

# TESLA COIL WIRELESS POWER TRANSMISSION

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## ABSTRACT

The intent of this paper is to present design of wireless power transmission using tesla coil. There are two ways of electrical energy transmission one is wired and another is wireless. Wired electric transmission is complicated in design, easy way to overcome this disadvantage by using wireless transmission. This paper explains how the electrical energy is transferred from a source to the load, without any wired conductive physical connection. In this proposed work two coils are used one is primary and another is secondary, Induction coupling principle is used which creates the magnetic field. The tesla coil can be used as a transmitter. Tesla coil induces high density flux. It produces high frequency, high voltage and low alternating current. This paper proposed simple and easy design which does not have ac voltage at the input.

**Keywords:** Tesla coil, dc voltage, induction coupling, wireless energy transfer.

## I. INTRODUCTION

The common way of transferring electric energy is by using cables and wires. However this conventional way is insufficient and messy. The use of electronic appliances increases the use of cables which creates the complicated connection in daily life. The solution for this problem is wireless energy transfer. Air is the only media to transfer the energy. The case in which interconnecting wires are complicated and unmanageable wireless electricity is beneficial. A tesla coil is air core resonant transformer which generates high frequency, high voltage, and low alternating current. It is efficient and safe when operated carefully.

## II. BACKGROUND HISTORY

In 1864, James C. Maxwell predicted the existence of radio waves by means of mathematical model. In 1884, John H. Poynting realized that the Poynting Vector would play an important role in quantifying the electromagnetic energy. In 1888, bolstered by Maxwell's theory, Heinrich Hertz first

succeeded in showing experimental evidence of radio waves by his spark-gap radio transmitter. The prediction and Evidence of the radio wave in the end of 19th century was start of the wireless power transmission. Nikola started efforts on wireless transmission in 1891 at his "experimental station" at Colorado. A small incandescent resonant circuit, grounded on one end was successfully lighted.[3]

Tesla coil is resonant high voltage transformer named after the inventor Nikola Tesla in 1891. It is used to produce, high voltage, low current, high frequency alternating current electricity. Nikola Tesla patented the tesla coil circuit in April 25, 1891, and first publically demonstrated it, May 20, 1891 in his lecture "Experiments with alternate current of very high frequency and their application to methods of artificial illumination" before the American institute of electrical engineers at Columbia college, New York.

Tesla invented his coil with the intension of transmitting electricity through the air. He purposed using a few coils spread across the globe to transmit electrical energy through the earth. Where ever power was needed one would need only a receiving coil to convert power into a useful form. As shown in fig.1 he used a simple spark gap to excite oscillations in the tuned transformer. Modern tesla coil also use spark gap as well as transistor or thyristor to drive resonant transformer.

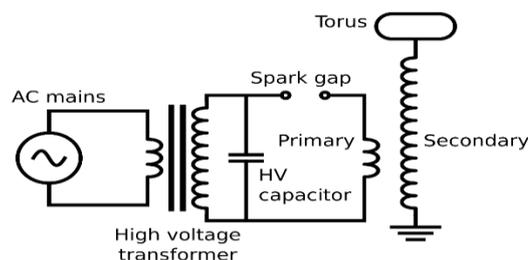


Fig.1 Basic configuration of Tesla Coil

## III. TYPES OF WIRELESS POWER TRANSFER

### 3.1. MICROWAVE BASED WIRELESS POWER TRANSMISSION

Far field techniques using microwave power. This method achieves longer ranges, often multiple kilometre ranges, where the distance can reach several thousand kilometres. The WPT comprises two distinct and distant parts in space a transmitting part and another receiver. The transmitting part includes a microwave source, supplied with DC power, and a transmitting antenna [1]

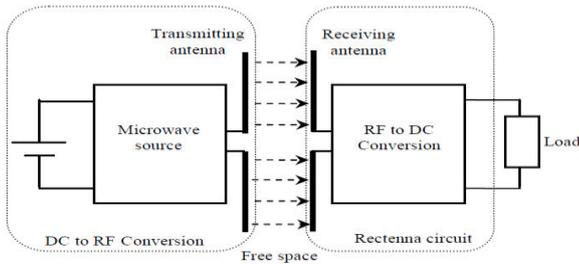


Fig.2 Basic design of wireless power transmission

For transferring the electric power through the long distance some approaches are used such as microwave power transmission, laser power transmission and solar power satellite. For the long distance electric power transfer, line of sight is required. Mostly the microwave power transfer technology is used for transferring the electric power from source to destination of long distance. First the electrical energy is converted into microwave energy and it is transferred through the antenna and then the microwave signal is converted into electrical energy at the destination side. For converting the Electrical Power in to the microwave signal we need to convert the AC signal in to the DC signal then the DC signal is converted into AC signal at receiver side [4].

