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Wireless Charging of Mobile Phones using Microwaves

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Abstract: With cell mobile phone devices becoming a basic part of life, the re-charging of cell mobile phone battery energy has always been a problem. The cell mobile phone devices differ in their talk-time and battery energy take a position by according to their producer and battery energy. All these mobile phones regardless of their producer and battery energy have to be put to renew after battery energy has cleared out. Primary of this current offer is to create the re-charging of the cell mobile phone devices individual of their producer and battery energy create. In this document a new offer has been created so as to create the re-charging of the cell mobile phone devices is done instantly as you discuss in your cellular phone! This is done by use of microwave ovens. The microwave indication is passed on from the transmitter along with the concept indication using special kind of antennas called placed trend guide aerial at a regularity is 2.45 GHz[1]. There are little improvements, which have to be created in the cellular devices, which are the addition of a indicator, a Rectenna, and a narrow. With the above installation, the need for individual rechargers for cell mobile phone devices is removed and makes asking for worldwide. Thus the more you discuss, the more is your cell mobile phone charged! With this offer the producers would be able to eliminate the talk-time and battery energy take a position by from their mobile phone specifications!

Keywords: Rectenna, Microwaves, Electromagnetic Spectrum, Transmitter, Antenna, Sensor.

1. INTRODUCTION

1.1 ELECTROMAGNETIC SPECTRUM[4]

As we know that when light shone through the prism it is divided in all the colors which we called rainbow prism and technically it is called visible spectrum. So light is made of photons. Photons are bundle of energy. Light is traveling at the speed of 3,00,000 km/hr[2] So when light hit an object coming on way it actually rebound from its surface. And it comes in to our eyes and we can see the object. But color of the object is seen by us is depend how much amount of energy is rebound as photons from the object.The electromagnetic spectrum is very useful to the human beings in very respects ,it helps in determine the various wavelength.

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

1.2 MICROWAVE REGION

Microwave wavelengths range from approximately one millimeter (the thickness of a pencil lead) to thirty centimeters (about twelve inches). In a microwave oven, the radio waves generated are tuned to frequencies that can be absorbed by the food. The food absorbs the energy and gets warmer. The dish holding the food doesn't absorb a significant amount of energy and stays much cooler. Microwaves are emitted from the Earth, from objects such as cars and planes, and from the atmosphere. These microwaves can be detected to give information, such as the temperature of the object that emitted the microwaves. Microwaves have wavelengths that can be measured in centimeters! The longer microwaves, those closer to a

foot in length, are the waves which heat our food in a microwave oven. 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. These microwaves are used for clouds and smoke, these waves are good for viewing the Earth from space Microwave waves are used in the communication industry and in the kitchen as a way to cook foods. Microwave radiation is still associated with energy levels that are usually considered harmless except for people with pace makers. [6]

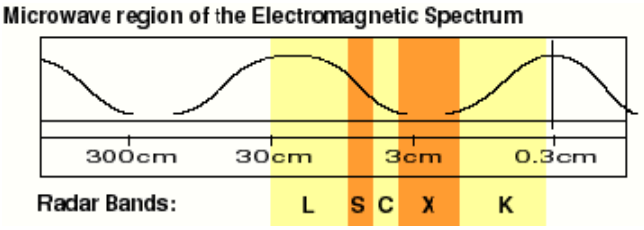

Figure1

I. The frequency selection is another important aspect in transmission. 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
II. 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:
III. 900 MHz band (33.3 cm) (also GSM communication in India)
IV. 2.45 GHz band (12.2 cm)
V. IEEE 802.11b wireless Ethernet also operates on the 2.45 GHz.

2. WIRELESS POWER TRASMISSION

Nikolas Tesla is the father of wireless electricity transmission. Who first transmitted electricity without wire. Magnetic induction is the main principle behind the wireless power transmission. As we put one coil carrying current through it, it creates a magnetic field near to it. And if we put other coil over there than it is induce by the first coil and it carry current from it! This is the simple principle behind it.

2.1 Wireless Power Transmission System

William C. Brown demonstrated how power can be transfer through space using microwaves. The concept of wireless power transmission is shown the block diagram. Which is attach to the Coax-Waveguide and here Tuner is the one which match the impedance of the transmitting antenna and the microwave source. Directional Coupler helps the signal to propagate in a particular direction. It spread the Microwaves in a space and sent it to the receiver side. It spread the Microwaves in a space and sent it to the receiver side.

