Wireless Power Transmission using TESLA Coil

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Abstract— Modern systems depend heavily on electrical power. It is crucial to be able to transmit power through methods other than wires or gearbox lines since it is used in everything from the smallest sensors and bionic implants to satellites, remote-controlled airplanes, vehicles, robots, and oil platforms. Systems might run remotely without the requirement for relatively large energy storage devices or regular maintenance if wireless power transmission was used on a bigger scale than that of magnetic induction devices. It will also be used to power remote communication equipment and in other situations where connecting wires would be difficult, dangerous, or impossible, such as in moist conditions or around rotating or moving joints. This essay explains the straightforward construction of a small Tesla coil and its advantages over a conventional Tesla coil.

***keywords** :Component, formatting, style, styling*

Introduction :

The standard Tesla coil uses voltage or high voltage as its input supply and is often large-scale. The Tesla g e is larger and more difficult to manoeuvre than an ion or mobility vehicle. As a result, this research should help with this issue.The goal of this project is to create a Tesla Coil that is more compact and lightweight than a regular Tesla Coil. Additionally, this project attempts to produce 2,500V of high-frequency medium voltage at the secondary side using a 24V direct current, DC source as an input to the primary circuit.The computer simulation work is done as a preliminary step to meet the project's objectives.A Tesla Coil is an air-cored resonant transformer. It is similar to a standard transformer but the mode of operation is different in s primary and secondary windings and the voltage transformation ratio is dependable on the turn ratio itself. In contrast, a Tesla Coil uses a relatively loose coupling between primary and secondary. The voltage in the Tesla coil is gained due to the resonance rather than the turn ratio. A normal transformer uses an iron core to operate at low frequencies, whereas the Tesla Coil uses air corporate to operate efficiently at higher frequencies [5, 6].

Tesla coil designs employed an AC power source, high voltage capacitor, induct e coil, and a spark gap to excite the primary side of the Tesla coil system with periodic bursts of high-frequency The primary and secondary coil is designed precisely in coordinate at the same frequency. Tesla coil consists of five important parts in its construction. Table I show the description of footnote roid, spark gap, capacitor tank, and coils in the Tesla coil [5, 6].

The miniature Tesla coil designed in this project has all parts as shown in Table I. However, the spark gap that's employed in the designs uses uan ncommon spark gap neither rotary gap nor spark gap. It employs the contactor of the relay as a spark gap because the ordinary spark gap is not able to work

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Due to that, the relay has to be used with a different approach. The contractors in the relay can be a good spark gap when it is forced to be open and closed with very fast time. By energizing and reenergizing the relay coil, the contactor can be made to open and closed faster. During the intermittent time which is opening and closing of relay's contact, the supply voltage 24V DC will charge and discharge the tank capacitor. As a result, the tank capacitor transfers the energy and electrifies the primary winding. Section III gives the details explanation about the energy transfer in the Tesla coil system.

II BASIC OPERATION OFTESLA COIL

Generally, there are two most common Tesla Coil circuit available. Figure 1 and Figure 2 are the typical and alternative circuit of Tesla coil respectively. In both circuit, it can be seen that, the circuit consisted of spark gap, capacitor tank, primary winding and secondary winding. The difference is, in typical circuit the spark gap is in parallel with the high voltage transformer meanwhile in alternative circuit the capacitor tank is in parallel with the HV transformer.

The typical circuit as shown in Figure 1 can prevent the transformer supply from high frequency oscillationsbecause it has a spark gap with short circuiting action.Meanwhile, the transformer in Figure 2 is exposing to the high amplitude and high frequency oscillations emerge across thecapacitor. This arrangement can induce the corona discharges between turns, finally weaken, and eventually destroy transformer's insulation [5].