**A. TRANSMISSION**

Transmission in WPT rely on its transmitting periphery which can be given as below. Transmitting antenna is used to transmit power in the free space [3].

**B. RECEPTION**

Receiving block receive the microwave power transmitted by the transmitter. It's has a receiving antenna to receive power and a band pass filter to remove harmonics from the received microwave power. Receiving antenna is used to receive the transmitted power from transmitting end. It extracts microwaves from free waves. A circularly polarized micro strip antenna array is used as a receiving antenna in this paper.

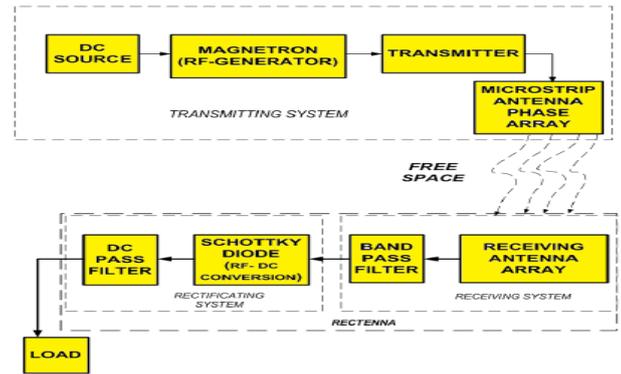


Fig. 3 WPTS block diagram

**C. RECTIFICATION**

Antenna output is passed through a band pass filter and then is applied to the diode. Band pass filter blocks the higher order harmonics. For maximum power to be transferred from antenna to diode, impedance matching is required. A matching circuit is provided with filter to match the impedance of antenna.

1) **DIODE:** Microwave-to-dc conversion is an important factor for microwave wireless power transmission system. A rectifier diode is used for this conversion.

2) **D.C. PASS FILTER:** Schottky diode's output is passed through dc pass filter so that microwave signals can be reflected back to diode, that are present in diode output due to its nonlinear action. D.C. pass filter is a dc blocking capacitor and is also helpful in impedance matching of rectenna side [3]

**3.2. WIRELESS POWER TRANSMISSION BY INDUCTIVE COUPLING**

The transformer is the good example of short range wireless electric power transmission which works based on inductive energy coupling methodology. The transformer transfers the electrical energy as an Electromagnetic field.

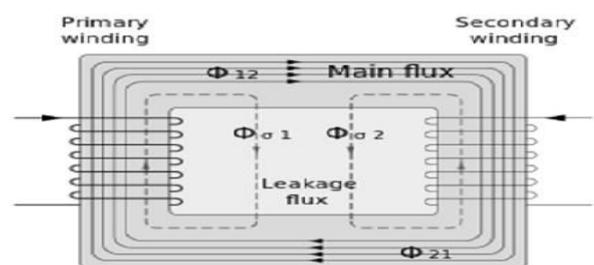


Fig .4 Typical construction of Transformer

When the electric current pass through the coil then there is some magnetic field will creates inside and outside the coil. The magnetic field creates inside the coil is called strong field and the magnetic field creates around the coil is called weak field. Two coils are used for transferring the electric power on is primary coil which is directly connected to the power source and another one is secondary coil which receives the electricity by means of magnetic field and it is connected to the load or any other circuit. The Electro Magnetic Flux (EMF) is created between the primary and secondary coil, the secondary coil is inducted by the magnetic field of primary coil [4].

The magnetic inductive coupling uses nonradioactive transmission using electro magnetically induced transparency. Here we describes about the utilization of solar energy and the wireless transmission of the generated power. First the solar power is stored in a battery which is then transferred through wireless medium based on inductive coupling. There is a high thrust for renewable energy to mitigate the effect of global warming. The inductive power transfer has wide applications along with renewable energy. To demonstrate this solar based wireless power transfer system for home appliances has been developed. The advantage of this project is to increase the usage of renewable energy resources in order to reduce the CO emissions [2].

Power transfer is attained by magnetic induction between the transmitter and receiver. In the Fig.4 the basic block diagram of WPT system was shown below. The design methods basically concentrated on designing of coils.

