Electrostatic Field Sensor for Detecting Lightning

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Electrostatic charge happens in the natural environment through friction between clouds and this sometimes causes lightning as a form of electrostatic discharges. The electrostatic charges creates an electrostatic field, E [kV/m] since charge q [C] is the source of the electrostatic field. Thus, fair weather electrostatic fields are disturbed when a thundercloud is present. One way to predict lightning and prevent the lightning accidents is to measure the strength of these electrostatic fields. In this paper, the novel electrostatic field strength sensor was introduced and its basic feature was quantitatively investigated based on performance on a laboratory scale. The novel electrostatic field sensor (hereafter, the novel sensor, Fig. 1) is a cylindrical shape that is 75 mm in dimeter, 150 mm in length. It consisted mainly of a metal plate, a metal rotating sensing sector, motor, signal cable, enclosure, and air supply line. The grounded plate, which had four fan shaped openings, was attached in front of the enclosure. The metal rotating sector had four wings and was designed in the same size as the openings in the grounded plate. It was placed 2 mm behind the grounded plate. The rotating sector was separated by the motor's axis by an insulator to measure signals. Also, the enclosure was supplied with compressed dry air in order to prevent unexpected material such rain, particles from getting into it, unlike conventional models. The experimental setup consisted of the novel sensor, an rotating sector controller, a high voltage (HV) power source, a quadrilateral metal plate (500 mm × 500 mm in area, 2 mm in thickness), a digital oscilloscope, an air compressor, an automatic air dryer, an electrometer, a mass flow meter, and other auxiliary devices. The quadrilateral metal plate in this study was assumed as the cloud and was attached to a HV DC power source to control its charge level. As for the experimental results, first, the applied voltage had a positive correlation to the detection signal. The positive and negative values were very similar, with only different signs, showing a fairly linear graph when plotted. This shows that as voltage increases the detected signal increased as well and that the novel sensor was able to detect the stronger voltages as being higher. The signal was clearly proportional to the E. Second, the distance between the novel sensor and the charging metal plate had no effect on the electrostatic field value, which shows the reliability of the novel sensor. This result indicates that the signal of novel sensor was the same no matter what distance, as long as E was constant. The validity of the novel sensor was confirmed.

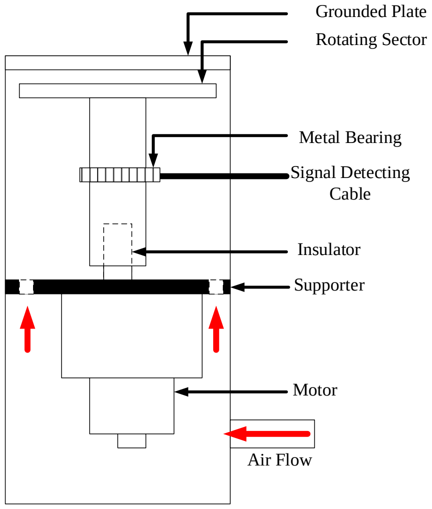

Fig. 1 Novel electrostatic field sensor.