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# Wireless transmission of electricity through EM waves

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## ABSTRACT

***Modern problems require modern solutions. The most important thing in power engineering is the transmission of electricity from place to place. No. of disturbance can be produced form the wireless transmission as like the conventional transmission lines. This paper is going to present brief information about one possible way of wireless transmission of electricity, which could be useful for the near future. The true potential of wireless transmission has never witnessed. The potential of wireless transmission can change the perception of what we see in the field of electricity. Transmission of power from the source to load could be easy through the air without any interconnecting wires. In this particular paper using EM waves from magnetron as transmitter and using carbon nanotubes placed in the solar panel as receiver for the conversion of EM waves into electrical energy can be explained. By this proposed constructional we can transmit electricity where the world has never seen.***

***Keywords***— *Solar Cell Architecture, Solar Absorber, Solar Cell Performance, Solar Energetic Particles, Solar Irradiation, Electro-thermal Simulation, Electromagnetic Beams, Carbon Energy Transition, Carbon Fiber Reinforced Polymer, Nanocomposite Structure*

## 1. INTRODUCTION

Electrical energy is a part and parcel of life. Everything is interconnected with electrical energy. Transmission of power is as important as the generation and distribution of power. The demand for electricity increases day by day. Electricity is transmitted from one place to place and this increases if the demand for electricity increases. Transmission of electricity is taken place by the conductors, which are limited in nature. And still depending on the conductor can increase the cost of the material, apart from the cost there are power losses, which are present in the transmission of power, and we also face faults during the climate troubles. As these are the troubles involved\going to be involved wire transmission for this the alternative can be a wireless transmission, which can reduce the interruption in power transmission. One of the ways of transmission of electricity is by using microwaves.

We structured this paper of every detail of the transmission of electricity using Em waves as follows. After the introduction, it about the history followed by that we are going to explain the constructional and working magnetron and conversion of electricity by nanotubes.

## 2. HISTORY

The history of wireless power transmission, According to Maxwell's theory of electromagnetism, published in 1865, mentions about electromagnetic waves moving at a speed of light and conclude that light itself just such wave. In 1886 Hertz performed a successful experiment with pulsed wireless energy transfer. He produced an apparatus that produced and detected microwaves in the UHF region.

Tesla also performed experiments in the field of pulsed wireless energy transfer in 1899. His Magnifying Transmitter, an early type of tesla coil that measured 16 meters in diameter, could transmit tens of thousands of watts without wires. Tesla supposedly managed to light 200 lamps without wires, from 40kms away, although no documentation from Tesla's record was ever published. In 1897 he filed is patent for the wardenclyffe tower, which was meant to be a pilot plant for his "world wireless system " to broadcast energy around the globe. The facility was never fully operational and was not completed due to economic problems. History of magnetron: H. Gerdien invented An early form of the magnetron in 1910. Another form of magnetron tube, the split-anode magnetron, was invented by Albert Hull of General Electric Research Laboratory in 1920, but it achieved only a frequency of 30 kHz. Many teams through the 1920s and 1930s experimented with similar devices. Hans Erich Hollmann filed a patent on a design similar to the modern tube in 1935, but the more frequency-stable klystron was preferred for most German radars during World War II. An important advance was the multi-cavity magnetron, first proposed in 1934 by A. L. Samuel of Bell Telephone

Laboratories. However, Aleksereff and Malearoff in USSR developed the first truly successful example in 1936, which achieved 300 watts at 3 GHz (10 cm wavelength).

John Randall and Harry Boot at the University of Birmingham, England radically improved the cavity magnetron in 1940. They invented a valve that could produce multi-kilowatt pulses at 10 cm wavelength, an unprecedented achievement. The high power of pulses from the device made centimeter-band radar practical for the Allies of World War II, with shorter wavelength radars allowing detection of smaller objects from smaller antennas. The compact cavity magnetron tube drastically reduced the size of radar sets so that they could be more easily installed in night-fighter aircraft, anti-submarine aircraft, and escort ships.

