PHYWE excellence in science

Van-de-Graaf generator

07645.90... 99

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Operating instructions

CE The unit complies with the corresponding EC guidelines.

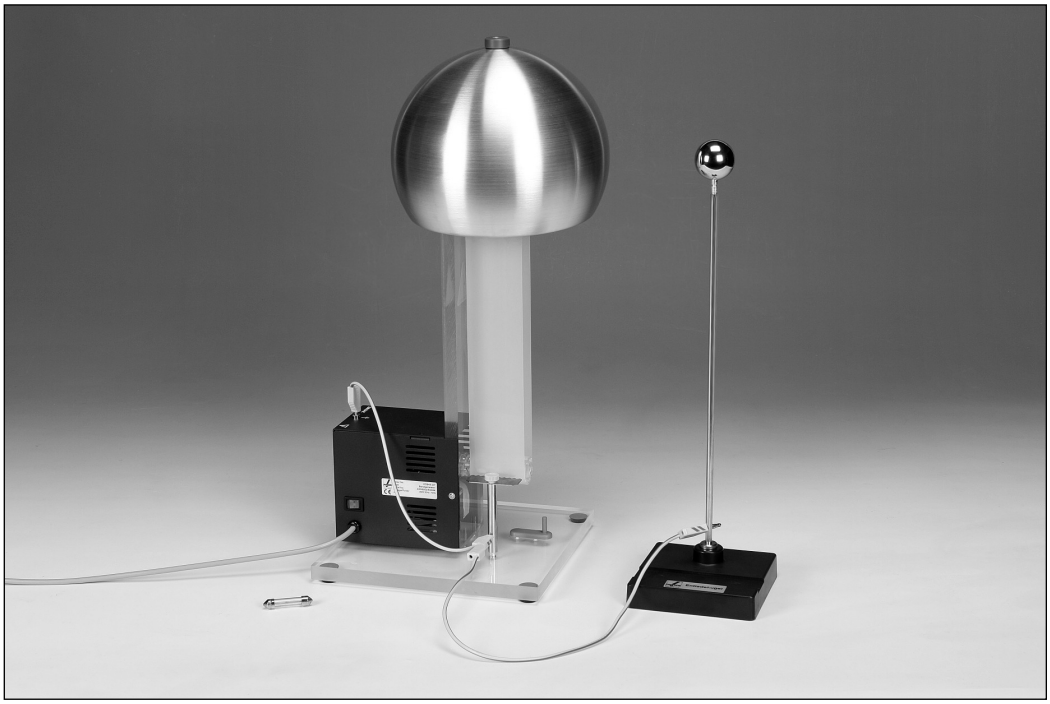

Fig. 1: Van-de-Graaf generator 07645.97.

1 SAFETY PRECAUTIONS

- Carefully read these operating instructions completely before operating this instrument. This is necessary to avoid damage to it, as well as for user-safety.
- Check that your mains supply voltage and mains frequency corresponds to that given on the type plate fixed to the instrument.
- Only use the instrument for the purpose for which it was designed.
- Only use the instrument in dry rooms in which there is no risk of explosion.
- Do not start up this instrument in case of visible signs of damage to it.
- The Van de Graaff generator is only to be operated by a qualified teacher.
- When the Van de Graaff generator is to be driven by the motor, be sure to check that the manual crank handle has been removed from the driving roller before switching on.

Caution!

- **Do not allow endangered people (e.g. people with a cardiac pacemaker) to linger near the instrument when it is in operation.**

2 GENERAL CHARACTERISTICS AND OPERATING MODE

The Van de Graaff generator serves to generate a very high direct voltage which enables electrostatic phenomena to be particularly well demonstrated. Despite the high voltage, working with the instrument is not dangerous as the currents that can be drawn off are very small (short-circuit current < 10 µA).

The Van de Graaff generator can be driven either by the mains-operated motor contained in it or by means of the manual crank handle. The latter is recommended to didactically show that voltage can be generated without connection to the electric mains.

The endless transport belt runs over two rollers and is driven by the lower acrylic glass roller. The upper roller is made of Teflon. Contact electricity causes this exciter roller and the belt to become charged with opposite charges. The positive charge on the part of the belt that is running down adheres to the belt. When this part of the belt reaches the metal comb, a charge of opposite sign is sprayed onto it, but this is subsequently removed by the second comb, which is conductively connected to the conductor sphere. As this process is continually repeated, the excess of charge on the conductor sphere, and so also the voltage on it, continually increases until the insulating capacity of it is reached.

