**Note**:

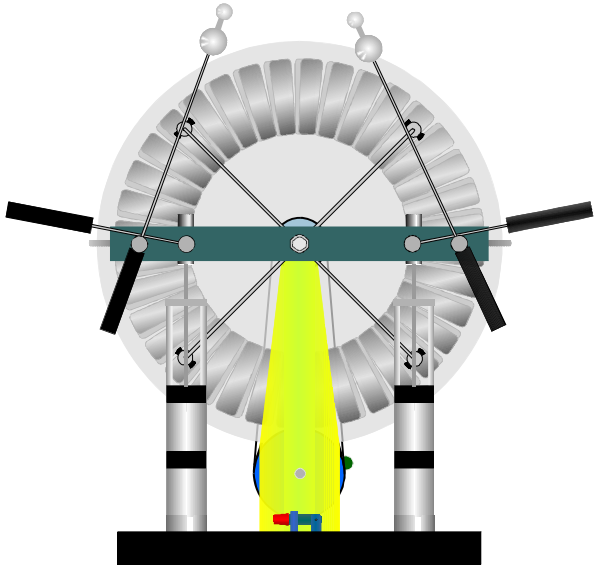
- This device may only be operated by qualified personnel or by persons they instruct in its use. **Supervision is obligatory.**
- Take care that the device does not fall during repositioning, packing or unpacking. In the event this does occur, have the device repaired immediately by authorized service personnel.
- In the event that unforeseen difficulties arise during operation, immediately notify the dealer. A high risk of danger exists if the device does not operate without difficulty. Therefore, always take care that the device is set up on a stable surface.
- The device may be repaired only be authorized service personnel.
- Do not use any connecting leads > 3 m in length
- EMC standards: EN50081-1, EN50082-1, EN60555
- Right to modifications and errors reserved

CE

NTL

# DE523-1A
# Wimshurst machine

**Manual**

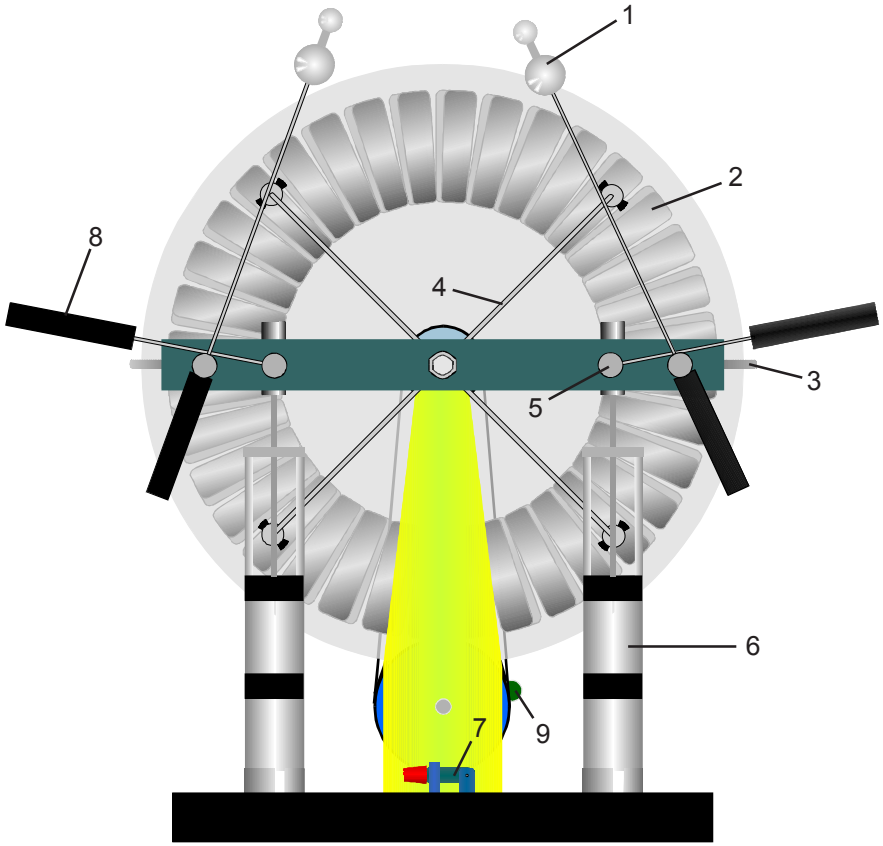


**Use:**

The Wimshurst machine is a device for generating very high DC voltages. Using electrostatic induction, it continuously separates and reinforces charges collecting on metal strips. This continues until the charges on the strips are so strong that they jump over to the tapping arms on the side and then collect on the spherical electrodes. Once the difference between the charges of the two spherical electrodes reaches a sufficient magnitude, a spark jumps from one electrode to the other. Two Leyden jars (high voltage capacitors) can be connected in parallel to the instrument by means of lever rods. The energy stored in the Leyden jars reinforces the spark when it jumps (flash).

