

The van de Graaff Generator and the Lightning Rod

ABSTRACT:

The van de Graaff generator consists of a belt of very low conductivity that carries electric charges from a source near its base to a sphere where they collect until they form a voltage sufficient to arc to a nearby grounded electrode. A thumbtack placed on the sphere will cause the charge to flow out from the sphere preventing the discharge, so it serves as a lightning rod.

DISCUSSION

The figure is a sketch of a van de Graaff generator. It consists of a base with a motor that drives a long non-conducting belt that ends inside a large conducting sphere. The base may be connected to ground.

As the belt comes off the drive pulley at the bottom it is given a slight charge by the brush, either because the brush and belt generate the charge (as hair stands on end when brushed on a dry day) or because a battery is connected in series with the brush. This charge is carried by the belt to the brush inside the sphere, gaining energy as it rises. The brush transfers the charge to the sphere where electrostatic forces carry it to the outside where it distributes itself over the sphere and raises its voltage. This continues until the voltage is sufficient for an arc to jump from the sphere to the grounded ball.

If a thumbtack is placed on top the sphere, so its point is away from the sphere, as the voltage of the sphere rises the electric field at the point of the tack will be much higher than that on the sphere, causing the nearby air to ionize carrying off the charge (if the room is very dark a glow should be visible at the point). Since charge is leaving the sphere it will not gain enough voltage to produce an arc. The thumbtack is acting like Ben Franklin's lightning rod.

