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Wireless Charging Of Mobile Phones Using Microwaves

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Abstract:- *With the improving technology ,the communication is very important .The use of mobile phones is everywhere now ,but the main problem faced by mobile users is the burden of carrying the chargers along where ever they go as the charging of mobile batteries is important for the working of mobile phones and it is very cruel when your mobile phone getting off by the time you urgently need it . Without the battery, we cant use it so the battery charging is a problem here. Different cell phones has different battery life depending on the manufacturer .To overcome this problem we present a technology which would charge the batteries permanently without the need of chargers and independent of the producer ,a mobile receiver simply uses the microwaves from source and gets the mobile battery charged.*

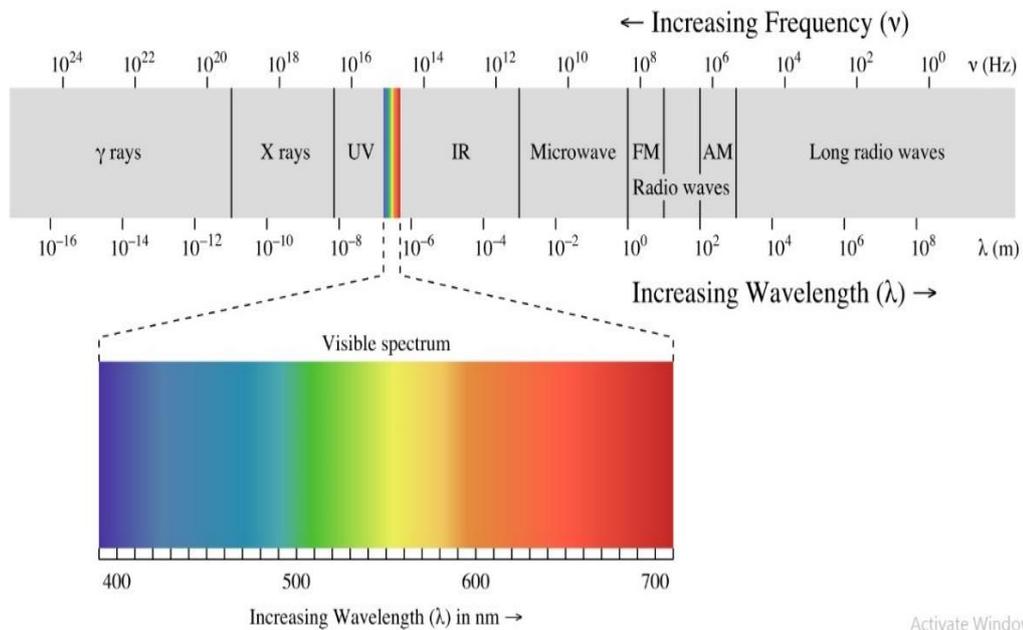
Keywords:- “Microwave Region” , “ Magnetron ” , “Schottky Diode ” , “Rectenna” , “ Sensory Circuit”

INTRODUCTION

The concept of transferring power without wires, however, has been around since the late 1890s. It was Nikola Tesla who dreamed of eliminating the need of wires for charging devices or powering devices. He was able to light electric bulbs wirelessly at his Colorado Springs Lab using electrodynamic induction (resonant inductive coupling). The thing which is important for this technology are the microwaves which are being applied in various other fields . A mobile user while having conversations sends along with the message signals ,the microwaves from transmitter using an antenna to the receiver using rectenna .At the receiving end these signal charges the receiver in charging his/her mobile phone without the need for cords or charging wires . So the understanding of microwaves is important.

