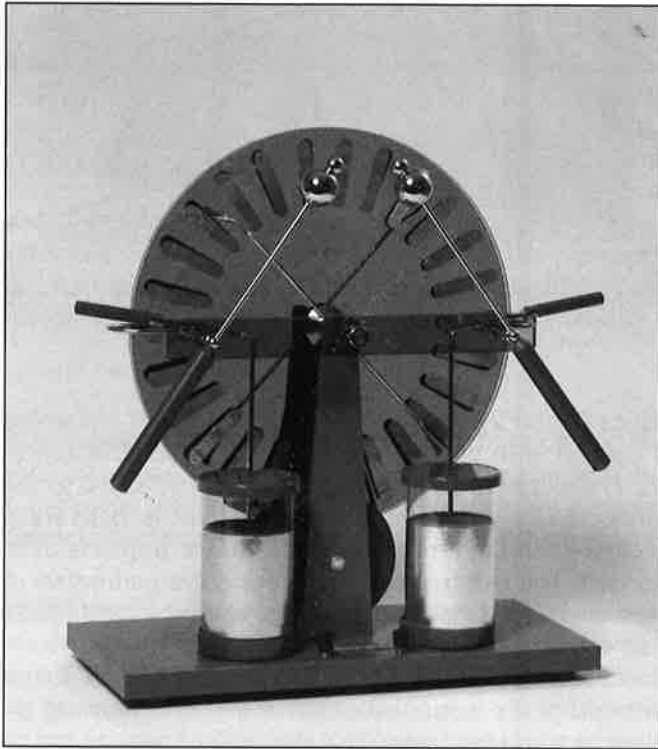


Armado 3
Balda 3.

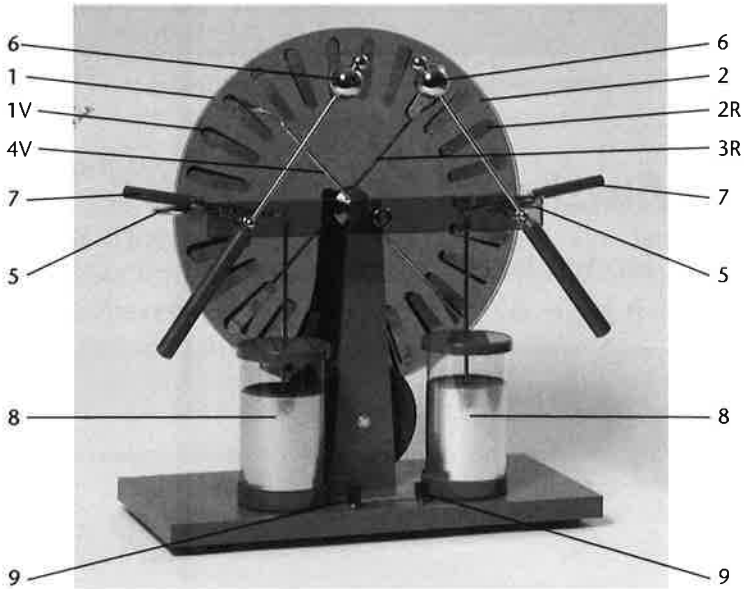
Manual

Wimshurst Machine

Order number 50315



Cornelsen
EXPERIMENTA



The Wimshurst Machine is a device for generating very high DC voltage.

Description:

Two circular discs (1 and 2), made of plexiglass and with a diameter of 31 cm, are mounted parallel with one another and with a short distance apart on a horizontal axis. The axis rests on two struts which are attached to the base plate. Each disc is connected independently to the drive shaft via belts and pulleys. One of the belts is crossed and as result the discs rotate in opposite directions when the crank is turned. The external surfaces around the perimeters of both discs are covered with metal foil stripes (1V and 2R). In front of each disc a conductor arm is mounted diagonally (3R and 4V), which can be rotated on their axes and which are fitted with metal brushes that drag over the metal foil stripes of the discs. The front end of the axle is extended and connected with the insulating bar (5) by means of a knurled screw. The charge is collected from the two discs by metal brushes located at the end of the insulating bar, which do not touch the discs. These brushes are connected to the two ball ended electrode rods (6) and by means of the lever rods (7) to the two Leyden jars (8). The Leyden jars of glass are coated with metal foil outside and inside. The two terminals (9) are connected to the outer coating of the Leyden jars and are used to draw off an AC voltage. Regularly the terminals are short circuited to enable a DC voltage to be drawn off. The maximal spark length obtainable with this machine is about 120 mm. The short circuit current is approx. 30 μA .

