WIRELESS CHARGING OF MOBILE PHONES USING MICROWAVES

Dimple[1], Divyanshi Singh[2]
UG, [1,2] Department of Electronics and Communication Engineering,
Raj Kumar Goel Institute of Technology for Women, UP (India)

ABSTRACT

In the modern era mobile phones are basic need of every person as these are the fastest and the easiest medium of communication. The charging of mobile phone batteries has always been a problem. Battery lifetime is dependent of the manufacturer Company and also price of phone. Many people complain that their phone's battery don't have long life-time and they have to charge it several times in a day. To overcome this problem wireless charging of mobile phones using microwaves is a very important and useful technique. With this technique you can use your mobile phone without thinking about the battery stand by. This technique works on microwaves. Microwave is sent with the message by the transmitter using antenna at the frequency of 2.45GHz. There are some additions in mobile phone to apply this technique as a sensor, a rectenna circuit and a filter. With this technique the need for separate chargers for mobile phones is eliminated and makes charging universal. Thus the more you talk, the more is your mobile phone charged.

Keywords: Electromagnetic spectrum, Microwave region, Microwave generator, Rectenna, Sensor circuitry

I INTRODUCTION

There are two main concepts which are the base of this technique, first one is Electromagnetic Spectrum and second is Microwave Region.

1.1 Electromagnetic Spectrum

When white light is shone through a prism it is separated out into all the colors of the rainbow this is called the visible spectrum. According to some physicians light consists of tiny particles called photons. Photons are bundle of energy. The speed of light is about 300,000,000 meters per second as light hit something that means it may be bounce off, go right through or get absorbed. If they bounce off something and then go into your eye you will see the thing they have bounced off. Some things will let them go through these materials are transparent. Black objects absorb the photons so you should not be able to see black things. But some theory can't be explained by taking the light as the bunch of photos.

So some physicians assume that it is some kind of wave. The visible spectrum is just one small part of the electromagnetic spectrum. They define an electromagnetic spectrum of different wave lengths which is divided in two parts. One is electric field and the other is magnetic field. The two fields are at right angles to each other.

1.2 Microwave Region

Microwaves are the Radio wave which has the wave length range of 1 mm to 1 meter and the frequency is 300MHz to 300GHz. Each and every object on the earth absorb different amount of microwave energy. 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. Microwaves are good for transmitting information from one place to another because microwave energy can penetrate haze, light rain and snow, clouds, and smoke. Microwave waves are used in the communication industry and in the kitchen as a way to cook foods. According to the range of frequencies there are different frequency bans which are shown below:

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 Bnad	30 to 50 GHz
U Bnad	40 to 60 GHz
V Band	46 to 56 GHz
W Band	56 to 100 GHz

The frequency selection is another important aspect in transmission. Here we have selected the license free 2.45 GHz ISM band for our purpose. As Industrial, Scientific and Medical (ISM) some bands are reserve for some specific purpose. So we can't use it. Here S band 2.45 GHz is freely available band which we can use for experiment.

II WIRELESS POWER TRASMISSION

Nikolas Tesla first transmitted electricity without wire and known as the father of wireless electricity transmission. Wireless power transmission works on the principle of Magnetic induction. 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 principle of magnetic induction.

2.1 Wireless Power Transmission System

William C. Brown gives the principle that how the power can be transfer through space using microwaves. This principle of wireless power is shown by the block diagram below:

The block diagram shown above in fig 1 consist of two parts 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 Tuner is the one which match the impedance of the transmitting antenna and

the microwave source. Directional couplers are used for the propagation of signal in a particular direction. It spread the Microwaves in space and sent it to the receiver side.

Receiver side Impedance matching circuit receives the microwave signal through Rectenna circuit. This circuit is nothing but the combination of filter circuit and the schottky Diode. The basic work of this circuit is to convert microwave energy into the DC power.

2.2 Components of wireless power transmission system

There are three 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.

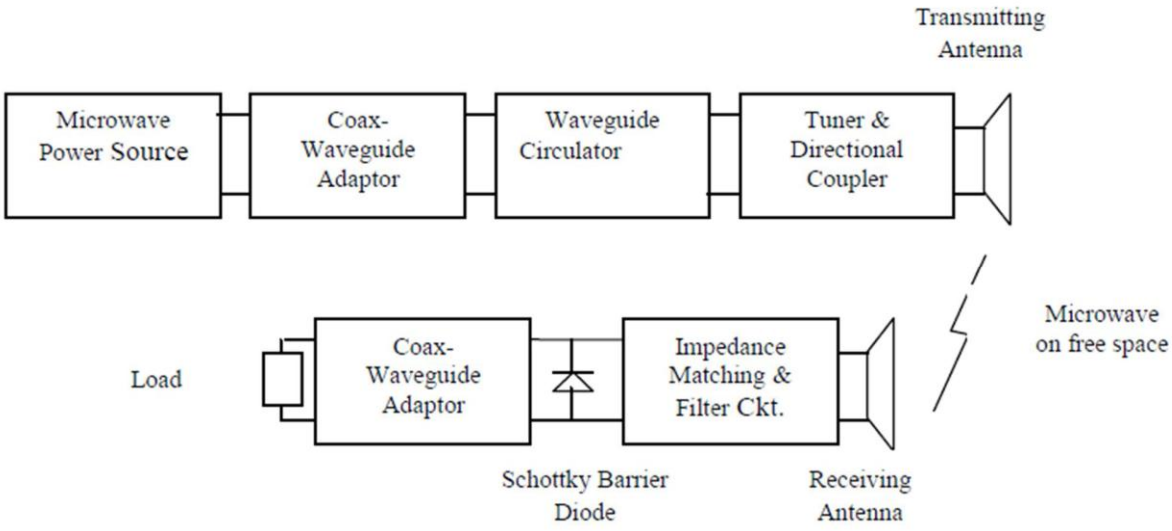

Fig 1: Block diagram of wireless power transmission system

2.2.2 Transmitting Antenna

Transmitting antenna are use to transfer the signal from free space to the device. There are many kind of slotted wave guide antenna available. Like parabolic dish antenna, microstrip patch antennas are the popular type of transmitting antenna.