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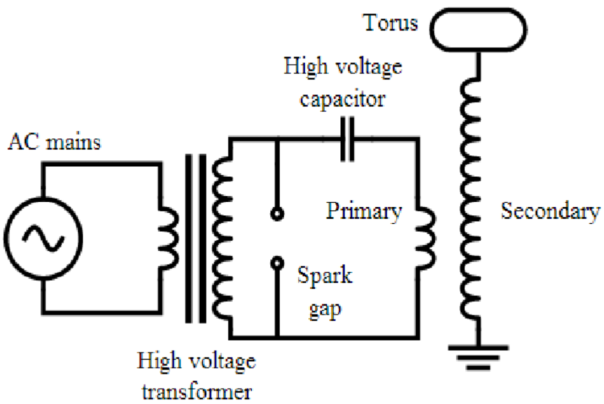

Fig 1. Typical Tesla coil circuit [9]

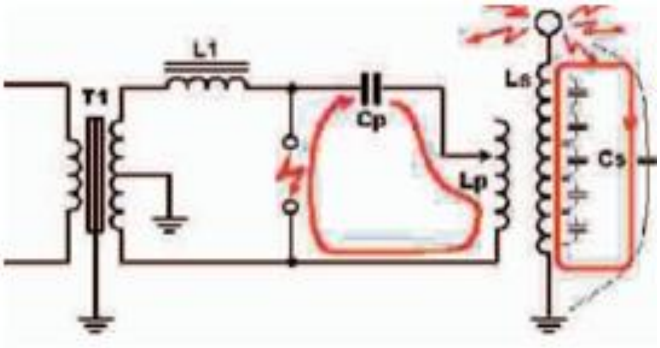

Fig 2.The working of The esla coil circuit

XI.HARDWARE DEVELOPMENTS

As mentioned before, the miniature Tesla coil proposed in this project has some modifications in the circuit of typical Tesla coil. One of the modifications is the employment of relay's contactor as a spark gap.

The relay's contactor that acts as a switch is utilized to initiate the tank capacitor to discharge the energy stored from input source. Then, transfer the energy to the primary winding of the Tesla Coil with periodic times.

The energy is transferred during the gap between the relay's contcontactes. The ratio between the primary and secondary coil is 1:100 and it is used to step up the 24V DC input voltage to approximately 2,500Volt in the oscillating form at the secondary side

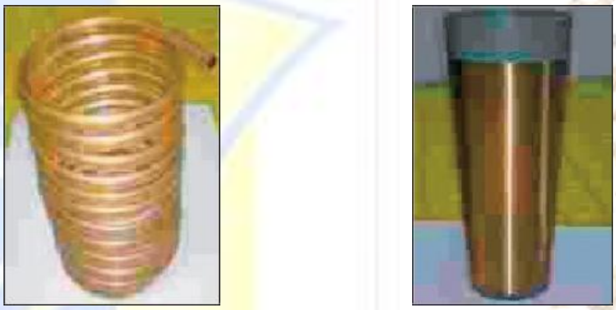

Fig 3 .Primary coil and secondarycoil

Fig 4. Miniature Tesla coil development

The ¾- inch copper rod tubing is used to build the primary coil. The diameter of the primary winding is 130 millimeters and the number of tunsis being. For the secondary coil, 35 SWG 0.224 mm enameled wire copper is used. The diameter for the secondary coil is 50 mm and the number of turns is 1000 turns. Figure 5 shows theminiature Tesla coil that has been developed in the laboratory.

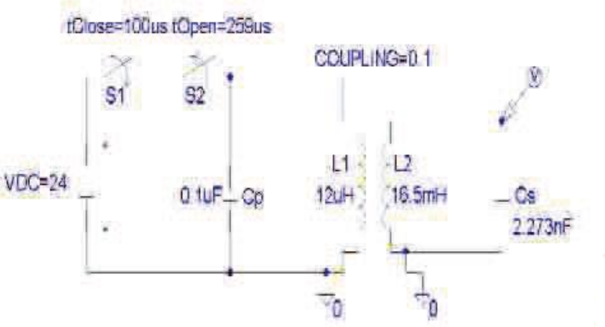

Fig 5. Simulation circuit using Pspice

Figure 6 shows the simulation circuit using Pspice software. The circuit is slightly different from the norm Tesla coil circuit as shown previously in Figure 1 and Figure 2.Commonly, the input for a typical Tesla coil is AC voltage. However, the input for the miniature Tesla coil is DC input. Due to that, the typical circuit need to be modified to obtain a circuit that can operate result, it has twoswitches that act as spark gaps. In addition, the two switches are located in series with DC input voltage whereas, in a typical circuit, the spark gap is parallelly joined with the power supply or connected in series with the primary winding.