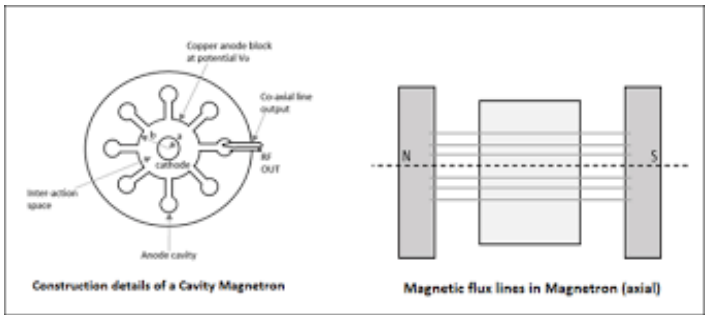
## 3. HOW IT WORKS

### 3.1 What is magnetron?

It works as the microwave oscillator, which produces the electromagnetic waves (radiation). Example: radio waves in the frequency range of as high of 300GHz to as low as 300kHZ.It is a large powered vacuum tube that generates the microwaves through the interaction of cathode and anode a magnetic field produced by permanent magnets which are located at the ends of the tube. In simple words, we can describe it as the grouping of many diodes with some powerful magnets. It is also called as the cross-field device.

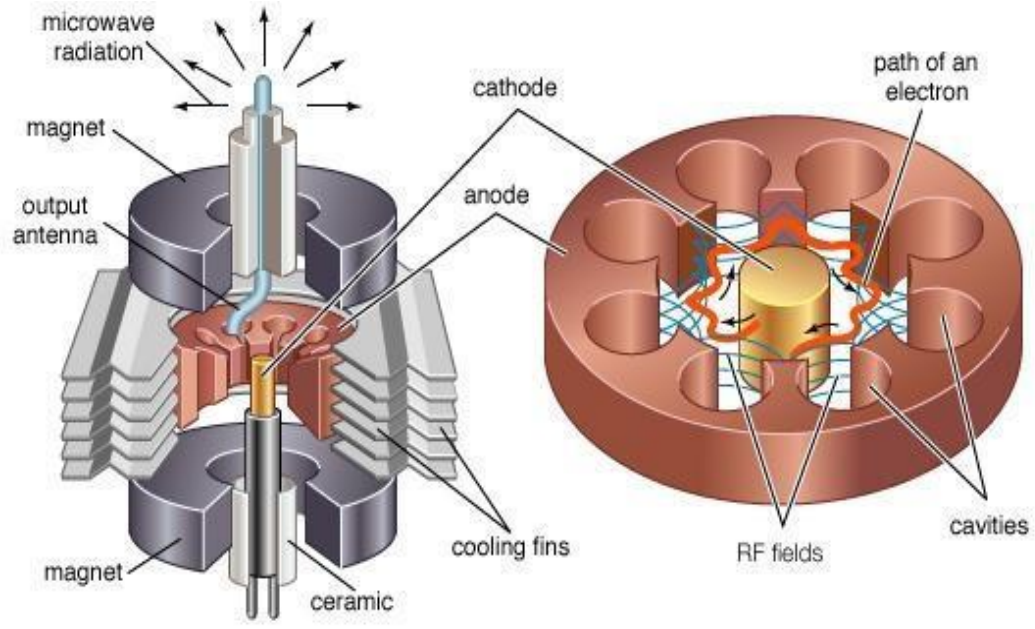
### 3.2 Construction of magnetron

Initially, the circular wounded coil (inductor) is connected to a voltage source, and it is placed parallel to another circular wounded coil (inductor), connect this 2nd inductor to the cathode. Magnetron consists of the cathode (which is a negatively charged electrode), which ejects the electrons towards the anode side. The cathode electrode placed such that it is surrounded by anode cavities. Powerful magnets are placed top and bottom side of the arrangement, which produce a powerful magnetic field in it.