Electromagnetic Spectrum and Microwaves

To charge mobile phones microwaves play a great role which are part of the electromagnetic spectrum. The electromagnetic spectrum which is the collection of energies , has been used here for even more broader application. The microwave region is one of the seven regions of electromagnetic (EM spectrum) is used for this purpose which fall in the range of the EM spectrum between radio waves and infrared waves . Microwaves are the invisible ,super-energetic, short wavelength waves. Microwave technology is used for this purpose because these waves are extensively used for point-to-point telecommunication(i.e non broadcast uses), because their small wavelengths allows conveniently sized antennas to direct them in narrow beams ,which can be pointed directly at the receiving antenna .This allows nearby microwave equipments to use the same frequency without interfering with each other ,as lower frequency radio waves do. Since they are more easily focused into narrower beams than radio waves allowing frequency reuse. Their comparatively higher frequencies allow broad bandwidth and high data transmission rates. Microwaves are good for transmitting information from one place to another because microwave energy can penetrate haze, light rain and snow, clouds, and smoke. Shorter microwaves are used in remote sensing. At much lower frequency, the wavelength is large enough that there is insignificant phase variation across the dimensions of the component. The longer microwaves, those closer to a foot in length, are the waves which heat our food in a microwave oven. Microwaves having wavelength of 1mm to 1m, refers to alternating current signal with frequencies between 300MHz and 300GHz. Microwave components are often distributed elements, where the phase of a voltage or current are changes significantly over the physical extent of the device because the device dimensions are on the order of the microwave wavelength.



Activate Window

Fig : Electromagnetic Spectrum

Designation	Frequency range
L Band	1 to 2 GHz
S Band	2 to 4 GHz
C Band	4 to 8 GHz
X Band	8 to 12 GHz
Ku Band	12 to 18 GHz
K Band	18 to 26 GHz
Ka Band	26 to 40 GHz
Q Band	30 to 50 GHz
U Band	40 to 60 GHz

Table: Microwave region

The microwave region is further divided into the following groups as shown in table. Here we have selected the license free 2.45 GHz ISM band for our purpose. The Industrial, Scientific and Medical (ISM) radio bands were originally reserved internationally for non-commercial use of RF electromagnetic fields for industrial, scientific and medical purposes. The ISM bands are defined by the ITU-T in S5.138 and S5.150 of the Radio Due to variations in national radio regulations. In recent years they have also been used for license-free error-tolerant communications applications such as wireless LANs and Bluetooth

DESIGN

To accomplish the task of wireless charging there should be a transmitting side which produces microwaves and a receiving side which receives these microwaves and gets charged. Based on this we have we have transmitting and receiving design.

Transmitter Design

The side in the process of wireless mobile charging which acts as the source for microwaves is the transmitting design. At transmitter there is a component called as magnetron . A magnetron is a diode vacuum tube actually behaves as an oscillator to produce microwaves. To help these microwaves to reach to the destination or receiving end , at transmitter side we use waveguide antenna which are kind of funnel which helps to beam out the waves into the air.



Fig: transmitter design and receiver design

Receiver Design

Receiving side process is little different as it is more than we think it would be . It receives the signals ,rectifies it and consume them to get the receiving end battery charged . At receiving end we need a sensor which detects the presence of message signals i.e while a subscriber is having conversations. The role playing component at the receiving end is the rectenna which is the term used for both the rectifier and the antenna .To understand the concept clearly how the transmitter produces microwaves and how the receiver receives them ,we consider the components of the system .

COMPONENTS OF THE WIRELESS CHARGING SYSTEM

The components make up a system, perform functions independently and collectively achieve the system objective. The various components are present both at the transmitting design and at the receiving design. The essential components at transmitting side are the Microwave generator (Magnetron) and the Transmitting antenna. The components at receiving end are the Rectenna and the sensory circuit.

Magnetron

Magnetron is a diode vacuum tube device that actually generates the microwaves at the transmitter. It has quite a lot in common with a cathode-ray tube that makes the pictures in an old style TV set, but the magnetron doesn't have the same purpose as TV. Instead of making pictures, it generates microwaves while the subscriber is on call conversation. The working of magnetron is important as it gives the reader to better understand the magnetron. There is a centrally placed metal rod in magnetron which is called the Cathode (yellow in color). The cathode is surrounded by a ring like structure called anode (red), When the magnetron is supplied the power or when it is switched on, the cathode boils off the electrons and zip across to the anode in straight lines (black arrows) much like the electron beams towards the phosphorus screen. The magnetron anode has holes or slots into it called the cavities or resonant cavities. A powerful magnet is placed underneath the anode to generate a magnetic field along the length of the tube parallel to the cathode. The presence of magnetic field makes the electrons feel a force and follow a curved path instead of a straight path (blue circle), whizzing around the space between anode.