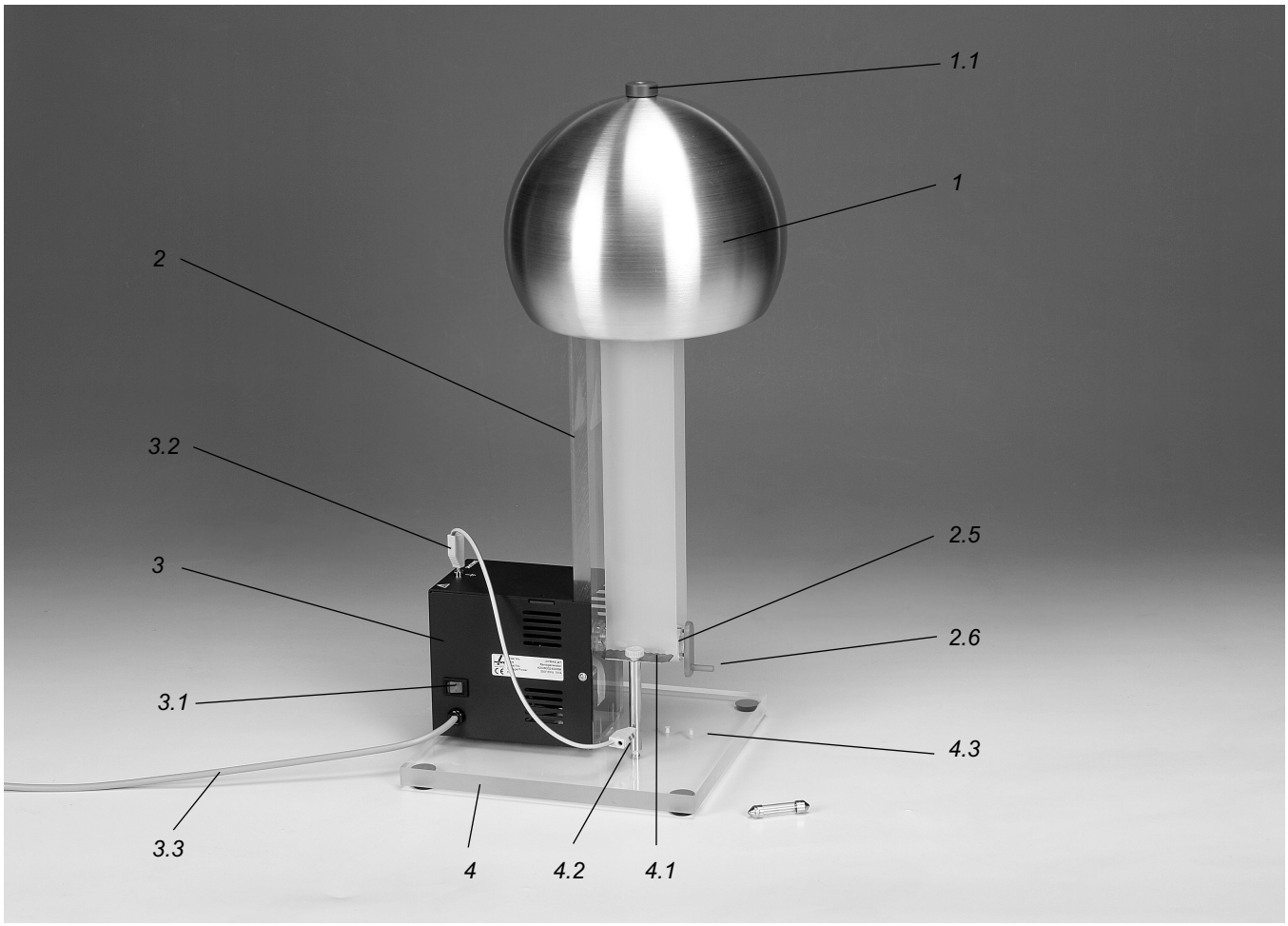

Fig. 2: Van-de-Graaf generator 07645.97.

