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WIRELESS MOBILE CHARGING USING MICROWAVE

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ABSTRACT

Mobile phones have become a part of our daily life. But these mobile phones especially the smart phones have poor battery life and hence require constant recharging. In our busy schedule it is not possible to find a power outlet wherever we go. This paper proposes an idea to charge the mobile phone without connecting it to its wired charger, with help of microwave radiations. The microwave signal is transmitted using a special kind of antenna at the frequency of 2.45GHz. In order to implement this method all we need to do is add a sensor, a rectenna and a filter to the mobile phone. The advantage of this device is that it can wirelessly charge up the batteries which can save time and money in a long run for the general public.

KEYWORDS: **Electromagnetic spectrum, Microwaves, Microwave Generator, Transmitter, Receiver.**

II. INTRODUCTION

A. ELECTROMAGNETIC SPECTRUM

The range of all possible frequencies of the electromagnetic radiation is called as the electromagnetic spectrum. It extends from very low frequencies to very high frequencies. These electromagnetic waves consist of both electric field and magnetic field. They have three main properties: frequency f, wavelength λ and photon energy E.

$E=hc/\lambda$.

The electromagnetic spectrum contains the following classification of frequencies;

- Radio Frequency (< 3 GHz)
- Microwave Frequency (3GHz – 3THz)
- Infrared Frequency (3THz – 43 PHz)
- Visible Frequency (43 PHz – 75PHz)
- Ultraviolet Frequency (75PHz – 30EHz)
- X-Rays (30EHz-3×10^17Hz)
- Gamma Rays (> 3×10^19Hz)

B. MICROWAVES

Microwaves are radio waves, with wavelength ranging from 1mm to 1m and their frequencies lie between 300 MHz and 300 GHz. The microwave technology is used for point to point communication, as they can be easily focused into narrow beams. They allow broad bandwidth and high data transmission rates. The energy levels of microwave radiations are considered to be harmless.

- L band (1-2 GHz)
- S band (2-4 GHz)
- C band (4-8 GHz)
- X band (8-12 GHz)
- Ku band (12-18 GHz)
- K band (18 -26.5 GHz)
- Ka band (26.5-40 GHz)
- Q band (33-50 GHz)
- U band (40-60 GHz)
- V band (50-75 GHz)
- W band (75-110 GHz)
- F band (90-140 GHz)
- D band 110-170 GHz)

For the purpose of wireless mobile charging we are going to use the S band of the microwave spectrum.

C. WIRELESS POWER TRANSMISSION

Wireless power transmission as the name indicates, refers to the transfer of electrical power from source to the device without using solid wires. It works on the principle of electromagnetic induction.

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Wireless power falls under two categories:
Non-radiative technique
Radiative technique

NON-RADIATIVE TECHNIQUE: Inductive coupling between coils of wire produced by magnetic field is used to transfer power over short distances or capacitive coupling between electrodes induces electric field by which power can be transferred.

RADIATIVE TECHNIQUE: In this type power is transmitted by electromagnetic radiations over long distances which have to be focussed on the receiver.

Brown's concept of power transmission

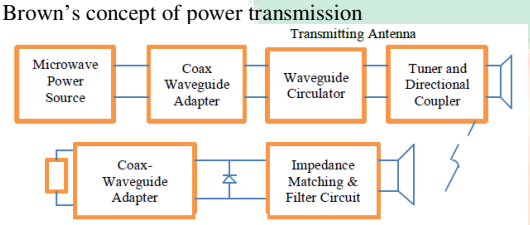

Figure no.1

III. COMPONENTS OF WIRELESS POWER TRANSMISSION

The major components of the Wireless power transmission are

- Microwave Generator
- Transmitting antenna
- Rectenna

MICROWAVE GENERATOR

Microwaves of the desired frequency (2.45GHz) are produced by the microwave generator. It is done by the interaction of a stream of electrons and magnetic field.

