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Wireless Charging of Mobile Phones using Microwave

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***Abstract*— Mobile phone has become a very important and basic part of our day today life. It has become the fastest and easiest medium of communication. The mobile phones vary in their manufactures and batteries. After the battery is drained out we have to put the mobile phone for recharging. But it is a hectic task to carry the charger of mobile phones everywhere while travelling or mobile phone gets off when we urgently need it. Hence we are proposing "Wireless Charging of Mobile phones using Microwave" means recharging mobile wirelessly. This is done using Microwave. The microwave is sent with the message by the transmitter using antenna. For this we have to make minimum addition in our mobile handsets such as a sensor, a rectenna and a filter.**

Keywords—Microwave generator, Rectenna, Rectification circuit, Sensor circuitry.

I. INTRODUCTION

Microwaves are the radio waves ranging from as long as one meter to as short as one millimetre. The prefix "micro" in microwave doesn't mean a wavelength in micrometer range it means that the microwaves are "small" compared to the waves used in radio broadcasting. Microwave technologies are used for point to point telecommunication. They are suitable for these since they are more easily focused into narrow beams than radio waves. [1]

The mobile phones people are using now a day vary in their talk time and battery standby according to their manufacturer and the batteries have to put to recharge after the battery is drained out. Microwave signal are used for mobile recharging. The microwave signal is transmitted from transmitter along with the message signal using special kind of antenna at a frequency of 2.45GHz. The advantage of this device is that it can wirelessly charge up batteries which can save time and money in a long run. [2]

A minimum addition is required for mobile handset such as a sensor, a rectenna and a filter. By adding these things recharge of mobile phones can be done using microwave while talking on mobile phones.

II. FUNCTIONING

A. Wireless Power Transmission:

The father of wireless electricity transmission 'Nikolas Tesla' first transmitted electricity without wire. Wireless power transmission works on the principle of magnetic induction. Putting one coil carrying current through it, it creates a magnetic field near to it. And by putting other coil over there than it is induce by the first coil and it carry current from it.

1. Wireless power transmission system:

The principle of how power can be transfer through space was introduced by William C. Brown. This principle is shown in the fig (1) below consisting of two parts one the transmitting part and the second is the receiving part.

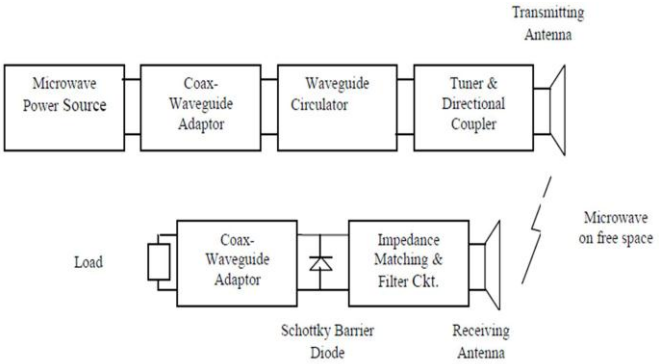

Fig (1): Transmitter and Receiver

B. Components of Wireless Power Transmission System:

There are mainly three components in the power transmission system they are: Microwave generator, Transmitting antenna and the Receiving antenna.

1. Microwave generator:

Microwave generator, generates the microwave of preferred frequency. It generates the microwave by interaction of steam of election and the magnetic field. Microwave

generator covers a much wider frequency from less than 1MHz to atleast 20MHz.

2. Transmitting antenna:

Transmitting antenna is used for transmission of signal through free space to the device. There are many kind of slotted wave guide antenna available for transmission. Such as parabolic dish antenna, microstrip patch antenna. These antennas are the popular transmitting antenna.

3. Rectenna:

A rectenna shown in fig (2) below is a rectifying antenna a special type of antenna that is used to convert microwave energy into direct current electricity. Its elements are arranged in a mesh pattern making it different from other antenna. A simple rectenna elements consist of a dipole antenna with an RF diode connected across the dipole elements.

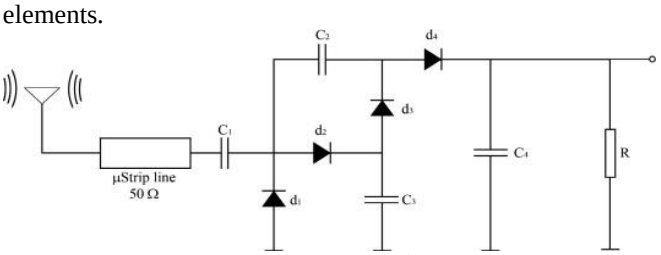

Fig (2): Block diagram of rectenna

The current included by the microwave in the antenna is rectified by the diode which powers a load connected across the diode. Schottky diodes are used here because they have low voltage drop and high speed so that they have low power loss.

Rectenna are highly efficient at converting microwave energy above 90% have been observed with regularity.

III. System Design

The block diagram of full operation of Wireless Charging of Mobile phones using Microwave is shown in below fig (3). The System Design of a Wireless Charging of Mobile Phones using Microwave mainly consist of four parts such as: transmitter design, receiver design, the process of rectification and the sensor circuitry.

A. Transmitter Design:

Typically a transmitter design includes generation of a carrier signal, which is normally sinusoidal, optionally one or more frequency multiplication stages, a modulator, a power amplifier, and a filter and matching network to connect to an antenna. A very simple transmitter might contain only a continuously running oscillator coupled to some antenna system. The Magnetron is a self-contained microwave oscillator that operates differently from the linear beam tubes. The magnetron is classified as diode because it has no grid.