In the simulation circuit, as shown in Figure 6, there is one unit normally open switch, S1 and one unit normally closed switch, S2. Both switches are connected in series with the supply voltage and the primary tank capacitor. Switch S1 is at a closed position at 100 microseconds, meanwhile, switch S2 is opened at 259 microseconds. It must be noted that the supply voltage is 24V DC with the value of primary capacitor Cp is 0.1μF and secondary capacitor Cs is 2.273nF.

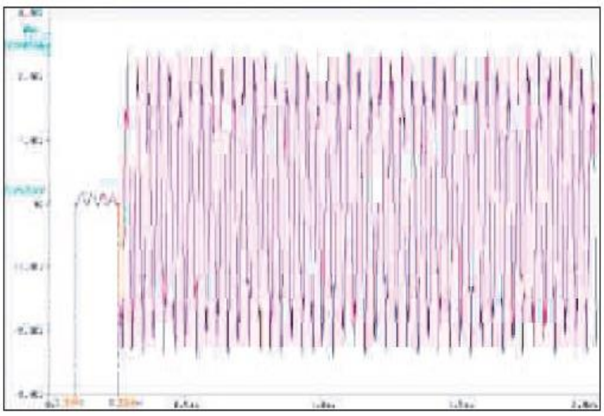

Fig 6. Voltage measured at the secondary coilof the miniature Tesla coil

By referring to Figure 7, the waveform indicates the voltage generated at the secondary circuit of the simulation circuit. It can be seen that the voltage waveform only started at 0.1miliseconds because the closing time of the switch S1 is 100µs. From 100µs onwards, the current and energy from the power supply flows through a capacitor as well as the primary coil and concurrently create the high rate oscillation. At the same time, the short distance between the primary and secondary windings creates a magnetic linkage among them. Due to that, the primary winding and secondary is facing the same high amplitude fluctuation current.

According to Figure 7, the peak voltage is 175.15V and occurred between 100µs to 259µs. In this period, the input voltage 24V DC has been changed to AC form, and the voltage increased by about 8% at the secondary circuit. This condition continues until the switch S2 change from the close position to the open position at 259µs. And after 259µs, the voltage obtained at the secondary circuit is 14 times larger than the previous voltage.

TABLE II. ENERGY AT THE SECONDARYWINDING

Primary Circuit			Secondary Circuit			
Supply, V_{dc} (V)	C_p (µF)	L_1 (µH)	C_s (nF)	L_2 (mH)	V_{peak} (V)	Energy (Joules)
24	0.10	31.64	2.27	27.12	1,670	3,165,401.5
24	0.17	31.64	2.27	27.12	1,814	3,734,826.5
24	0.10	12.00	2.27	16.50	2,392	6,494,088.6
24	0.17	12.00	2.27	16.50	2,565	7,467,420.4
24	0.68	31.64	2.27	27.12	3,146	11,233,453.7
24	0.68	12.00	2.27	16.50	3,693	15,479,412.6

Table II shows the energy calculated in joules by varying the capacitance and inductance values and fixing the input voltage at 24V DC. Equation 1 in Section III is employed to calcu to the energy at the second y circuit using the value of the secondary voltage, Vpeak. All the data indicates that the proposed circuit is capable to step up the DC input voltage approximately 50 times greater at the secondary circuit. It is good to know that the voltage at the secondary circuit is in AC form or isolation form even though the supply is only dc voltage.