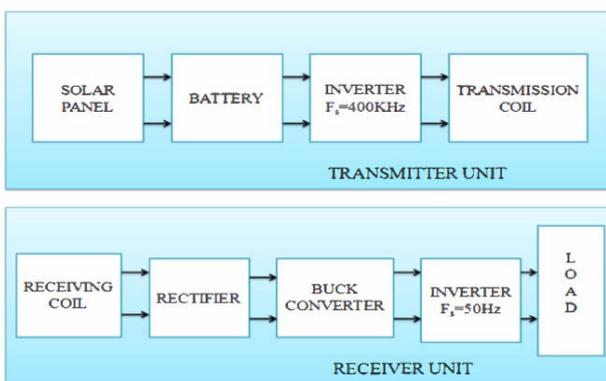


Fig.5 Block diagram of the solar based WPT system

In the basic block diagram a battery shown as a source which is going to get charged by solar panels, the inverter is used to produce AC voltage. To transfer high efficient power in the WPT system shown above impedance matching is very important. At transmitter side the inverter switching frequency is 400 K Hz and

in receiver side the switching frequency is 50Hz. In the receiver block rectifier and buck converter is used to get proper DC voltage. From that one inverter is placed to produce AC supply to the load.

### 3.3. WIRELESS POWER TRANSFER USING MAGNETIC RESONANCE

We propose the use of a new technology, based on strongly coupled magnetic resonance. It consists of a transmitter, a current carrying copper coil, which acts as an electromagnetic resonator and a receiver, another copper coil of similar dimensions to which the device to be powered is attached. The transmitter emits a non-radiative magnetic field resonating at MHz frequencies, and the receiving unit resonates in that field. The resonant nature of the process ensures a strong interaction between the sending and receiving unit, while interaction with rest of the environment is weak.

The circuit diagram of Mini Tesla Coil Project given below is very simple. So let us understand how it works and learn how to build it. The main component in this circuit is the secondary coil (golden colour), which is made by winding a magnetic wire (enamelled) around a cylindrical object (any non-conductive object will work).

A high current high frequency transistor like 2N2222 is used to supply current through the primary coil (violet colour). The whole set up is powered by a 9V battery as shown above. The positive end of the battery reaches the collector of Transistor through the primary coil, and the emitter is grounded. This means that whenever the transistor conducts, current is flown through the primary coil.

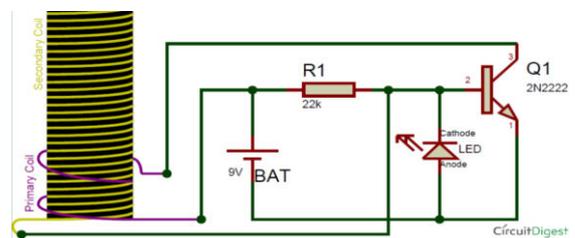
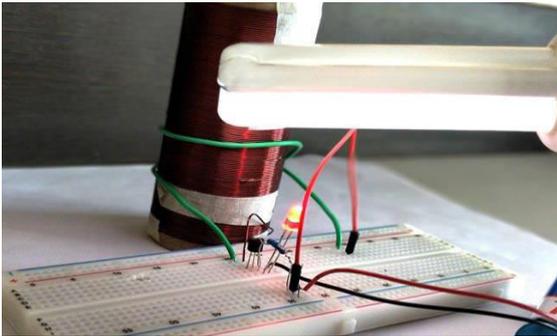


Fig.6 Tesla coil circuit diagram

So, with this arrangement we have a primary coil which will have an oscillating current, and hence will produce a carrying magnetic flux around it. Now, this coil is wound around the secondary coil and hence a according to law of electromagnetic induction a voltage will be induced in the secondary coil. Since the number of turns in the secondary coil is very large than primary coil, this voltage will be a very high voltage

and hence this coil will have a very strong electric flux around it that is powerful enough to glow normal CFL bulbs and is used in Wireless Power Transmission.



### WINDING THE SECONDARY COIL:

One very important step in this project is winding the secondary coil. It is a time consuming process and hence do not rush yourself in this part. First of all, you will need a magnetic coil, which is also called as enamelled coil wire. These wires can be found inside relays coils, transformers and even motors. You can either reuse one or buy yourself a new one. The thinner the wire is the better the results will be.

