

Electroscope

An electroscope is a scientific instrument that is used to detect the presence and magnitude of the electric charge on an object. It was the first electrical measuring instrument. The first electroscope was invented by British physicist William Gilbert around 1600.

Pith ball electroscope:

The pith ball electroscope, invented by British schoolmaster and physicist John Canton in 1754, consists of a small ball of lightweight nonconductive substance, originally a spongy plant material called pith, the ball is suspended by a silk thread from the hook of an insulated stand (Fig. 1). In order to test the presence of a charge on an object, the object is brought near to the uncharged (or electrically neutral) pith ball. If the object is charged, the ball will be attracted to it and will move toward it. The attraction occurs because of the induced polarization of the atoms inside the pith ball. The pith is an insulator (or nonconductor), so the electrons in the ball are bound to the atoms of the pith. These atoms are not free to leave the atoms and to move in the ball, but they can move a little within the atoms.

The pith ball can be charged by touching it to a charged object, so some of the charges on the surface of the charged object move to the surface of the ball. Then the ball can be used to distinguish the polarity of charge on other objects because it will be repelled by the objects charged with the same polarity or sign it has, but attracted to charges of the opposite polarity.

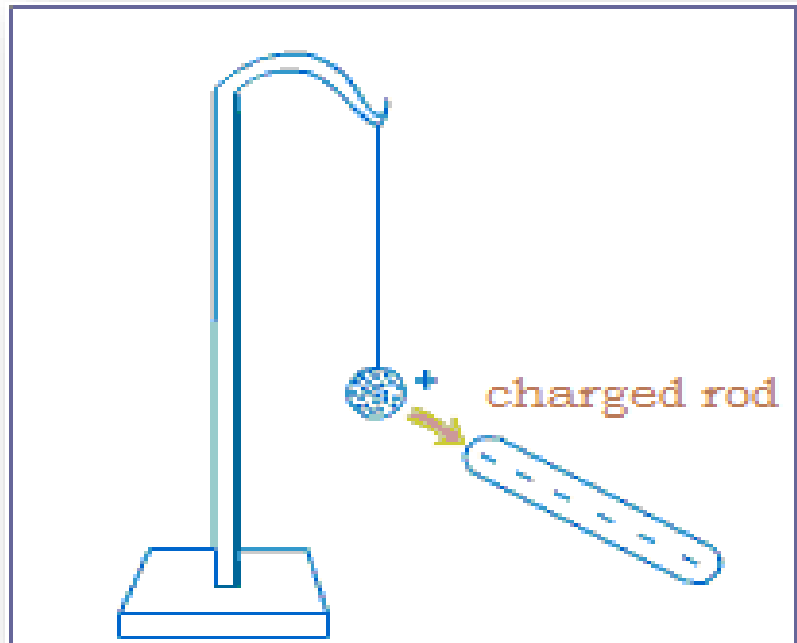


Fig. 1: A pith ball electroscope.

Gold leaf electroscope:

The gold leaf electroscope was developed in 1787 by British priest and physicist Abraham Bennet, as a more sensitive instrument than pith ball (or straw-blade electroscopes) then in use. It consists of a vertical metal rod, usually brass, from the end of which two parallel strips of thin flexible gold leaf hang. A disk or ball terminal is attached to the top of the rod, where the charge to be tested is applied to protect the gold leaves from drafts of air they are enclosed in a glass bottle, usually open at the bottom and mounted over a conductive base (Fig. 2).

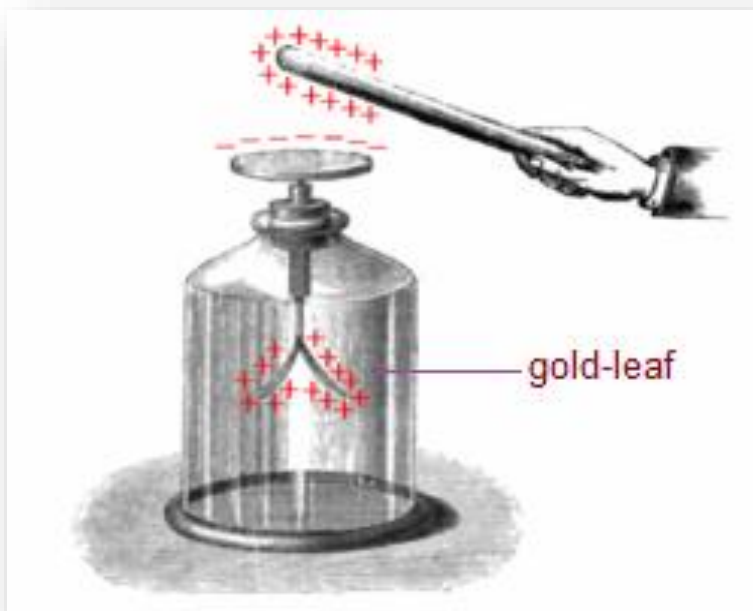


Fig. 2: A gold leaf electroscope.

Often there are grounded metal plates or foil strips in the bottle flanking the gold leaves on either side. These are a safety measure; if an excessive charge is applied to the delicate gold leaves, they will touch the grounding plates and discharge before tearing. They also capture charge leaking through the air that could accumulate on the glass walls, and increase the sensitivity of the instrument. In precision instruments the inside of the bottle was occasionally evacuated, to prevent the charge on the terminal from leaking off through ionization of the air.

Teachers may suggest students to make a brief idea about scientific instruments in physics.