Generally microwave sources use vacuum tubes, which use the ballistic motion of electrons in a vacuum tube under the influence of controlling electric or magnetic fields and magnetron, klystron, travelling-wave tube (TWT) and gryotron. These devices work in the density modulated mode, rather than the current modulated mode.

TRANSMITTING ANTENNA

The transmitting antenna is the one that transmits the generated microwave signal from the free space to the device. When a current of electrons is forced through the antenna, an oscillating magnetic field is produced while the charge on the electrons produces an oscillating electric field. These time-varying fields radiate from the antenna as transverse electromagnetic waves.

There are many antennas available like the slotted wave guides, micro strip patch antenna and the parabolic dish antenna.

RECTENNA

The rectenna means a rectifying antenna. It is passive element that comprises of an antenna, rectifying circuit with a low pass filter. Rectenna converts the energy of the received microwaves into direct electricity.

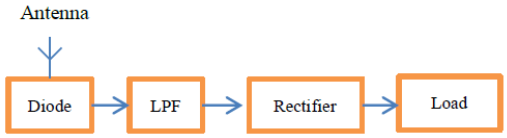

Figure no.2

IV. DESIGN

TRANSMITTER DESIGN

The transmitter comprises the magnetron, diode vacuum tube which acts as the oscillator. It operates differently from the linear-beam tubes. Here the magnet is put between the resonating chambers which are the centre of the oscillator. Electrons that flow out of the cathode move towards the resonating chambers which act as the anode in the presence of magnetic field. As it passes through the field it starts circulating in the resonating cavity and waves are produced. The other RF signal that is generated flows out of the chamber.

RECEIVER DESIGN

The receiver comprises the sensor and the rectenna. The charging process is done while the phone is in use. The sensor senses the presence of microwaves and indicates it to the user and also detects whether the phone is using the microwave or not. The rectenna is the special type of antenna which directly converts microwave energy into DC Electricity.

PROCESS OF RECTIFICATION

There is some energy loss when the microwave travels through the media. To rectify the waves at low cost the detection process should be made more sensitive. Generally Bridge Rectification is more efficient than other rectification techniques and shotky diode is used to get the better impedance.

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SENSOR CIRCUIT

Here a simple frequency to voltage converter such as LM2907 can be used. In India the operating frequency of the GSM is 900 MHz- 1800 MHz. It acts as a switch to trigger out rectenna circuit on or off. Thus whenever our phone is receiving microwave signal automatically the battery gets charged. This is significant as the phone needs to be charged as long as the user is talking.

V. WORKING

When the user is talking, the microwave signal from the transmitter is sensed and it is received by the receiver which consists of the rectenna which converts the microwaves into electricity and the battery gets charged.

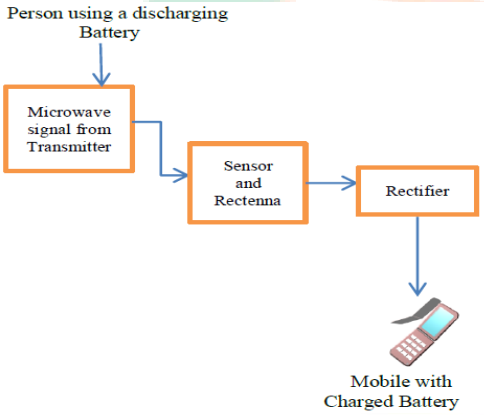

Figure no.3

VI. ADVANTAGES

- Wireless charging has the low risk of electrical shock or shorting.
- The wireless phone charging never allows the phone to die and it becomes easier for the users to charge their mobiles.
- The need of different type of chargers by different manufactures is totally eliminated.

VII. DISADVANTAGES

- The size of the rectenna is very large and so it has to be reduced with the help of nanotechnology which is costlier.
- Radiation causes some drastic effects to human body.
- The transmitter and the receiver should be powerful devices because when the distance increases, the charging gets slower.

VIII. CONCLUSION

This paper demonstrates a unique method of using the microwaves to charge our mobile phones without the power sockets and the wires. Mobile phones added with a rectenna and a special sensor is ready for wireless charging.

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