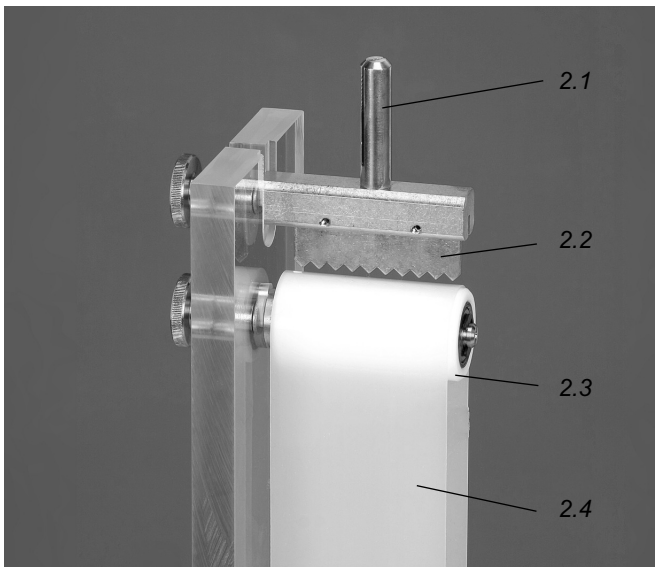

Fig. 3: Van-de-Graaf generator without conducter sphere.

3 FUNCTIONAL AND OPERATING ELEMENTS

1 Conductor sphere
Removable sphere seated on a pin *(2.1)* on the acrylic glass support *(2)*. It has an integrated 4 mm socket *(1.1)* for connection of other pieces of equipment, e.g. of a film brush for demonstration of the electrostatic repulsion between bodies having like charges.

2 Holder for the transport device (acrylic glass support)
2.1 Pin on which the conductor sphere is placed (*1)*
2.2 Upper metal comb for charge up-take, height adjustable and lockable in position with a knurled thumbscrew.
2.3 Teflon roller,
height adjustable and lockable in position with a knurled thumbscrew.
2.4 Transport belt
2.5 Driving roller with blind holes in the front in which the manual crank handle fits *(2.6)*.
2.6 Manual crank handle

3 Protective housing with motor
3.1 On/off switch
3.2 4 mm Earthing socket, connected to protective earthing
3.3 Mains lead with plug with earthing contact

4 Base plate with rubber feet
4.1 Metal comb for applying charges
4.2 4 mm Diameter bore for the earthing cable
4.3 Pair of holes for holding the manual crank handle so that it does not get lost.

Fig. 4: Impressively demonstrated: Like charges repel each other.

4 HANDLING

4.1 Putting into operation and handling of the Van de Graaff generator

The Van de Graaff generator is ready for use when the conductor sphere has been fitted on and connection has been made between the metal comb *(4.1)* and the earthing socket *(3.2)* via socket *(4.2)* using the connecting cable supplied. When first switched on (on/off switch *3.1*), or after the belt has been replaced, the Van de Graaff generator usually requires 2 - 5 minutes warm-up time before it reaches full performance.

When an object which is well or less well earthed is brought nearer to the charged conductor sphere, a discharge process occurs that results in either a dark discharge, a needle-point discharge, a corona discharge or a spark-over (arcing). This also occurs with the human body. When the conductor sphere is firmly held on to, the continuous current that flows through the body is hardly perceptible. Arcing on to insensitive parts of the body, such as a hand, is not at all dangerous, although it can cause somewhat of a shock effect under some circumstances. If this is to be avoided, then a distance of 15 to 20 cm should be maintained.

When the Van de Graaff generator is switched off, it only discharges relatively slowly because of the good insulation of the conductor sphere, so that a high voltage may be on it for some time. For quick discharging, touch the conductor sphere with the free end of a connecting cable that is connected to earth.

If required, the Van de Graaff generator can be operated using the crank handle that is supplied. This can be useful when only small charges are to be worked with.

Caution

When the Van de Graaff generator is to be driven by the motor, be sure to check that the manual crank handle has been removed from the driving roller before switching on.

Take care that the belt is only so much tautened by the Teflon roller *(2.3)* that the motor can still freely start up, otherwise the motor could be damaged.

Avoid unnecessarily long operating times of the generator because, due to its function, it could cause unavoidable high-frequency disturbances.

Also take care that the length of connected leads that are used does not exceed 1 m.

Do not brake a switched-on motor down to standstill.

Caution!

Do not allow endangered people (e.g. people with a cardiac pacemaker) to linger near the instrument when it is in operation.