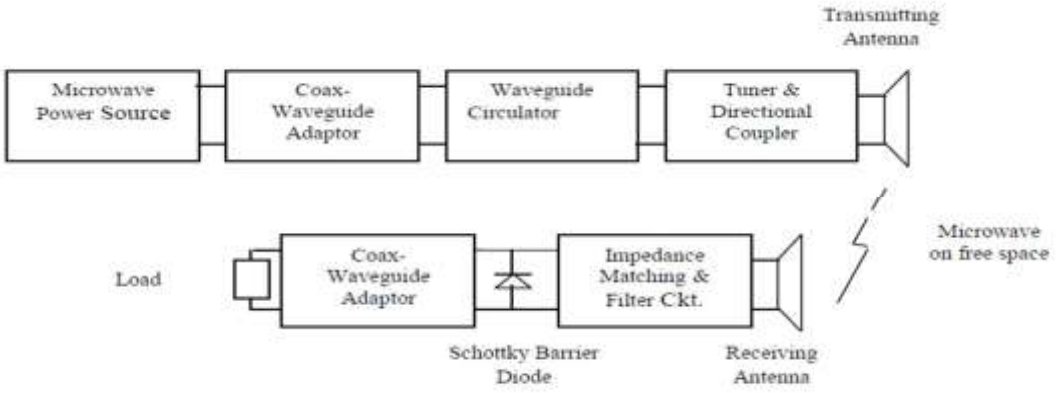

Figure 2

Here as we can see there are two part. One is transmitting part and the other is the Receiving part. At the transmitting end there is one microwave power source which is actually producing microwaves. Which is attach to the Coax-Waveguide and here Tuner is the one which match the impedance of the transmitting antenna and the microwave source. Directional Coupler helps the signal to propagate in a particular direction. It spread the Microwaves in a space and sent it to the receiver side. Receiver side Impedance matching circuit receives the microwave signal through

Recteena circuit. This circuit is nothing but the combination of filter circuit and the schottky Diode. Which actually convert our microwave in to the DC power!

2.2 Components of wireless power transmission system

The important components of this system are Microwave generator, Transmitting antenna, and the receiving antenna.

2.2.1 Microwave Generator

The Microwave Generator is the one which generates the microwave of preferred frequency. It generates the Microwave by the interaction of steam of elections and the magnetic field

2.2.2 Transmitting Antenna

There are many kind of slotted wave guide antenna available. Like parabolic dish antenna, microstrip patch antenna are the popular type of transmitting antenna.

2.2.3 Rectenna

A **rectenna** is a **rect**ifying an**tenna**, a special type of antenna that is used to convert microwave energy into direct current electricity. A simple rectenna element consists of a dipole antenna with an RF diode connected across the dipole elements. The current included by the microwaves in the antenna is rectified by the diode which powers a load connected across the diode. Schottky diodes are used because they have low voltage drop and high speed so that they have low power loss.

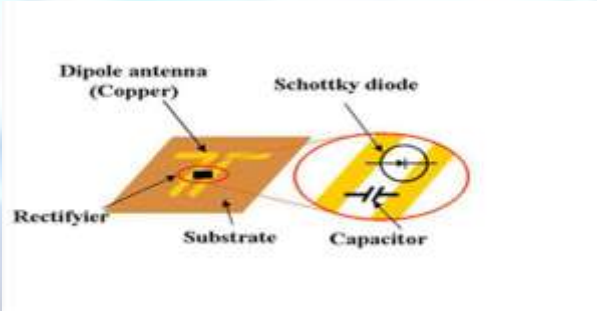

Figure 3

3. TRANSMITTER DESIGN

3.1 The Magnetron

The MAGNETRON (A), is a self-contained microwave oscillator that operates differently from the linear-beam tubes, such as the TWT and the klystron. View (B) is a simplified drawing of the magnetron. CROSSED-ELECTRON and MAGNETIC fields are used in the magnetron to produce the high-power output required in radar and communications equipment.