Once you are ready with the magnetic wire, you will need a cylindrical object. The only rule while selecting this object is that it should not be conductive, you can select PVC pipes, cardboard roll or even stack 4-5 A4 sheets together and roll them up. The diameter of the cylinder can be anywhere between 5cm to 10cm, and the length should be at least 10cm. The longer the object is more number of turns it can fit in. Automatic wireless charging point in office, home and vehicles

- Wireless TV , DVD players, Home theatre's and home lighting system
- In industrial sector such as robots, packaging machine etc.

### IV. METHODOLOGY/DESIGN & IMPLEMENTATION

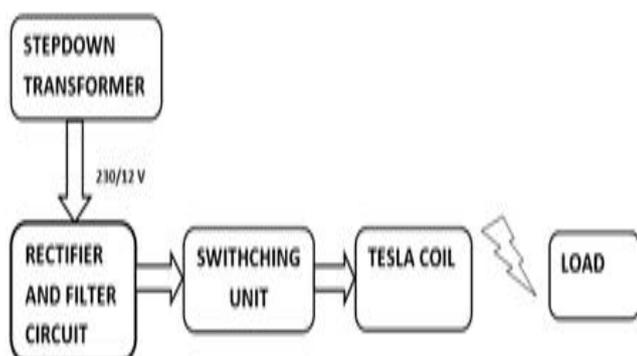


Fig.7 Block diagram of Tesla coil

Fig.7 shown the block diagram of wireless power transmission using tesla coil. It consist of step down T/F rectifier and filter circuit switching device and tesla coil 230v 50 Hz Ac supply is given to step down T/F this T/F step down the voltage to 12v this 12v is given to rectifier and filter circuit the circuit this rectifier the 12v Ac to Dc and filter out the ripple at into o/p three points are terminated with different voltage of 3v, 5v &12v The result are taken for this three voltage.

Here NPN transistor is used when we closes the switch the base of transistor is got turned ON and current flows through the primary coil then emf is get induced in the secondary coil as per induction coupling principle. As secondary is open current will not flow through it but the high voltage is available at the secondary to keep transistor ON base needs 'P' the emf induced in secondary coil is such that the base gets 'n' which stops base and hence transistor will not conduct. Here when the transistor is ON the coil is get charged and when it off coil is get discharged which will give the voltage in alternating nature to the primary and according to that the emf is get induced in secondary The amount of induced emf at secondary depends on No. of turns Here the no. of primary turns are 7 and that of secondary are 1001 When the CFL bulb of SW is hold near to the tesla coil transmitter the bulb glows.

### V. HEALTH HAZARD

- The high voltage radio frequency discharge from the output terminal of tesla coil pose a unique hazard not found in other high voltage equipment when passed through the the body they often do not cause the painful sensation and muscle contraction of electric shock as lower frequency AC or DC.
- The danger is that since no pain is felt experimental often assume the currents are harmless if the arcs from the high voltage terminal strike the bare skin, they can cause deep seated burns called RF burns.
- The effects of tesla coil is often no sensation is felt ,or just a warmth or tingling however this does not means the current harmless even a small tesla coil produces many times the electrical energy to stop the heart.
- Particularly if passes through the narrow structure such as blood vessels or joints it may raise the local tissue temperature or other injuries.
- As per international ICNIRP standard for RF current in tesla coil frequency range of 0.1-1 MHz specify a max current density is 0.2mA per square

meter and max SAR 4w/kg in limb and 0.8w/kg avg body.

- If a person touching or connected to output terminal then allowing strike his body then high primary current could passes through ionized air path through person body.

## VI. RESULT

The testing of tesla coil were made to 3v, 5v,12v with diameter of 32mm, and parameter of winding 1000 turns.The measurement was made best on the illuminated of the fluorescent bulb.

Voltage	3V	5V	12V
Sensitivity Distance(cm)	Illumination Level		
1	22.4	28.5	40
2	13.8	15.4	23.6
3	5.5	8.6	15.4
4	3.6	5.0	11.3
5	2.0	3.2	8.2
6	1.5	2.8	6.8
7	1	2.1	5.0
8	-	2	4.2
9	-	1.8	3.6
10	-	1.8	2.1

## VII. CONCLUSION

The wireless transmission of electric power is now possible. The electrical energy can be transmitted from the source to the load without application of messy cables, different techniques of the WPT system, demonstrate the WPT is one of the promising technologies and may be the best alternative for efficient power transmission. Novel method of wireless power transmission is done in proposed work. Prototype model is designed can supply 5 Watt bulb for the distance 10cm. By increasing the no of turns the distance can be increased. Proposed model is simple effective design to realize the wireless electric, transmission.

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