Wireless Charger

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Abstract— It is based on the need of developing a wireless device that can transmitting power or electricity through an air gap to an electrical device such as mobile and other small electronic devices. This device is used charge small electronic devices at a distance with an air gap of no interference between them with les charging time. It is based on the principle of resonant inductive charging method where mutual induction is used to transfer the power from transmitter to receiver. This device contains a transformer 9-0-9 to convert 220 volt ac in 18 volt which is further converted in direct current by rectifier which is converted into AC again by an 18 watt CFL circuit, two copper coils are used for receiving and transmitting the power, then the output power is amplified by darlington pair as an current amplifier. This device is used as charging stations and for commercial uses also.

Key words: Power Transmitter, Power Receiver, E.M., Wireless communication, Induction

I. INTRODUCTION

Wireless power transmission involves the exchange of power without the need for physical connectionsFirstly the concept of wireless charging had been proposed by Nikola Tesla in June 1900 [1]. Wireless charging also known as Inductive charging which consists two coils one is a transmitter coil another one is receiver coil. An alternating current is passed through transmitter coil, generating a magnetic field .this is turn induces a voltage in receiver coil this can be used to power a mobile device or charge a batteryThe power efficiency depends on the tightness of coupling between two coils and their quality factor. The tightness of coupling is determined by the alignment and distance, the ratio of diameters, and the shape of two coils. The quality factor mainly depends on the materials, given the shape and size of the coils as well as the operating frequency. The advantages of magnetic inductive coupling include ease of implementation, convenient operation, high efficiency in close distance (typically less than a coil diameter) and safety.

Using wireless charging has many benefits. It improves user-friendliness by eliminating the connecting cables. The same charger is used by different brands and different models of portable devices.It provides better product durability such as waterproof and dustproof for contact-free devices. It enhances flexibility, especially for the devices that replacing their batteries or connecting cable for charging is costly, hazardous, or infeasible for example body-implanted sensors. Wireless charging can avoiding an overcharging problem and minimizing energy costs. The block diagram is shown in fig. 1.

In the first section we mentioned Introduction of the paper, in the second section we mentioned about the theory of the topic. In the third section we mentioned about design methodology of the circuitry for the research and in fourth section we mentioned the result and discussion made after the successful implementation of design .In the last section conclusion of the paper is given.

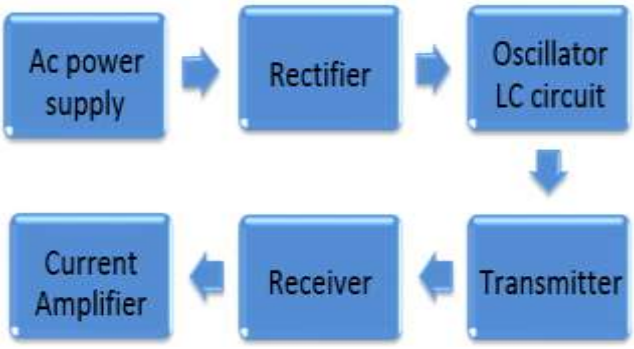

Fig. 1: Block diagram of wireless charger

II. THEORY

A. Working Operation

Wireless charging works on the principle of electromagnetic induction. Electromagnetic induction was first discovered by Michael Faraday. Inductive resonance charging uses an electromagnetic field to transmit power between two copper coils that resonate at the same frequency. Wireless charger consists of Ac power supplier, rectifier, LC oscillator circuit, transmitter, receiver and current amplifier. In the first step AC supply of 220V is given to the circuit, then transformer is connected which convert this 220V to 18V supply. This converted 18V is of AC nature and for further process this supply needs to convert into DC supply. For conversion, bridge rectifier is used. The conversion process of AC to DC gives ripples in output. For removing ripples a filter circuit is needed which consist of capacitor and resistor. After this smooth DC is obtained which is supplied to oscillator circuit consist of inductor and capacitor. Oscillators convert a DC input (the supply voltage) into an AC output (the waveform), which can have a wide range of different wave shapes and frequencies that can be either complicated in nature or simple sine waves depending upon the application. Then this signal is given to transmitter which transmits the signal. Then it is receive by receiver. The mobile phones are not charged at AC so we need to convert it again in DC output. Which is of low value therefore a current amplifier is needed for the circuit. Electric power is distributed as alternating current because AC voltage may be increased or decreased with a transformer. This allows the power to be transmitted through power lines efficiently at high voltage, which reduces the power lost as heat due to resistance of the wire, and transformed to a lower, safer, voltage for use. The voltage gain of resonantly coupled coils is proportional to the square root of the ratio of secondary and primary inductances