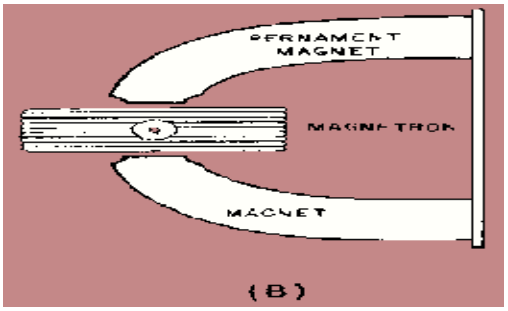

Figure 4

The magnetron is classed as a diode because it has no grid. A magnetic field located in the space between the plate (anode) and the cathode serves as a grid. The plate of a magnetron does not have the same physical appearance as the plate of an ordinary electron tube. Since conventional inductive-capacitive (LC) networks become impractical at microwave frequencies, the plate is fabricated into a cylindrical copper block containing resonant cavities that serve as tuned circuits. The magnetron base differs considerably from the conventional tube base. The magnetron base is short in length and has large diameter leads that are carefully sealed into the tube and shielded. The cathode and filament are at the center of the tube and are supported by the filament leads. The filament leads are large and rigid enough to keep the cathode and filament structure fixed in position. The output lead is usually a probe or loops extending into one of the tuned cavities and coupled into a waveguide or coaxial line. The plate structure is a solid block of copper.

The cylindrical holes around its circumference are resonant cavities. A narrow slot runs from each cavity into the central portion of the tube dividing the inner structure into as many segments as there are cavities. Alternate segments are strapped together to put the cavities in parallel with regard to the output. The cavities control the output frequency. The straps are circular, metal bands that are placed across the top of the block at the entrance slots to the cavities. Since the cathode must operate at high power, it must be fairly large and must also be able to withstand high operating temperatures. It must also have good emission characteristics, particularly under return bombardment by the electrons. This is because most of the output power is provided by the large number of electrons that are emitted when high-velocity electrons return to strike the cathode. The cathode is indirectly heated and is constructed of a high-emission material. The open space between the plate and the cathode is called the INTERAC TION SPACE. In this space the electric and magnetic fields interact to exert force upon the electrons.

3.2 Receiver Design

The basic addition to the mobile phone is going to be the rectenna. A rectenna is a rectifying antenna, a special type of antenna that is used to directly convert microwave energy into DC electricity. Its elements are usually arranged in a mesh pattern, giving it a distinct appearance from most antennae. A simple rectenna can be constructed from a Schottky diode placed between antenna dipoles. The diode rectifies the current induced in the antenna by the microwaves. Rectennae are highly efficient at converting microwave energy to electricity. In laboratory environments, efficiencies above 90% have been observed with regularity. Some experimentation has been done with inverse rectennae, converting electricity into microwave energy, but efficiencies are much lower--only in the area of 1%. With the advent of nanotechnology and MEMS the size of these devices can be brought down to molecular level. It has been theorized that similar devices, scaled down to the proportions used in nanotechnology, could be used to convert light into electricity at much greater efficiencies than what is currently possible with solar cells. This type of device is called an optical rectenna. Theoretically, high efficiencies can be maintained as the device shrinks, but experiments funded by the United States National Renewable Energy Laboratory have so far only obtained roughly 1% efficiency while using infrared light. Another important part of our receiver circuitry is a simple sensor. This is simply used to identify when the mobile phone user is talking. As our main objective is to charge the mobile phone with the transmitted microwave after rectifying it by the rectenna, the sensor plays an important role.

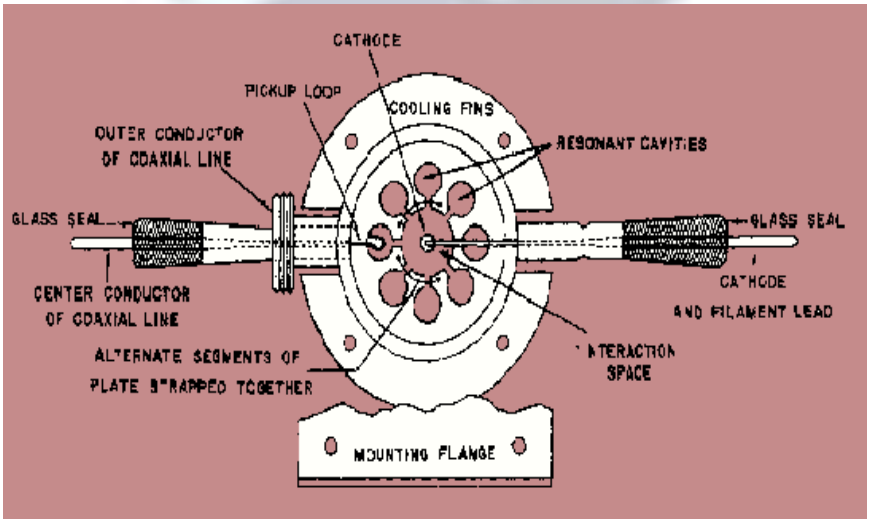

Figure 5

The whole setup looks something like this.