### 3.3 Working principle of magnetron

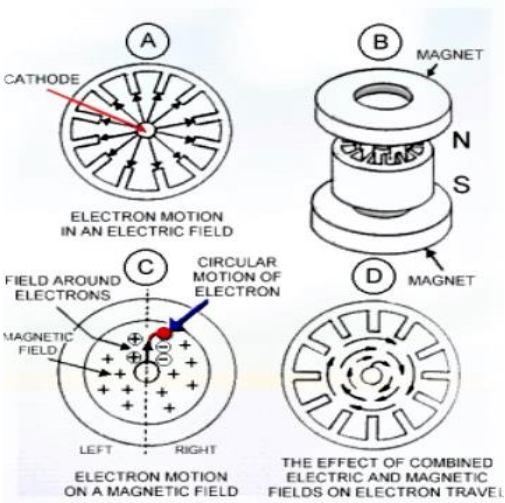
The magnetron work on the basic principle on fleming's left hand. Where the electrons flow experience a force due to the powerful magnetic field present across it. The electrodes and powerful magnets are placed in such a way that both electric and magnetic fields are perpendicular to each other. Due to this arrangement, the electron combines with anode following a curved path. The curved path is due to presence of both electric and magnetic field present inside.




$$F_e = q\ (V \times B)$$

In the absence of magnetic field the electron moves in a straight part.

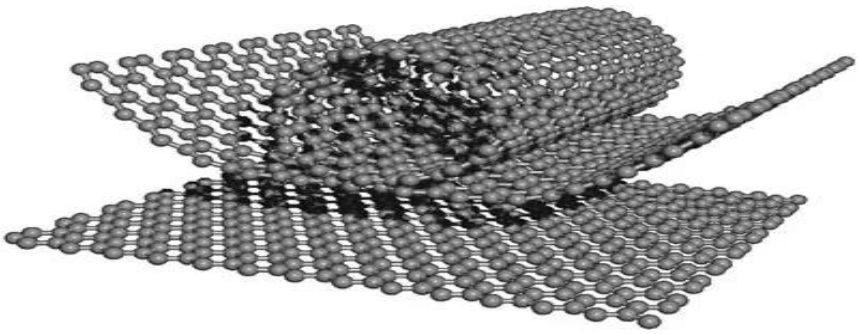



**3.4 Cavity Magnetron**

For the Generation of electricity, the use of cavity magnetron is best as it produces high-frequency EM waves. The cavity magnetron is designed with a cathode and filament when current flows through it electron is emitted from the filament this is called "thermionic emission" and the electron comes back to the cathode if no anode is present over it. But when an anode is present around it, the electrons interact with the anode and produces radiation "As accelerated particle produce radiation". But the time spent in interaction space is very less .A permanent magnet is placed across it which makes the electron curvature curved which increases the time spent by an electron in the interaction space. And the final structure is called "Hall Magnetron". The efficiency of hall magnetron can be further improved by placing cavities in the anode where it is further acts as a capacitor. The no .of cavities must be even and they should be charged with opposite polarities simultaneously the and the curved surface of the cavity acts as an inductor, by this, there is LC oscillation produced in the cavity, produces resonance of $1/2\pi\sqrt{LC}$. By connecting an antenna to the cavity EM waves are produced. And the remaining electrons form a spoke wheel inside the cavity. Since the charges in the cavity are oscillating the spoke wheel spin around. Here only one cavity is connected it is because as magnetic field lines generated by one cavity is still in link with other cavities so there is no need of another antenna this concept is called mutual coupling. The EM waves, which are generated, have short wavelength and high frequency.

## 4. NANOTUBES

The Nanotubes are made up of carbon, it is an allotrope of carbon. These are idyllically structured large molecules and it is arranged in such a way that all the hybridized atoms are in a hexagonal manner. The nanotubes consist of rolled-up of single-layered carbon atoms. The Carbon nanotubes are chemically bonded with sp2 bonds; they are so strong form of molecular interaction. They are constructed with a length to diameter ratio of 132,000,000:1. And the carbon nanotubes belongs to the fullerene structured family. Nowadays it is used in the field of science such as medical, electronics, optics, etc.