The amount of voltage that may be achieved is dependent on atmospheric influences such as air pressure, temperature and humidity as well as on the speed of the disc and the position of the compensating conductor arms.

The machine can generate up to 160,000 V and 20-30 µA. Maximum spark length 100 mm.




01 - Spherical electrode

02 - Metal strips

03 - Tapping arms

04 - Compensating conductor arms

05 - Connection jacks

06 - Leyden jars

07 - Isolating switch (AC)

08 - Lever bar for Leyden jars

09 - Crank

**Alternating current / voltage:**

The Wimshurst machine generates a DC potential between points A1 and A2. The following steps can be taken in order to generate alternating current: First, reduce the distance between the spherical electrodes to between 5 and 8 mm. Only small sparks jump from one side to the other. Now open the isolating switch on the base. Current is collected from the two switch terminals. (The isolating switch connects the two lower connections of each of the Leyden jars; *it is not shown in the diagram*.) With each discharging spark between the spherical electrodes, the polarity of the switch terminals is reversed and the device consuming electricity receives „alternating current".

**Caution:** This device may only be operated by qualified personnel or by persons they instruct in its use. Avoid contact with parts under current.

## Technical data:

| | |
|---|---|
| Output voltage: | Max. 160,000 V, $I_{max}$ = 20 … 30 µA |
| | Spark length: Max. 100 mm |
| Disc diameter: | 300 mm |
| Metal strips: | grainy metal layer 10 x 60 mm; 28 strips per disc |
| Leyden jars: | set of 2; glass tube Ø = 32 mm; capacitance 40…50 pF |
| Electrodes: | outer electrode – aluminium foil; inner electrode – aluminium chips |
| Power: | Hand crank powering belt discs, one belt crossed |
| Dimensions: | approx. 352 x 400 x 250 mm |
| Weight: | approx. 4.1 kg |



## Operation:

Place the device on an insulated surface. Prior to each experiment, electrodes should be discharged. To do this, move the electrodes together. The brushes of the conductor arms should only slightly contact the strips.
The conductor arm (4) on the crank side should be positioned at a 45 ° angle, from the top left to the bottom relative to the perpendicular, and the one at the rear at a 90 ° angle to the first one.
**Note:** The Wimshurst electrostatic generator, a self-exciting device, separates and reinforces charges through **influence** or electrostatic induction, not through frictional electricity. The conductor arms positioned at an angle to the plates do not, therefore, ***„brush or rub"*** the disc, rather they touch it only lightly, serving to compensate the charges between pairs of strips (2) (refer to section on „functioning"). The tapping arms (3) should be at least 1-2 mm from the discs.
The nuts on the Plexiglas lids of the Leyden jars should not be tightened, nor may the glass jars show any cracks, otherwise there is a danger of a short-circuiting. Now lower the two lever rods for the Leyden jars (8). The isolating switch on the base must be closed (please refer to functioning of the electrostatic induction machine).
When cranking (9) as shown by the arrow, the disc on the crank side must rotate in clockwise direction and the disc on the side of the spherical electrodes must rotate in the opposite direction (crossed belts). Set the distance between the spherical electrodes to a maximum of 100 mm. One of the two electrodes should always be positioned slightly higher than the other one. Now begin to crank the apparatus...
The polarity of the charges is not predetermined, yet it does not change during a given experiment. Touch each of the spherical electrodes (1) one after the other with a glow lamp; only the negative electrode causes the lamp to glow.

Make sure that the copper brushes of the conductor arms only touch the strips lightly. Despite this, a few grains may nonetheless come free of the strips during initial use.

Always keep the discs dry and free of dust. Clean with a lint-free cloth. Only use pure naphtha as a cleaning fluid.

