of microwave with present communication systems.

4.4 Biological Impact

Common beliefs fear the effect of microwave radiation But the microwave radiation level would be never higher than the dose received while opening the microwave oven door.
It is slightly higher than the emissions created by cellular telephones.

Cellular telephones operate with power densities at or below the ANSI/IEEE exposure standards.

V. PROPOSED WIRELESS POWER TRANSMISSION SYSTEM

There are several possible ways to improve our design in order to increase the power output.

5.1 Multiple Rectifiers

One way is to use multiple rectifiers. By doing so, more power is getting rectified by these the multiple rectifiers in the circuit.

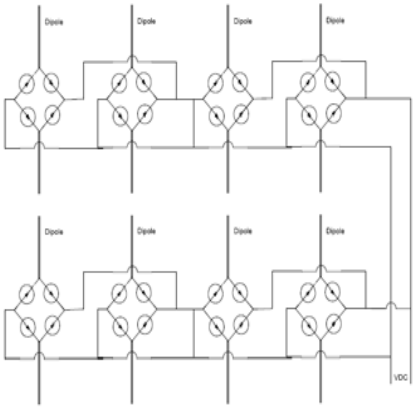


fig.8 Multiple rectifiers

However, this design will need to use multiple antennas separated by a certain distance. This problem can be solved by using a spiral antenna array, which is difficult to design.

5.2 High Gain Parabolic Antenna

Another way is to use a high gain parabolic antenna . This parabolic antenna will be able to transmit power from the transmitter with a much higher gain, and receive approximately seven times greater power than the 9 dBi Yagi antenna. The disadvantages of using this parabolic antenna are the size and the fixed direction of the antenna.

5.3 Improved Slot Antenna

The disadvantage of parabolic antenna will be overcome by using Slot antenna. It has high aperture efficiency (> 95%) and high power handling capability.
Slot antennas can be used for fixed stations, satellite ground stations and beacons. With proper mounting, a slot antenna can also be used for 'microwave mobile'. With a 16-slot total, the antenna can have 10-12 dBi gain.Slot antennas can be built from surplus waveguide sections, which will give an omnidirectional pattern and horizontal polarization. Because the antenna is of one-piece construction, it is rugged and can be built cheaply, requiring only access to a reasonably precise drill press or milling machine.

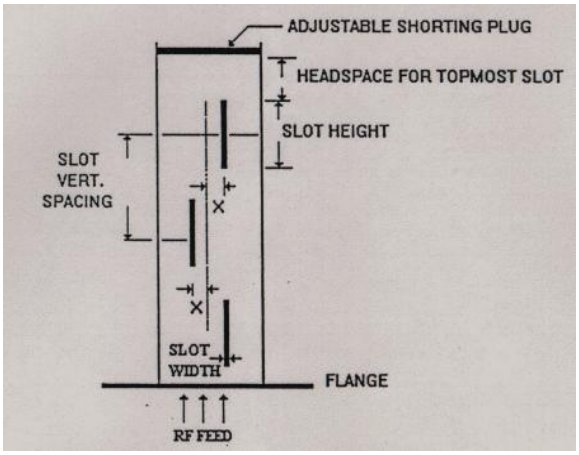
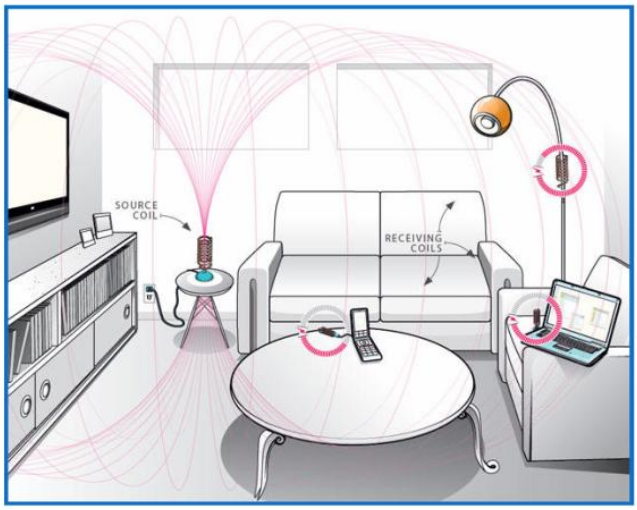


Fig.9 Slotted waveguide antenna

CONCEPTUAL ILLUSTRATION



VI. CONCLUSION

The transmission of power without wires is not a theory or a mere possibility, it is now a reality. The electrical energy

can be economically transmitted without wires to any terrestrial distance.From this review I have decided to work on designing of an antenna which increases output power to charge mobile phone without using wires.

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