2.2.3 Rectenna

A **rectenna** is a **rect**ifying ant**enna**, a special type of antenna that is used to convert microwave energy into direct current electricity shown in fig 2.

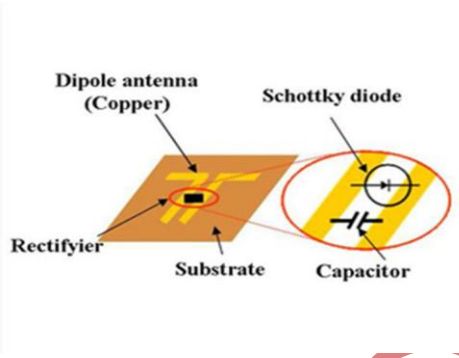

Fig 2: Rectenna system

Its elements are usually arranged in a mesh pattern, giving it a distinct appearance from most antennae. 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. Rectenna are highly efficient at converting microwave energy to electricity. In laboratory environments, efficiencies above 90% have been observed with regularity.

III SYSTEM DESIGN

The system designing of wireless charging of mobile phone using microwaves mainly consist of four parts as transmitter design, receiver design, the Process of Rectification, sensor Circuitry.

3.1 Transmitter design

A magnetron is a diode vacuum tube with filament in which filament act as the cathode shown in fig 3. Magnetron is actually behaved as an oscillator to produce microwaves. It can be done by putting magnet between the resonating chambers which is the center of the oscillator. These resonating chambers are named as anode in the magnetron.

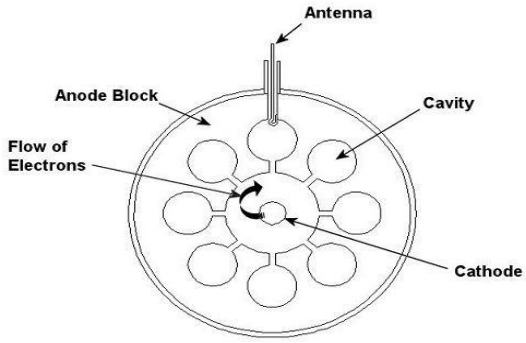

Fig 3: Magnetron

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.

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. Actually the size of rectenna can be reduce using the Nano technology.

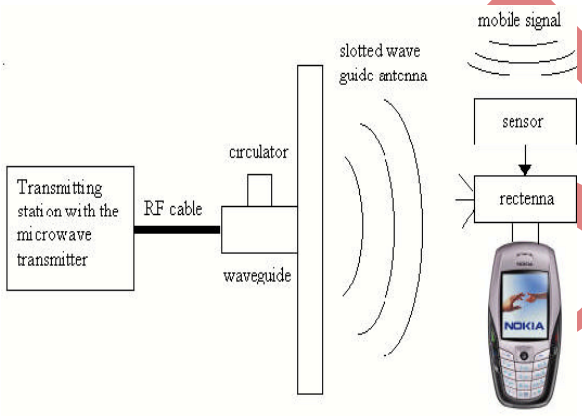

Fig 4 Whole set up for charging

We also have to add a sensor at receiver side. As we know we are going to charge the phone while a person is talking. So here sensor is used to detect wither the phone is using microwaves or not.

3.3 The Process of Rectification

Microwave can easily travel through the media but it also loses some energy. So our key objective is to rectify the circuit and 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 we use this for the better performance. We use the shottky diode to get the batter impedance.

The Schottky barrier diode is a ideal diode, such as for a 1 ampere limited current PN interface. Another advantage of the Schottky barrier diode is a very low noise index that is very important for a communication receiver; its working scope may reach20GHz.

3.4 Sensor Circuitry

The sensor circuitry is a simple circuit, which detects if the mobile phone receives any message signal. This is very important as the phone has to be charged as long as the user is talking. . Thus a simple frequency to voltage converter would serve our purpose. And this converter would act as switches to trigger the rectenna circuit to on.

So when our phone is receiving microwave signal it make the recteen circuit on and charge the battery. Here in India

the operating frequency of the GSM is 900 MHz to 1800 MHz. We can use LM2907 for F to V conversion. The general block diagram for the LM2907 is given below in fig 5.

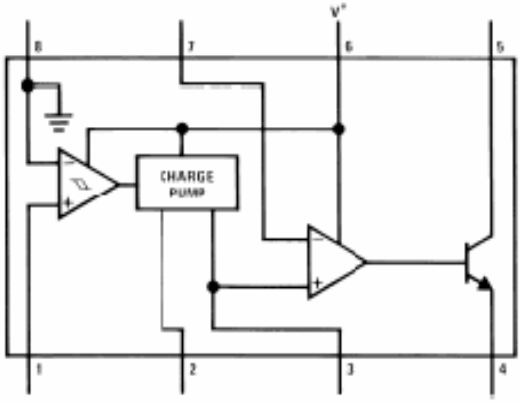

Fig 5 Block diagram of LM2907

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.

IV CONCLUSION

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. The main advantage of this technique is this that the mobile phone users to carry their phones anywhere even if the place is devoid of facilities for charging.

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