**Collecting potential:**

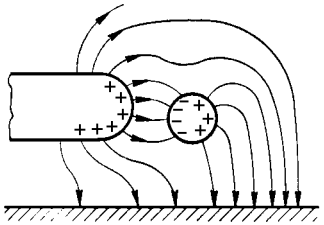
Electrical potential may be collected directly at the terminals of the Leyden jars or from rods of the spherical electrodes using crocodile clips. Keep connecting leads apart as these are only able to isolate up to about 4 kV. Sparks may be reinforced by additionally connecting the Leyden jars, yet this has no effect on spark length.

**The machine does not function:**

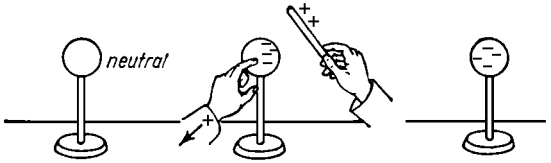
- If the machine only functions when cranked in a counter-clockwise direction, either the conductor arms or the belts are reversed. - Please refer to the information in the section on „Operation".
- Are the discs soiled or moist? Clean them or dry them with a hairdryer.
- Check the glass of the Leyden jars for cracks (cause short-circuiting).

**Electrostatic induction (influence):**

Under normal conditions, a metal object contains an equal number of negative and positive charges. As these charges are distributed evenly over the object, on the outside it is electrically neutral. Yet if the object is moved toward an electrically charged object, for instance a charged Plexiglas rod, the opposite charge of the metal object will be attracted to the Plexiglas rod and collect there. This phenomenon is termed electrostatic induction or influence. When the Plexiglas rod is once again moved away from the vicinity of the metal object, it has no more influence on the charges. The effect of electrostatic induction is thus only temporary.



Influence




Charging an isolated metal object through electrostatic induction

The effect of electrostatic induction may easily be demonstrated. Set a metal object, for instance a sphere, on a base and move a positively charged acrylic rod toward it. Then touch the opposite side of the sphere briefly with your finger and take away the rod once again. Testing with an electroscope reveals that the metal object is negatively charged, without having contacted the Plexiglas rod. The **free positive charge** flowed through your hand to the ground, while the acrylic rod, capable of electrostatic induction, bound the negative charge to the metal object.

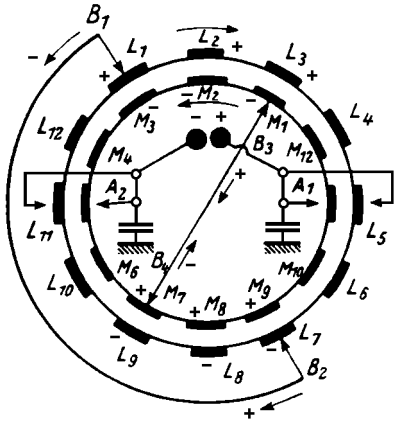
The electrostatic induction machine utilizes this method for separating charges. Here the conductor arms, acting like your finger, conduct the charges, not to the ground but, in intervals, back to the strips on the other side.

**Functioning:**

The Wimshurst machine utilizes the residual charges on the metal strips and belongs therefore to the group of „self-exciting“ machines. The **polarity** of the high voltage that is discharged is not, therefore, predetermined, rather it depends on the polarity of the residual charges present when the machine begins operating.

The machine generates an electrical field between the spherical electrodes i.e. between points A1 and A2. Pay attention to the position of the conductor arm brushes (B1 and B2, B3 and B4). In the following, we assume that strip M9 has a small positive residual charge. The charges on metal strip L7 are separated due to electrostatic induction (refer to diagram below). Particles carrying negative charges are opposite strip M9 (on the disc side), while the positive charges collect on the surface facing brush B2. Strip L1 thus receives a slightly positive charge compared with conductor arm B1. During rotation, strip L1 is positioned first at L2 then






at L3. At this point it is opposite conductor arm B3. A negative charge is electrostatically induced in this arm, while positive charges are repelled toward strip M7. Let’s follow strip M1 further as it travels on to M2 and M3. Here the charge on strip M3 excites a positive charge in the strip currently opposite it, i.e. L1, and conversely repels the negative charge toward strip L7. Strip L1, which has become positively charged, returns to L3 and there excites once again the process which reinforces the charge. In addition, L3 takes up position L5 and there gives off its charge to A1 to be consumed. These processes continue repeatedly until the charging cycle comes to an end with a discharge taking place between the spherical electrodes or through a device consuming electricity.