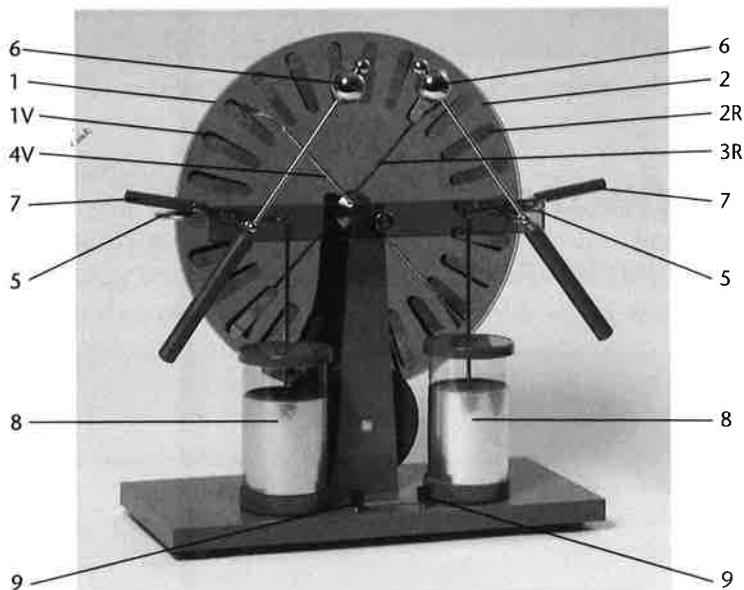
Operating principle:

Initially the charge on the metal foil stripes is only small, but static induction created during operation of the device increases this charge until the operating voltage has been reached. For example, if the metal stripes on disc (1V) are charged positively against the brush (3R) this will induce a negative charge on the opposite metal stripes (2R), and an equivalent but positive charge will flow across the brush (3R) to the diametrically positioned metal stripes (2R), where it binds a corresponding negative charge on the opposite metal stripes (1V). The disc (2) is then rotated so that the negatively charged coating (2R) referred to previously comes to a rest opposite the brush (4V). Here a positive charge is induced in the stripes (1V), while the corresponding negative charge is applied via the brush (4V) to the diametrically opposed stripes (1V). Here it again binds a positive charge on the opposite stripes (2R). Following this stage we examine the corresponding rotation of disc (1), which positions the positively charged stripes (1V) opposite the brush (3R). Although they are described as taking place in sequence, in actual fact these two actions take place simultaneously. Positive or negative charges are induced on disc (1) under the brush (4V) as a result of the influence of the charges on disc (2). After passing the opposite brush (3R) and after having induced positive or negative charges on the corresponding metal stripes on disc (2), these charges are further conducted until they are discharged through the brushes. The same process takes place simultaneously on disc (2).

Operation:

The machine is supplied ready for use. The best position for the diagonally mounted conductor arms (3 and 4) is reached when they cross at an angle to the insulating bar of approx. 45° (see ill.). When the Leyden jars are connected more electrical capacity is discharged by arcing, but without increasing the length to the spark.

The polarity of the electrodes can be determined by charging up an electroscope (e.g. order no. 50110). In case the electroscope can be discharged by making contact with the Plastic Rod (order no. 50015) which has been charged through friction before, this proves that the electrode in use is charged positive, because the plastic rod has acquired a negative charge by being rubbed with wool. If the electroscope receives an additional charge, this demonstrates that the electrode is negative. A change of polarity does not occur while the machine is operating. The polarity can only alter following an interval. To discharge AC voltage via the terminals (9), the electrodes (6) must be placed so close together that only a small spark can jump the gap.



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Experiments:

The Wimshurst machine can be used as a power source for electrostatic experiments e.g. using the Equipment for Electrostatic Experiments (order no. 50331).

Additional informations:

In case the machine only operates when rotating in an anti-clockwise direction, this is due either to the fact that the diagonal conductor arms (3 and 4) are incorrectly positioned or because the belts are not correctly attached.

If the brushes of the conductor arms (3 and 4) are very worn, trim the ends very slightly to ensure a clean metal surface.

A too low power output can be occurred by a defective insulation given by dust on the operating parts or a high humidity in air around the machine. Then it may be necessary to clean all parts from dust or to blow a warm dry airstream from a heater over the machine for some minutes before starting the experiments. Only the brushes on the diagonal conductor arms (3 and 4) should come into contact with metal foils on the discs. The brushes (5) should only be close to the discs without actually touching them.

The Leyden jars of glass may crack sometimes. They should therefore be examined to ensure their conductivity. If defective, the jars will only produce a very small spark. In order to fully discharge the Leyden jars, the external coating should briefly be connected to the upper end of the rod, or the two ball ended electrodes can be connected for a short time. The smell produced when the machine is operating is due to the fact that the sparks produce a chemical reaction, converting the oxygen in the air into ozone.

For educational purposes it is allowed to exceed the limit value of EN 55011 (class A) shortly.