Transmitting Antenna

The transmitting antenna (blue outer arrow) are the structures which convey the microwaves from transmitter to the sky from where receiving antenna catches these signals. The transmitting antenna is attached to the Tuner which matches the impedance of the transmitting antenna and the microwave source. Directional Coupler helps the signal to propagate in a particular direction. It spreads the microwaves in a space and sends it to the receiver side.

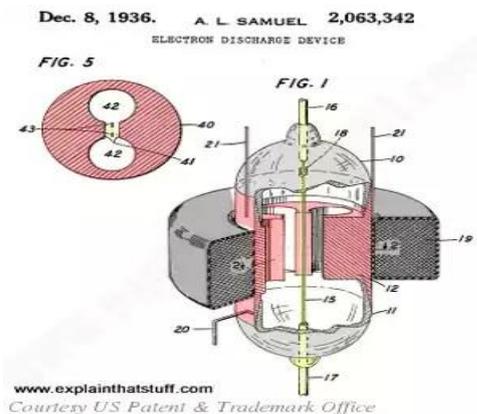


Fig : Magnetron

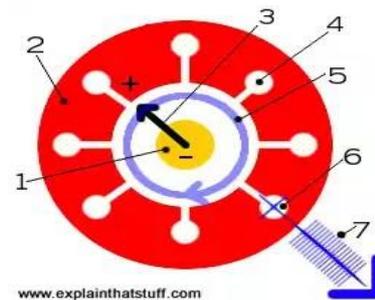


Fig : cross-section magnetron

Rectenna

At the receiving end we also need an antenna for receiving the microwaves from sky and the antenna used here is special type of antenna in the sense that it acts both as the antenna and as the rectifier as because of that it is termed as the Rectenna . It receives the microwaves as antenna and rectifies them as rectifier .The microwaves undergo power loss when propagating through air, the rectenna rectifies them at the receiver side to gain the power again .Also the important work done by a rectenna is to convert the current induced by the microwaves in antenna to direct current (DC). A dipole antenna and a diode (a schotkky barrier diode) make a rectenna. The rectification process should be efficient and exact ,so a rectifying element which costs less should be used .Diode used for rectification is a schotkky diode which is used particularly for having low turn on voltage ,low voltage drop and high speed .

Sensory Circuit

Sensor circuit is a sensor employed at receiver side which is required for the detection of message signals while on call because microwaves are available during that time and mobile phone has to get charged as long as the sensor detects the message signals. The sensor outputs the presence of message signals to the rectenna i.e. the sensor works in front of rectenna as an indicator of the presence of microwaves.

DRAWBACKS

This system needs a device rectenna which should be of molecular size otherwise the mobile devices would become bulky .The charging efficiency decreases with the increased distance between two sides .The charging devices have been found heating up quickly than the direct contact electricity. Also the microwaves are very harmful and can cause serious problem in humans like cataract. The work for improving the efficiency is going on.

PRACTICAL IMPLEMENTATION AND FUTURE

The magnetic inductive charging technologies spearheaded by the Qi consortium and smartphones like Nokia Lumia 920 have taken the stage. The wireless power consortium's inductive Qi standard is most likely to be familiar to you ,as it powers a range of smartphones accessories and products .The PMA standard which is now folded into AirFuel has also appeared in a number of smartphones. Wireless charging is also branching out from its roots to become even more useful to consumers .The technology has communication protocols built in to ensure the correct power transfer between devices .At home we can a single hub to save space ,money and conveniently charge all your devices from one hub wirelessly .

CONCLUSION

Thus this paper successfully demonstrates a novel method of using the power of the microwave to charge the mobile phones without the use of wired chargers. Thus this method provides great advantage to the mobile phone users to carry their phones anywhere even if the place is devoid of facilities for charging. A novel use of the rectenna and a sensor in a mobile phone could provide a new dimension in the revelation of mobile phone.

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