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Wireless Power Transmission- A Novel Concept

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Abstract: In this paper we present the idea of wireless transmission of electricity. Though, in recent times through technological advancement, we have achieved a lot in the field of power generation, transmission and distribution but we also cannot deny of the fact that till now we suffer from a lot of losses that need to be minimized so that our resources that we utilize for the same reason can be put to a better use.
The idea of wireless transmission couples two concepts; one is the generation of power though solar plants situated in space and then transmitting that energy through the atmosphere with the help of wireless transmission, receiving the same energy on our stations on earth.

Keywords: TWT, MPM, ISM.

INTRODUCTION

With the increase demand of power in the recent times, our inclination has increased towards the non-conventional sources of Energy like solar, wind, tidal etc. But we have to admit that these sources have their limitations and cannot be applied everywhere.

Solar Energy has its certain limitations. One of which is of tropical and sub-tropical regions. So, the concept of wireless transmission has increased our chances of harnessing this source of energy.

If we could set solar panels in the space and then sunlight would be available at every instant and thus electricity can be generated most of the times(excluding the cases of eclipses). Another advantage that we get from this is that we can reduce the conductor cost and also the losses that are associated with them.

The main reason for power loss during transmission and distribution is the resistance of wires used for grid. Theefficiency of power transmission can be improved to certain level by using high strength composite overhead conductors and underground cables that use high temperature super conductor.

But, the transmission is still inefficient. According to the World Resources Institute (WRI), India's electricity grid has the highest transmission and distribution losses in the world – a whopping 27%. Numbers published by various Indian government agencies put that number at 30%, 40% and greater than 40%

COMPONENTS

There arenumerous components that would be used in the wireless power transmission plant. But some of them are very essential and thus those are discussed as follows.

Microwave Generator

The microwave transmitting devices are classified as Microwave Vacuum Tubes[6] (magnetron, klystron, Travelling Wave Tube (TWT), and Microwave Power Module (MPM)) and Semiconductor Microwave transmitters [1](GaAs MESFET, GaNpHEMT, SiC MESFET, AlGaN/GaN HFET, and InGaAS). Magnetron is widely used for experimentation of WPT.

Themicrowave transmission often uses 2.45GHz or 5.8GHz of ISM band. The other choices of frequencies are 8.5 GHz [2], 10 GHz [2] and 35 GHz [4]. The highest efficiency over 90% is achieved at 2.45 GHz among all the frequencies [4].

Transmitting Antenna

There are different sorts of antennas which can be used for reception. Some of them are- slotted wave guide antenna, microstrip patch antenna, and parabolic dish antenna. Based on the range and the geographical locations specific antennas can be used.

Rectenna

Conceived by W.C. Brown of Raytheon Company, rectenna was derived in the early 1960s.[4] 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.

The patch dipole antenna achieved the highest efficiency among the all. [4]The performance of various printed rectenna is shown in Table I. Schottky barrier diodes (GaAs-W, Si, and GaAs) are usually used in the rectifying circuit due to the faster reverse recovery time and much lower forward voltage drop and good RF characteristics.

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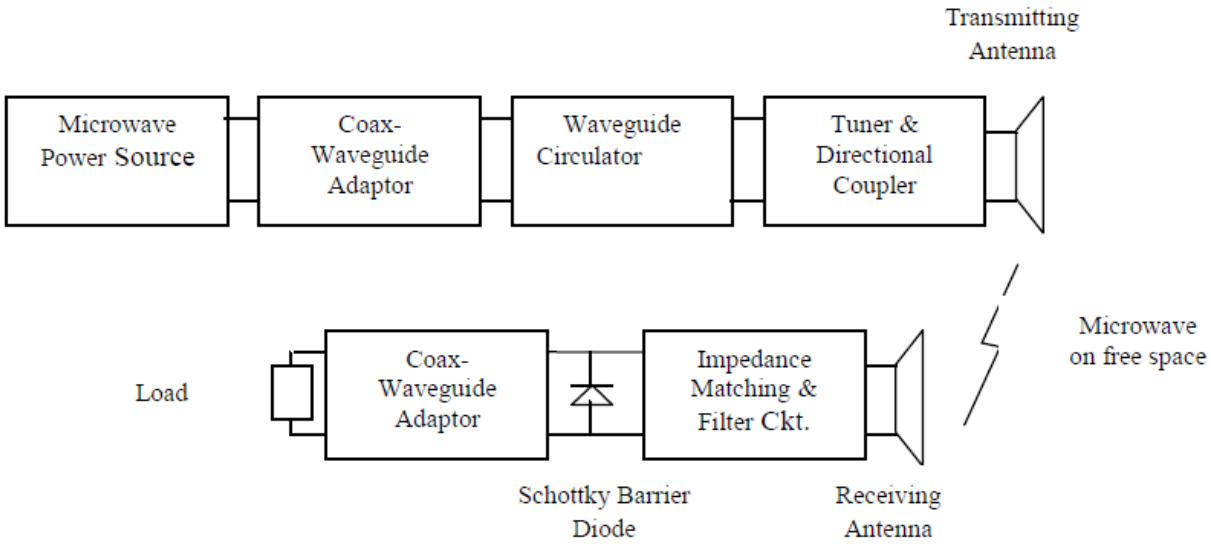