Lastly, the simulation results prove that the proposed circuit is capable to generate medium voltage where it was fulfilled and aligned with the theory of the typical Tesla Coil. The simulation result also gives a good sign in the effort of hardware development.

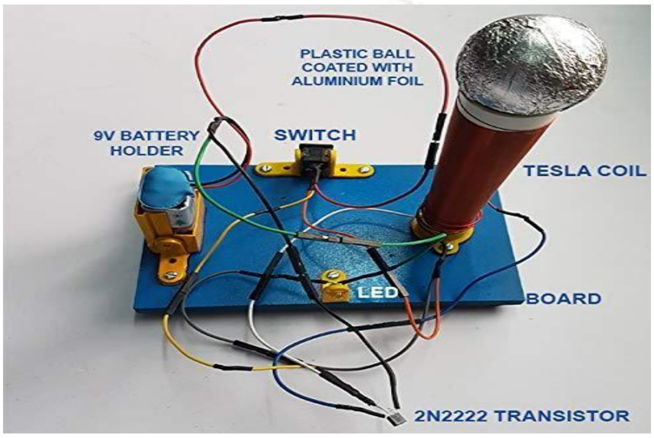

Fig 7. Miniature Tesla Coil Diagram

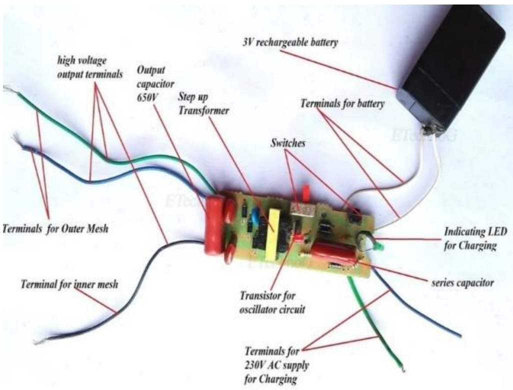

Fig 8 Miniature Tesla Coil Using Bug Zapper Racket Circuit

A BUG ZAPPER RACKET circuit gets power from an electric reachable battery. Therefore a charging circuit is needed to charge the battery. This type of circuit is known as the capacitive power supply. By using this we can create an arc for the Tesla coil.

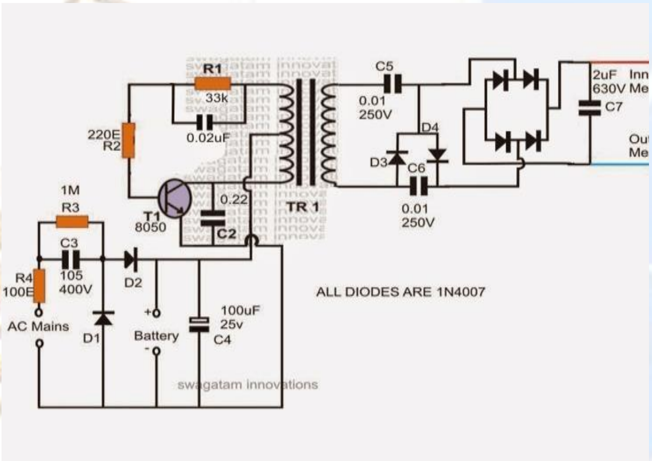

Fig 9 Circuit Diagram for TESLA coil

CONCLUSION

Generally, the race to develop the modern and rugged Tesla coil among scientists and engineers is ongoing. Since the scientific literature about the mini Tesla coil employing the DC voltage is not easily found, therefore this paper is carried out to be a sensible part of further research studies.

Before this, a computer simulation using PSpiceas was done earlier to develop a reliable circuit. In addition, the simulation result gives a meaningful indicator regarding the effort to create a small-scale Tesla Coil for innovation purposes. In addition, the proposed circuit is executed to generate a high voltage with high-frequency oscillation currents like the standard Tesla coil. It should be noted that the final systems of this project would provide an understanding of systems principles and give a significant contribution to further research of mini Tesla Coil.

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