



# Generation of high voltage AC by using Tesla Coil

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ELECTRICAL DEPARTMENT



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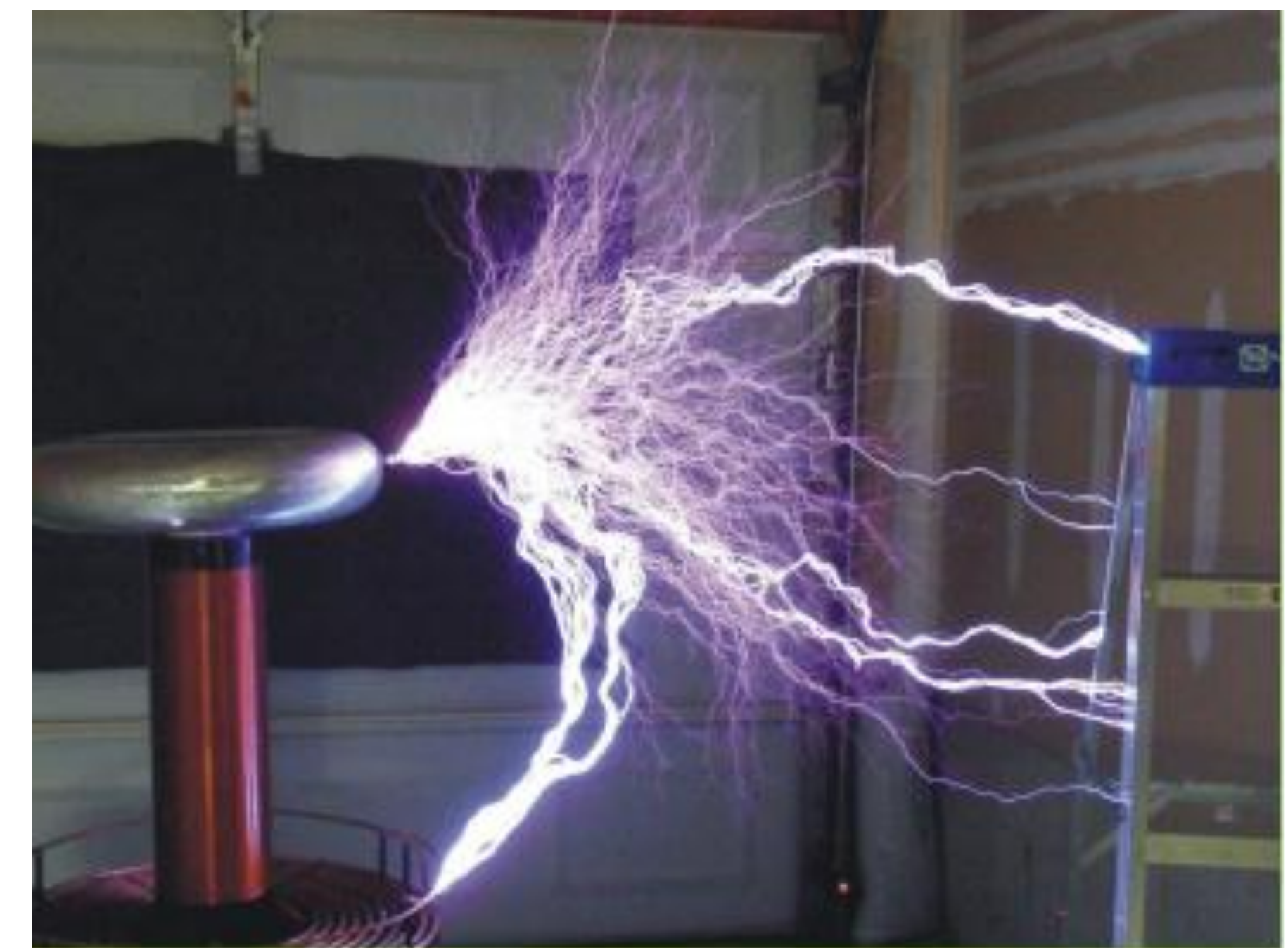
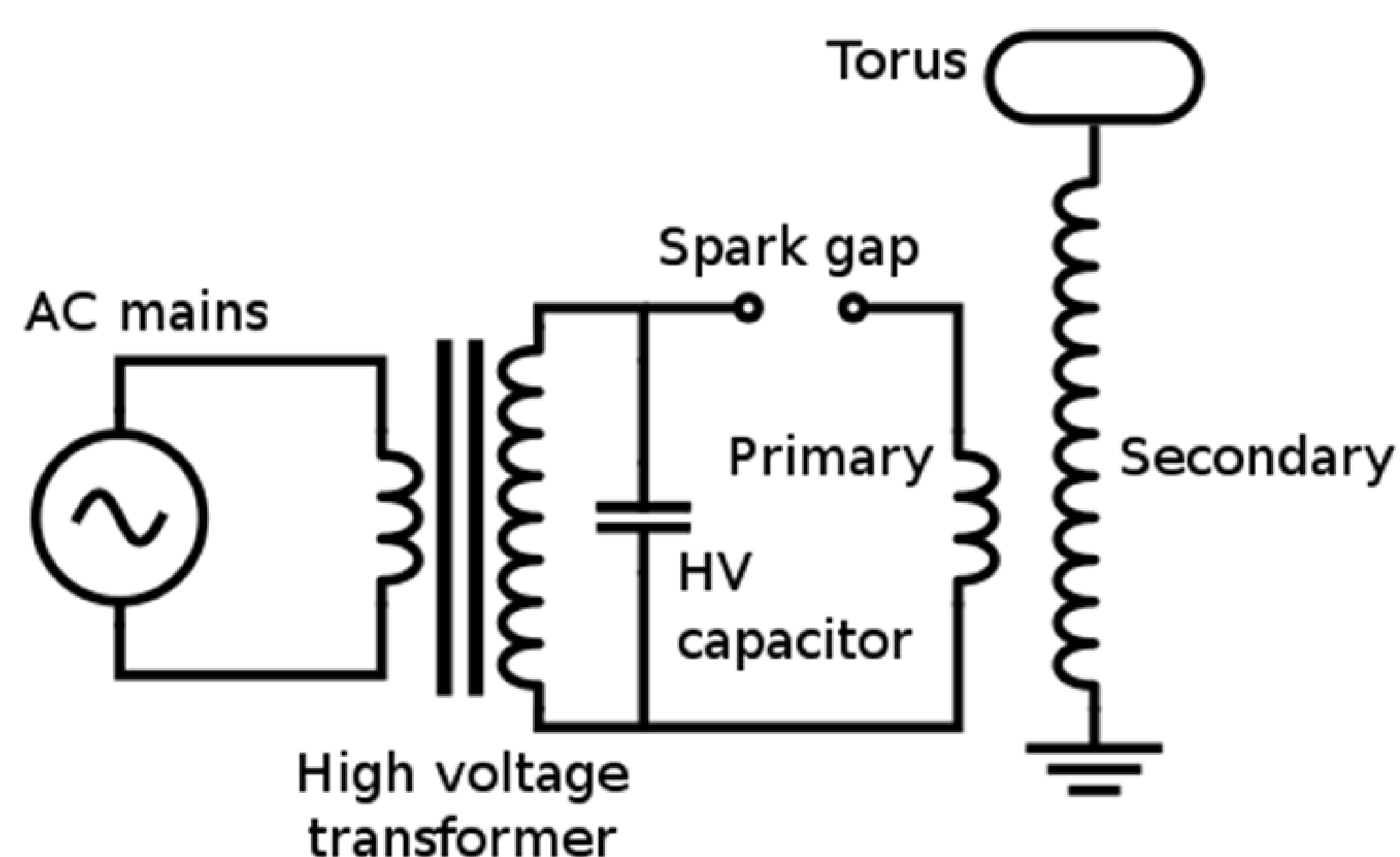
## Guided By:

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## INTRODUCTION

- ✓ A Tesla coil is an electrical resonant transformer circuit designed by inventor Nikola Tesla in 1891. It is used to produce high voltage, low current, high frequency alternating current electricity.
- ✓ A Tesla coil is an air-cored resonant transformer. It has some similarities with a standard transformer but the mode of operation is somewhat different.
- ✓ A standard transformer uses tight coupling between its primary and secondary windings and the voltage transformation ratio is due to turn ratio alone. In contrast, a Tesla coil uses a relatively loose coupling between primary and secondary, and the majority of the voltage gains is due to resonance rather than turn ratio.
- ✓ A normal transformer uses an iron core in order to operate at low frequencies, whereas the Tesla coil is air cored to operate efficiently at much higher frequencies.

## SCHEMATIC DIAGRAM



Working condition of Tesla Coil

- ✓ Energy is gradually transferred from the primary resonant circuit to the secondary resonant circuit. Over several cycles the amplitude of the primary oscillation decreases and the amplitude of the secondary oscillation increases. When the secondary voltage becomes high enough, the Toroid is unable to prevent breakout and sparks are formed as the surrounding air breaks down.
- ✓ Eventually all of the energy has been transferred to the secondary system and none is left in the primary circuit. If the spark gap continues to conduct then energy begins to transfer from the secondary circuit back into the primary circuit. This energy transfer process can continue for several hundred microseconds.
- ✓ During each energy transfer some energy is lost in either the primary spark gap, RF radiation or due to the formation of sparks from the secondary. This means that the overall level of energy in the Tesla Coil system decays with time. Therefore both the primary and secondary amplitudes would eventually decay to zero, so the spark gap stops conducting.
- ✓ Since the spark gap is now open-circuit the tank capacitor begins to charge again from the HV supply, and the whole process repeats again.

## COMPONENTS

- ✓ High voltage power supply
- ✓ High voltage capacitor
- ✓ Primary coil
- ✓ Secondary coil
- ✓ Toroid

## ADVANTAGES

- ✓ Absence of iron core in transformer so saving in cost and size
- ✓ Pure sine wave output
- ✓ Slow buildup of voltage over few cycles hence no damage due to switching surges

## OPERATION

- ✓ The spark gap initially appears as an open-circuit. Current from the HV power supply charges the primary tank capacitor to a high voltage. The voltage across the capacitor increases with time.
- ✓ Eventually the capacitor voltage becomes high so that breakdown of air in the spark gap occurs. The capacitor is now connected across the primary winding through the spark gap and forms a parallel resonant circuit. The capacitor discharges its energy into the primary winding in the form of a damped high frequency oscillation. This frequency is usually in hundreds of kilohertz.
- ✓ During the damped primary oscillation energy passes back and forth between the primary capacitor and the primary inductor. Energy is stored alternately as voltage across the capacitor or current through the inductor. Some energy is lost in the primary circuit.
- ✓ The close proximity of the primary and secondary windings causes magnetic coupling between them. The oscillating current flowing in the primary causes a similar oscillating current to be induced in the secondary coil.
- ✓ The self-capacitance of the secondary winding and the capacitance formed between the Toroid and ground result in another parallel resonant circuit being made with the secondary inductance. The resonant frequency of the primary circuit is deliberately chosen to be the same as that of the secondary circuit so that the secondary is excited by the oscillating magnetic field of the primary.

## APPLICATION

- ✓ Education demonstrations
- ✓ Novelty lighting and music
- ✓ Vacuum system leakage detector

## ACTUAL MODEL