TECHNIQUES USED

Techniques used for wireless transmission of power are briefly classified into three depending on the distance between the transmitter and receiver.[3]

1. Short Range
2. Moderate range
3. Long range

- SHORT DAISTANCE TRANSMISSION

This method can be used up to few centimeters of the distance. We can implement the action used in transformer. The primary and secondary circuits are isolated but the transfer of energy takes place through electromagnetic induction.

So we can use the induction coupling principle top recharge some devices.

- MEDIUM DISTANCE TRANSMISSION

An efficient way to transfer power between coils separated by a few meters is by adding resonance.

As in case oftrumpet,by playing trumpet can cause nearby trumpet to begin vibrating.

Both trumpets have the same resonant frequency.

Induction can take place a little differently if the electromagnetic fields around the coils resonate at the same frequency. A capacitance plate, which can hold a charge, attaches to each end of thecoil and electricity travels through this coil, the coil begins to resonate. Its resonant frequency is a product of the inductance of the coil and the capacitance of the plates.

Electricity, traveling along an electromagnetic wave, can travelfrom one coil to the other as long as they both have the same resonant frequency.

In a short theoretical analysis they demonstrate that by sending electromagnetic waves around in a highly angular waveguide, evanescent waves are produced which carry no energy.

If a proper resonant waveguide is brought near the transmitter, the evanescent waves can allow the energy to travel.

As long as both coils are out of range of one another, nothing will happen, since the fields around the coils aren't strong enough to affect much around them. Similarly, if the two coils resonate at different frequencies, nothing will happen. But if two resonating coils with the same frequency get within a few meters of each other, streams of energy move from the transmitting coil to the receiving coil. Hence one coil can even send electricity to several receiving coils, as long as they all resonate at the same frequency.

- LONG RANGE WIRELES POWER

Whether or not it incorporates resonance, induction generally sends power over
relatively short distances. But some plans for wireless power involve moving
electricity over a span of miles. A few proposals even involve sending power to the
Earth from space. In the 1980s, Canada's Communications Research Centre created a
small airplane that could run off power beamed from the Earth. The unmanned plane, called the Stationary High Altitude Relay Platform (SHARP), was designed as a
communications relay. Rather flying from point to point, the SHARP could fly in
circles two kilometers in diameter at an altitude of about 13 miles (21 kilometers).
Most importantly, the aircraft could fly for months at a time..
(SHARP) unmanned plane.

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The secret to the SHARP's long flight time was a large, ground-based microwave
transmitter. The SHARP's circular flight path kept it in range of this transmitter. A
large, disc-shaped rectifying antenna, or rectenna, just behind the plane's wings
changed the microwave energy from the transmitter into direct-current (DC) electricity. [3]Because of the microwaves' interaction with the rectenna, the SHARP hada constant power supply as long as it was in range of a functioning microwave array.
Rectifying antennae are central to many wireless power transmission theories.

They are usually made an array of dipole antennae, which have positive and negative poles. [3]These antennae connect to shottkey diodes. Here's what happens:
1. Microwaves, which are part of the electromagnetic spectrum reach the dipole antennae.

2. The antennae collect the microwave energy and transmit it to the diodes.

3. The diodes act like switches that are open or closed as well as turnstiles that

let electrons flow in only one direction. They direct the electrons to the[4]

rectenna's circuitry.

4. The circuitry routes the electrons to the parts and systems that need them.

EFFICIENY

The efficiency of wireless power is the ratio between power that reaches the receiver and the power supplied to the transmitter.

Rectenna conversion efficiencies exceeding 95% have been realized. Power beaming using microwaves has been proposed for the transmission of energy from orbiting solar power satellites to Earth and the beaming of power to spacecraft leaving orbit has been considered[7].

Also Massachusetts Institute of Technology[5]researchers developing wireless power transmission have found that the system becomes more efficient as more devices are being powered.

Powering one device with one receiving coil results in less than 20% efficiency in power transfer. But with two devices and two receiving coils, the efficiency jumped to 30%.

The reason seems to lie in the fact that the two receiving coils, besides resonating with the sending coil, also resonate with each other.