Magnetron behaves as oscillator to produce microwaves. It can be done by putting magnet between the resonating chambers which is the centre of the oscillator. These resonating chambers are named as anode in the magnetron. When electrons come out from the cathode and go direct towards the anode, it passes through the magnetic field. It starts circulating in the resonating cavity and start producing waves according to its frequency. And the generated RF signal by this flow outside of the chamber.

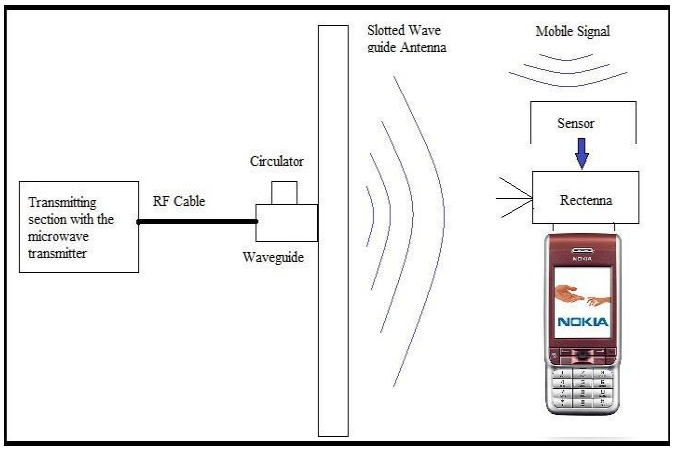

Fig (3): Block diagram of Full Operation

B. Receiver Design:

At the receiver side we have to add the rectenna and a sensor. Rectenna are very powerful to convert the microwave into electricity. The size of the rectenna can be reduced by using the nanotechnology. As we know here we are going to charge our mobile phone as we are talking so we are going to add a sensor at the receiver side. Here the sensor is used to detect whether the phone is using a microwave or not.

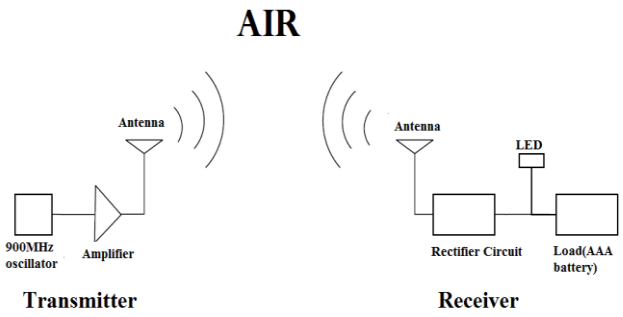

Fig (4): Transmitter and Receiver Design

C. The Process of Rectification:

Microwave energy transmitted from space to earth apparently has the potential to provide environmentally clean electric power on a very large scale. Microwave can easily through the media but it has also loses some energy. Hence our key objective is to rectify the circuit and to rectify the

waves at the low cost and also make the detection more sensitive. The bridge rectification is more efficient than the single diode so we use this for the better performance. We use the shottky diode to get the better impedance.

D. Sensor Circuitry:

It is a simple circuit which detects whether the mobile phone is receiving any message signal or not. It is very important as the phone has to be charged as long as the user is talking. Thus a simple frequency to voltage (F to V) convertor is used for this purpose. In India the operating frequency of the mobile phone is generally 900MHz to 1800MHz for mobile communication. Thus we use a simple F to V convertor which acts as a switch to trigger the rectenna circuit. So on the reception of the signal the sensor circuitry directs the rectenna circuit and it gets on and hence our mobile phone begins to charge using the microwave power.

IV. Limitation

1. The mobile handset should have additional device "Rectenna" which would make it bulky and hence device size up to molecular level is essential.
2. The transmitter and receiver also should be very powerful device as the distance increase the charging is very slower
3. Wireless transmission of the energy causes some drastic effects to human body because of its radiation.

V. Inductive Charging

Though some Handsets on the market currently provide wireless charging, the technology is not exactly same as mentioned here. For charging, phones are required to keep near the Charging Plate. The below fig (5) shows the charging of mobile phones using the inductive charging process.

A transmitter coil is positioned at the bottom (L1) and the receiver coil (L2) is situated at the top and these coils are embedded into different electrical devices. L1 would be the Nokia Wireless Charging Plate and L2 would be the Nokia Lumia 920, for example. In coming days, Microwave might fix various issues in the current system. Fig (6) shows some of the mobile phones using power transfer charging system.

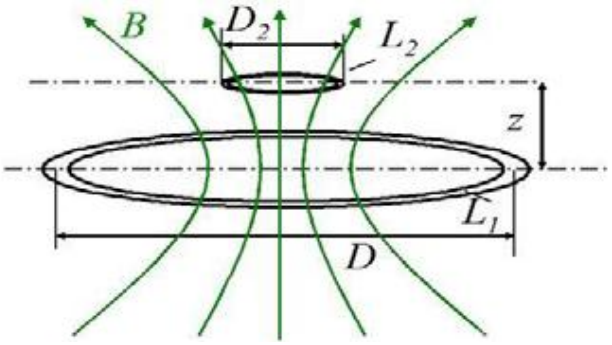

Fig (5): Existing Power Transfer System

Nokia Lumia 920(A & AT) HTC Windows Phone AX Nokia Lumia 882

Fig (6): Mobile Phones Using Power Transfer Charging System.

VI. Conclusion

In the modern era of Science and Technology we don't have enough time to constantly be at one place and recharge our mobile phones or recharge our phone when we urgently need it while travelling. This paper successfully shows a novel way of using the power of the microwave to recharge our mobile phones without using wired chargers. Also 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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