Fig. 2: Wireless charger

B. Hardware Description:

1) Transmitter Coil:

Power supply is given to the transmitter. Copper coil is wound into number of turns as per the requirement. When the power is supplied to transmitter the coil energizes and results in the magnetic coupling. Hence the power is transferred.

The transmitter coil is of diameter 10cm and no. of turns of the coil is 150.

$$N = \left(\frac{\sqrt{\text{Ll}}}{\mu A}\right) \qquad (1)$$

Where,
L- Inductor
l- Length
μ- Permeability of copper (1.256629 μH/m)
A-Area

Fig. 3: Transmitter coil

2) Receiver Coil:

The secondary receiver coils are similar designs to the primary sending coils. Running the secondary at the same resonant frequency as the primary ensures that the secondary has a low impedance at the transmitter's frequency and that the energy is optimally absorbed. To remove energy from the secondary coil, different methods can be used, the AC can be used directlyrectified and a regulator circuit can be used to generate DC voltage. The receiver coil is shown in fig.3. The receiver coil is of same diameter as transmitter coil but the no. of turns is 200.

Using the equation 2 find the inductance of the receiver coil.

$$N = \left(\frac{\sqrt{\text{Ll}}}{\mu A}\right) \qquad (2)$$

Where,
L- Inductor
l- Length
μ- Permeability of copper (1.256629 μH/m)
A-Area

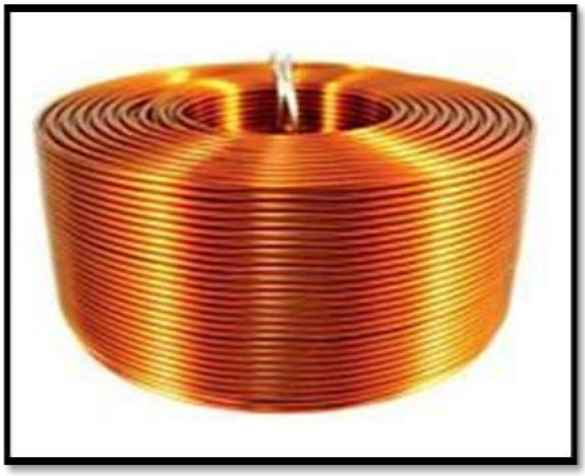

Fig. 4: Receiver coil

3) AC-To-DC Converter:

A Rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification. We use full wave rectifier for this. The average (DC) output voltage is higher than for half wave, the output of the full wave rectifier ha much less ripple than that of the half wave rectifier producing a smoother output waveform.In the first half of the AC cycle, D2 and D4 conduct because they're forward biased. Positive voltage is on the anode of D2 and negative voltage is on the cathode of D4. Thus, these two diodes work together to pass the first half of the signal through.In the second half of the AC cycle, D1 and D3 conduct because they're forward biased: Positive voltage is on the anode of D1 and negative voltage is on the cathode of D3.The net effect of the bridge rectifier is that both halves of the AC sine wave are allowed to pass through, but the negative half of the wave is inverted so that it becomes positive.