4.2 Varying voltage and determining polarity

When a measurement requires a lower voltage than the voltage of the non-loaded generator, you can adjust the voltage by withdrawing an appropriate loading current from the conductor sphere. The simplest way to do this is to bring an earthed metal tip near to the conducting sphere. As a result of the gas discharge that occurs, the current flowing across the metal tip reduces the generator voltage. The smaller the distance between the metal tip and the conductor sphere, the greater the voltage reduction.

The high generator voltage can be particularly clearly demonstrated by arcing. To do this, earth the 40 mm conducting sphere on a rod that is standardly supplied and bring it nearer to the generator conducting sphere.

The sign of the applied charge can be determined using a neon tube, also standardly supplied. Simply hold this with your hand on one of the caps and bring the other cap nearer to the conductor sphere. The cathodic glow at the negative electrode of the tube lights up when the distance is appropriately small. Do not let any small sparks jump across to the tube, however, as they would destroy it.

4.3 Notes on operation

This high-quality instrument fulfils the technical requirements compiled in the current European Community Guidelines. The product characteristics justify the CE-mark.

The instrument is only to be operated in technical rooms in teaching, research and training facilities under the supervision of qualified personnel. The person or persons responsible for the carrying out of experiments and demonstrations must take all necessary measures (e.g. screening, short lead lengths, short operating times) to ensure that the intended function of equipment operating outside of the technical room or in the direct electromagnetic environment is not impaired. The experimental set-up can exceed Class A (Group 2, EN 55011 norm) limiting values. The arcing that results during discharging can cause radio disturbances at distances of up to some hundred metres. Further to this, the instrument should not be operated in the vicinity of electronic equipment such as computers and digital measuring instruments, as they could be destroyed by the high voltage of the Van de Graaff generator. The maximum uninterrupted operating time when the generator is motor driven is not to exceed 1 hour.

4.4 Maintenance

Prerequisite for the perfect functioning of the Van de Graaff generator is that the critical instrument components for charge generation, charge transport and charge storage are kept free of dust and moisture. The acrylic glass support *(2)* provides very good insulation when clean and dry. We recommend, however, that you use a fluff-free cloth wetted with water containing washing-up agent or alcohol to clean this support, the transport belt and the two rollers from time to time. The subsequent drying can be speeded up by using a fan.

When the time comes that the transport belt has become unusable, replace it as follows: Remove the conductor sphere and push the new belt over the two rollers. The new belt centres itself automatically during operation. When pushing it on (and also during operation), make sure that it is not scratched by the combs. This would reduce both the generator performance and the service life of the belt. The two combs should each be at a distance of approx. 1 mm from the transport belt. Please take into consideration that it takes 2 to 5 minutes for the new or reversed belt to provide full performance.

If the motor does not start, the cause could be that the transport belt is too taut.

5 TECHNICAL SPECIFICATIONS (typical for 25°C)

Air humidity < 50%

The instrument corresponds to protection class I and is only to be connected to electric sockets with protective conductor protection (PE).

Connecting voltage (+6%/-10%)	see the type plate
Mains frequency (Hz)	see the type plate
Power consumption	approx. 70 VA
Direct voltage	max. (150 - 200) kV
Short-circuit current	< 10 µA
Conductor diameter	200 mm
Conductor capacity	approx. 15 pF
Rotational speed	approx. 2800/min
Connectors	4 mm bore in holding rod (+ pole) 4 mm socket on conductor sphere (- pole)
Dimensions	270 x 240 x 560 (mm)
Weight	approx. 5 kg

6 LIST OF EQUIPMENT

Parts supplied:

Van de Graaff generator
Conductor sphere, *d* = 40 mm on insulated base
Neon tube
2 Connecting cables

Replacement material

Transport belt	07643.01

Recommended accessory

Set of electrostatics apparatus	07644.00

7 NOTES ON THE GUARANTEE

We guarantee the instrument supplied by us for a period of 24 months within the EU, or for 12 months outside of the EU. Excepted from the guarantee are damages that result from disregarding the Operating Instructions, from improper handling of the instrument or from natural wear.

The manufacturer can only be held responsible for the function and technical safety characteristics of the instrument, when maintenance, repairs and alterations to the instrument are only carried out by the manufacturer or by personnel who have been explicitly authorized by him to do so.

8 WASTE DISPOSAL

The packaging consists predominately of environmentally compatible materials that can be passed on for disposal by the local recycling service.

Should you no longer require this product, do not dispose of it with the household refuse. Please return it to the address below for proper waste disposal.

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