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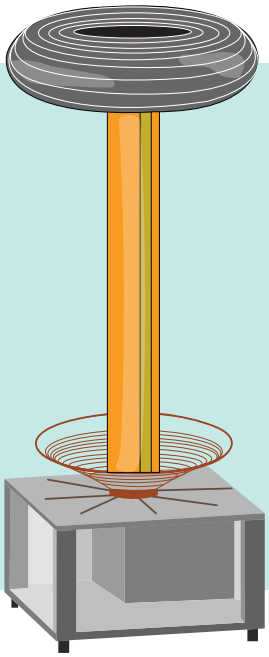
ELECTRIC FIELD, ELECTRIC CHARGE, & POTENTIAL

TESLA COIL



CONCEPT A Tesla coil is a device for creating high voltages. Voltage is a way to measure how much energy an electric charge has. Tesla coils can create voltages over 1 million volts. Typically, such high voltages are dangerous, but the Tesla coil handles high frequency electricity. This means the coil turns on and off so quickly that electricity flows on the outside of skin instead of through the body.

BACKGROUND

Nikola Tesla worked tirelessly to develop a way to supply power without stringing wires across the globe. His experiments culminated in Tesla's US patent No. 454,622 (1891), for use in new, more efficient lighting systems. In its basic form, the circuit calls for a power supply, a large capacitor, the coil (transformer), and adjustable spark-gap electrodes. Although it was the first revolutionary system that could wirelessly transmit electricity, it was not universally adopted as the primary form of powering cities, as hoped.

Early radio antennas and telegraphy used the invention, but variations of the coil can also demonstrate spectacular things like shooting lightning bolts, sending electric currents through the body and creating electron winds.

Tesla developed the coil before conventional iron-core transformers were used to power lighting systems and telephone circuits. These conventional transformers can't withstand the high frequency and high voltage that the looser coils in Tesla's invention can tolerate.

TERMINOLOGY

VOLTS OR VOLTAGE: The standard unit used to measure how strong an electrical current is sent around an electrical system.

CAPACITOR: Also known as condensers, are devices for storing electrical energy, consisting of two conductors in close proximity and insulated from each other.

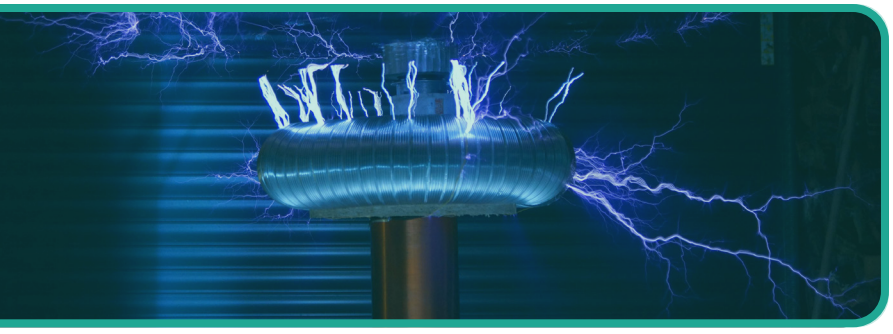
INDUCTORS: Also known as coils, are a passive electronic component that store energy in the form of a magnetic field. In its simplest form, an inductor consists of a wire loop or coil. The inductance is directly proportional to the number of loops in the coil.

FORMULAS

Capacitors (or condensers) and inductors (or coils) are electrically opposite in operation. Whereas current builds quickly in a capacitor as it charges up, voltage lags. In an inductor (coil), voltage is felt immediately, while current is slowed as it works against the magnetic field created as it builds in the coil. If a coil and condenser are sized perfectly for opposite timing—with voltage peaking in the coil just as it reaches a minimum in the capacitor—then the circuit may never reach an electrically quiet, stable state. Like the sloshing of water back and forth in a tub, current and voltage can be made to chase each other back and forth, from end to end of the circuit.

To set his oscillator "ringing," Tesla employed sudden discharges, sparks, across an adjustable gap between two electrodes. Voltage on a capacitor builds until it reaches a level at which air in the gap breaks down as an insulator.

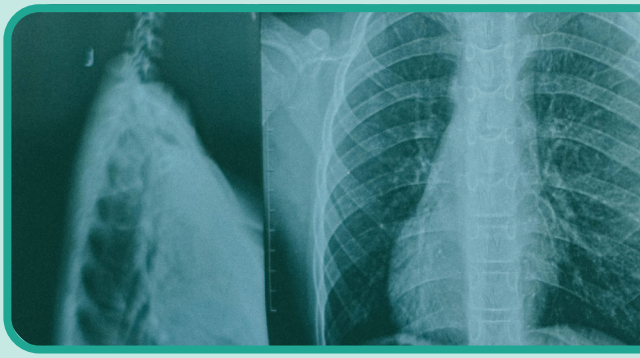
The initial impulse is very powerful—all the energy stored over several microseconds is released in a rush, and that impulse is itself transformed to a higher voltage in passing from the primary coil to the secondary coil. This completes a single cycle in the circuit's operation. The whole process can repeat itself many thousand times per second.



Make sure it measures up

REAL WORLD CONNECTIONS

Tesla coils also operate as powerful radio transmitters. In the early decades of radio, most radios used Tesla coils in their transmission antennas. In addition to radio, Tesla used larger or smaller versions of his coil to investigate fluorescence, x-rays, radio, wireless power, biological effects, and the electromagnetic nature of the earth and its atmosphere.



APPLICATION

Today, high-voltage labs often operate Tesla coils, and amateur enthusiasts around the world build small ones to create arcing, streaming electrical displays which can easily reach a quarter million volts. The coil has become a commonplace in electronics, used to supply high voltage to the front of television picture tubes, in a form known as the flyback transformer.