

## Electromagnetism and Induction

### Transformers

#### Model of a high-voltage transformer

High-voltage coil with horn electrodes

### Object of the experiment

1. Demonstrate the design and function of a high-voltage transformer with horn electrodes

### Setup



#### Safety notes:

A life-threateningly high voltage develops between the horn electrodes.

Only touch the horn electrodes with the plastic rod (541 04) unless the mains coil is switched off.

Keep the duration of the experiment for demonstration of an arc down to about 1 minute.

### Evaluation

When the high-voltage transformer is assembled, the numbers of windings of the primary and secondary coils are related as follows:

$$\frac{N_1}{N_2} = \frac{500}{23000} = \frac{1}{46}$$

Due to the voltage conversion performed by the high-voltage transformer,

$$\frac{N_1}{N_2} = \frac{U_1}{U_2}$$

the secondary voltage is 46 times greater than that of the primary, which in this experiment makes it about 10 kV.

An electrical field develops across the horn electrodes on top of the apparatus when the primary coil is switched on.

The strength of the field is at its greatest where the electrodes are closest together.

Due to ionisation caused by collisions between the charge carriers produced and molecules of air, additional charge carriers are released at this point, which greatly increases the electrical conductivity of the air.

A gas discharge then takes place in the form of an electric arc.

As the arc rises up the electrodes, the distance between the two electrodes becomes greater and the strength of the field between them decreases. This is why the arc fizzles out.

### Apparatus

1 U-core with yoke.....	562 11
1 Clamping device with spring clip.....	562 121
1 Mains coil, 500 turns.....	562 21
1 Coil, 23 000 turns .....	562 17
2 Saddle base.....	300 11
2 Demonstration insulator.....	540 52
2 Connecting lead, 19 A, 25 cm, black.....	500 414

### Procedure

- Set up the experiment as shown in the picture. Position the horn electrodes in such a way that the bottoms of the electrodes are about 3 mm apart.
- Turn on the mains coil and observe the arc.

### Observation

An arc is triggered between the bottoms of the horn electrodes, which then rises up the electrodes before fizzling out.

Remark:

If no arc is triggered, the separation of the two electrodes needs to be reduced.

Turn off the mains coil to do this or use the plastic rod.