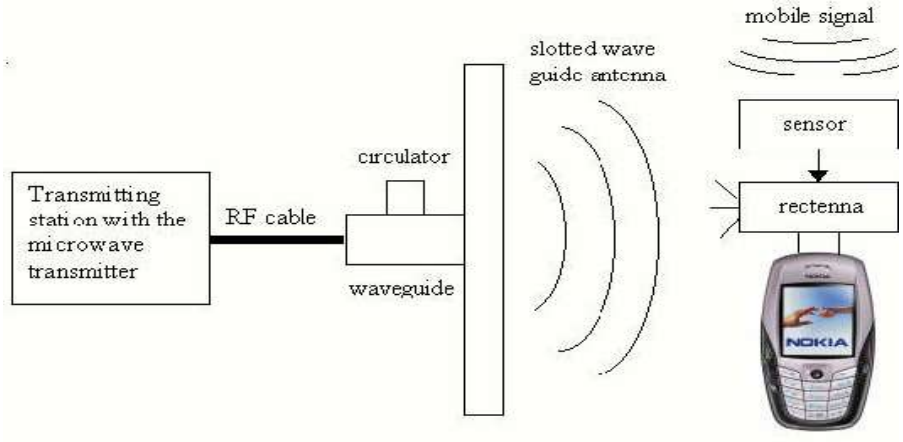

Figure:6 Mobile Transmission

3.3 The Process of Rectification:

Microwave can travel through the media but it also lose some energy. So our key objective is to rectify the circuit our objective is to rectify the waves at the low cost. And also we have to make the detection more sensitive. As we know that bridge rectification is more efficient than the single diode. And we use the shotky diode to get the batter impedance.

4. SENSOR CIRCUITRY

The sensor circuitry is a simple circuit, which detects if the mobile phone receives any message signal. This is required, as the phone has to be charged as long as the user is talking the Thus a simple F to V converter would serve our purpose. In a India the operating frequency of the mobile phone the operators is generally 900MHz or 1800MHz for the GSM system for the mobile communication. Thus the usage of simple F to V converters would act as switches to trigger the rectenna circuit to on. A simple yet powerful F to V converter is LM2907. Using LM2907 would greatly serve our purpose. It acts as a switch for triggering the rectenna circuitry. It spread the Microwaves in a space and sent it to the receiver side. The magnetron base differs considerably from the conventional tube base. The magnetron base is short in length and has large diameter leads that are carefully sealed into the tube and shielded. The cathode and filament are at the center of the tube and are supported by the filament leads. The magnetron base is short in length and has large diameter leads that are carefully sealed into the tube and shielded. The cathode and filament are at the center of the tube and are supported by the filament leads.. The magnetron base is short in length and has large diameter leads that are carefully sealed into the tube and shielded. The cathode and filament are at the center of the tube and are supported by the filament leads.The general block diagram for the LM2907 is given below.

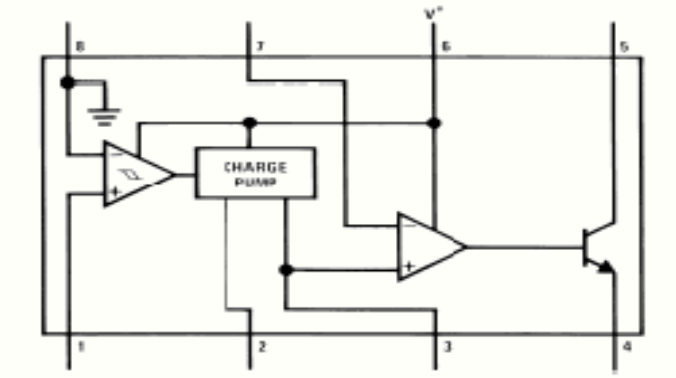

Fig 7: Sensor Circuitary

Thus on the reception of the signal the sensor circuitry directs the rectenna circuit to ON and the mobile phone begins to charge using the microwave power.

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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