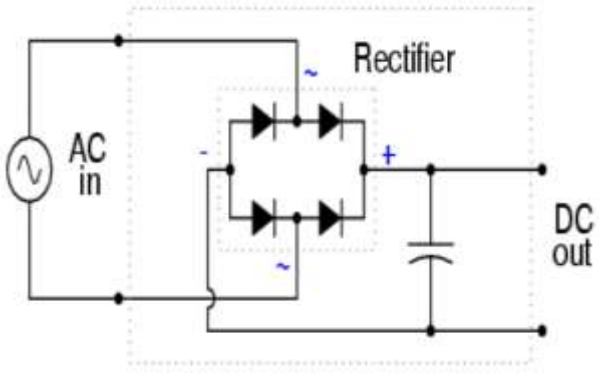

Fig. 5: Rectifier circuit

4) Oscillator Tank Circuit:

An oscillator converts DC energy of the battery into AC energy in a coil capacitor circuit. The base bias may cause the collector electron flow to be cut off during a portion of the cycle. The frequency of oscillation of an LC circuit depends on the magnitudes of L and C.

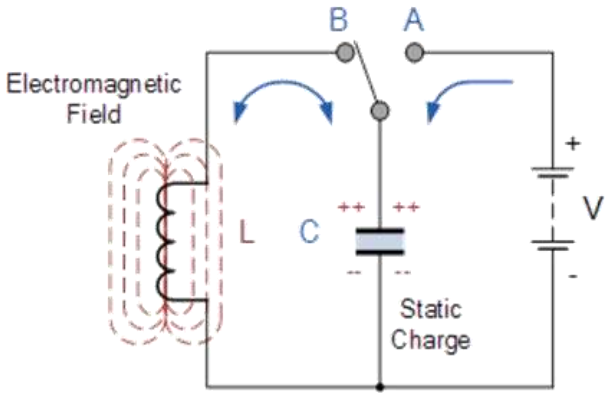

Fig. 5: Basic oscillator tank circuit

5) Current Amplifier:

Current Amplifier consists of two Darlington pairs because we have to amplify the current from 40mA to 450mA. Darlington pair is used as a current amplifier. Each Darlington pair has two transistors one is BC-547 and another one is TIP-122. TIP 122 has maximum Collector to Emitter and Collector to Base voltage 100V and maximum voltage at Emitter to Base is 5V. Maximum collector current is 5A and the maximum power dissipation is 65W.

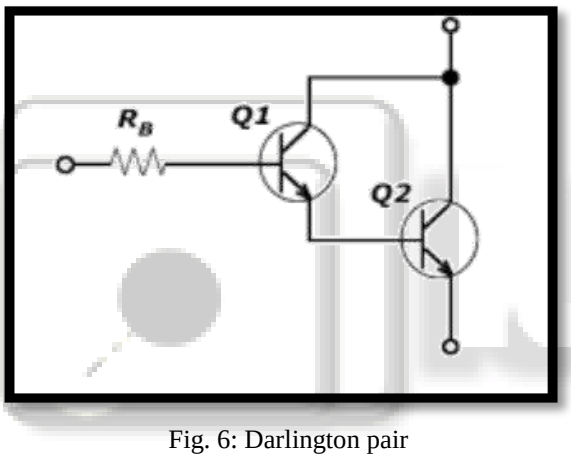

Fig. 6: Darlington pair

III. Results

In this paper, wireless charging of 1050mAh battery has been focused. The output current found to be 450mA at 5V dc and it charges 100% battery in 30mins within the range of 6cms.

IV. Conclusions

Wireless charging can be as efficient as a wired charging. Based on the reviewed literature and collected data, suggests that wireless power transmission could be feasible. Modern science has now made it possible to use electricity without having to plug in any wires for charging.

In this paper, wireless charging of 1050mAh battery has been focused. The circuit for this purpose has been designed, fabricated, implemented and tested. This circuit consists of transformer, rectifier, oscillator tank circuit, transmitter coil, receiver coil, current amplifier. Initially, output current is 13mA so there is a need to amplify current by using a transistor based current amplifier whose gain is 0.93. Thereafter the output current found to be 450mA at 5V dc and it charges 100% battery in 30mins within the range of 6cms.

A. Future Aspect:

- The following project can also be automatic by using Bluetooth module and microcontroller.
- The range can be increased by increasing the number of turns of the coils.
- Charging time can be reduced.

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