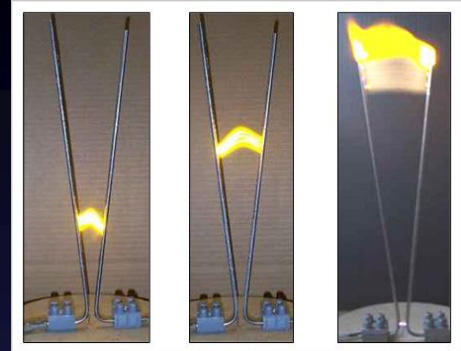# JACOB'S LADDER

What to do
1. Press the button
2. Use the screws to adjust the horns

BEWARE! HIGH VOLTAGE!

How does the Jacob's Ladder work?

A large voltage is applied across the two vertical wires. The wires are separated by air, an insulator, so current cannot travel between the wires. This creates a spark gap.

When the voltage becomes large enough, the electric field from the wires ionizes the air in between the wires. Ionized air is a conductor and a current can now flow between the wires. This is the spark that is observed. The current reduces the charge difference between the wires, lowering the voltage.

The ionized air becomes hot and rises. Because the current travels through the ionized air, the spark also rises. Eventually the distance between the wires becomes too large to maintain a current and the spark disappears. When this occurs, the voltage between the wires builds up again until another spark forms.

Another example of a spark gap is a spark plug. Spark plugs consist of two electrodes separated by a mixture of air and fuel. The two electrodes and the air/fuel form the spark gap. One electrode is connected to a high voltage source. This allows for a spark to be produced to ignite the fuel.

How do you generate such high voltages?

This Jacob's Ladder uses an ignition coil, the same device used in cars to apply high voltages to spark plugs.

An ignition coil is a type of transformer. Transformers consist of a primary and secondary coil, both wrapped around an iron core. When an AC voltage is applied to the primary coil, a time varying magnetic field is generated. This field induces an emf in the secondary coil, equal to the emf in the primary coil.

The voltage in the secondary coil is proportional to the emf of the coil and the number of turns. If there are more turns in the secondary coil then the voltage will be larger than the source voltage.

Ignition coils can thus be used to convert a small source voltage into a voltage large enough to set up a spark gap.

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