## 5. CONSTRUCTION INVOLVED IN NANOTUBES FOR GENERATION OF ELECTRICITY.

Tiles of carbon nanotubes are packed with gold which is surrounded by lithium hydride. when an EM wave radiates to these particles, the gold atom ejaculates a high-energy electron that passes through the carbon nanotubes and passes into lithium hydride. when the atom passes into lithium hydride which is an anode a photon is released.and this photon helps in the generation of electricity.

## 6. WHY CARBON NANOTUBES ARE IMPLANTED IN SOLAR CELL AND WHAT MAKES THE DIFFERENCE

In general, we know that the efficiency of the solar panel is 15-22% and with the sophisticated tech, we can make it to 29%.In the solar cell, it is not able to convert all the is all the Em wave (sunlight) on it into electricity. It is only a particular frequency light of the spectrum that is converted into electrical energy.

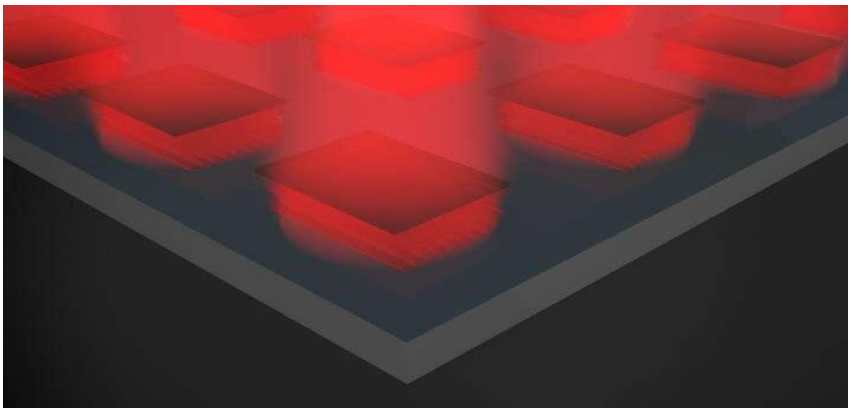
Light ($hc/\lambda$)----→Electricity

The solar panel generally uses a 250-2500nm range of light spectrum for the conversion of electricity. To overcome this problem we are going to implant the CNT's in the solar cells, by this way the CNT's traps the maximum amount of the light and convert it to the permissible ranges for the solar cell, by this way we can improve the efficiency of the solar panel to 80%.

Heat---→Light------→Electricity.

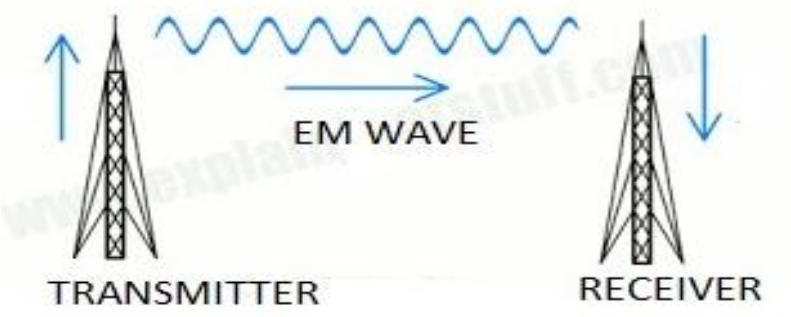
The CNT traps the ME waves for range 0.04GHZ to 0.1GHZ. As this range is in between the frequency range of radio waves the energy gets converted.



NOTE: we have to adjust the frequency of magnetron to match the trapping levels of nanotubes.

## 7. CONSTRUCTION OF THIS ARRANGEMENT

The transmitter should be placed on a pole and the receiver should be placed on the other pole through the EM wave the energy is transmitted from one to another without any physical contact.




## 8. CONCLUSION

We have been following the conventional transmission systems to transmit electrical energy till date. In order to overcome the demerits of the traditional transmission system, a wireless transmission system can be used that transmits power through air using EM waves. It transmits energy with no transmission and distribution losses. It would eliminate the need for an inefficient, costly and capital-intensive grid of cables, tower making transmission more economical. Therefore, we can adapt to the Wireless Power Transmission method as one of the possible ways to transmit energy.

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