That additional resonance strengthens the magnetic field and increases the power transfer efficiency.

ADVANTAGES

1. Wireless Power Transmission system would completely eliminates the existing high-tension power transmission line cables, towers and sub stations between the generating station and consumers and facilitates the interconnection of electrical generation plants on a global scale.

2. The cost of transmission and distribution become less and the cost of electrical energy for the consumer also gets reduced.

3. Loss in transmission is at negligible level in the Wireless Power Transmission.

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

5. The power failure due to short circuit and fault on cables would never exist inthe transmission and power theft would be not possible in case wireless transmission, hence more secure.

DISADVANTAGES

1. Capital Cost of implementation of wireless power transmission increases.
2. Interference in the microwave transmission channel.
3. Availability of spectrum.
4. During bad weather conditions the transmission efficiency decreases.

BIOLOGICAL EFFECT

The micro wave radiation will not affect the living world as the level of these radiation will never be higher than the dose received by opening the microwave.

CONCLUSION

Though solar energy is one of the beneficial power generating sources available to us but we must also admit the limitations and disadvantages associated with the same. Wireless power transmission helps us to reduce some of them. Not only it provides continuous power but also overcome some of problems such as availability of land and other issues.
Efficiency is considerably good from the point of researchers of MIT developing wireless power.
Studies have shown that it could help in the transmission to a great extent. Though by now it is just on the research

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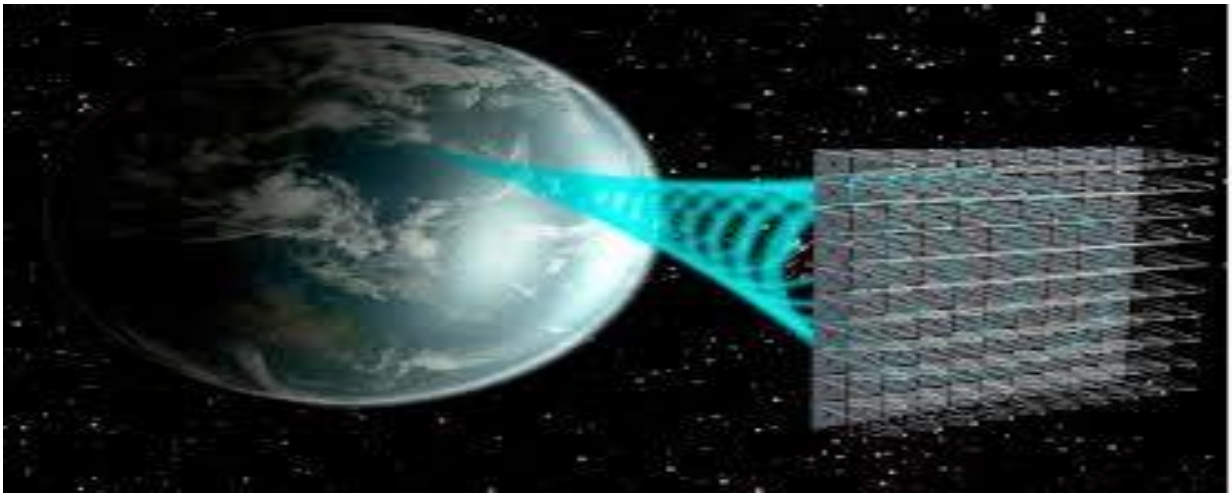
scale but in the future there are maximum chances that such method will be contributing to the energy requirement of the globe.



REFERENCES

[1] The Electrician (London), 1904
[2] http://cleantechindia.wordpress.com/2008/07/16/indiaselectricity-transmission-and distribution-losses
[3] IEEE PAPER "Wireless Power Transmission: An Innovative Idea" 1Vikash Choudhary, 2Satendar Pal Singh 3Vikash Kumar and 4Deepak Prashar
[4] "Wireless Power Transmission – A Next Generation Power Transmission System" by S. Sheik Mohammed, K. Ramasamy , T. Shanmuganantham
[5] MIT researchers boost efficiency of wireless power
[6] Massa, A. Massa, G. Oliveri, F. Viani, and P. Rocca; Oliveri, Giacomo; Viani, Federico; Rocca, Paolo (June 2013). "Array designs for long-distance wireless power transmission - State-of-the-art and innovative solutions". Proceedings of the IEEE **101** (6): 1464–1481.doi:10.1109/JPROC.2013.2245491.
[7]Jump up^ G. A. Landis, "Applications for Space Power by Laser Transmission," SPIE Optics, Electro-optics & Laser Conference, Los Angeles CA, 24–28 January 1994; Laser Power Beaming, SPIE Proceedings Vol. 2121, 252–255.