the applied voltage up to a certain point when the figure breaks to form "slips" which then allow no accurate analysis. The direct range of reliable voltage records, with the ordinary klydonograph or surge voltage recorder, is approximately between 1500 and 30,000 volts. This range may be extended indefinitely by means of a potentiometer.

Using this same method of recording discharge figures, it is possible to obtain pictures of electrostatic fields under various conditions. Figure 92 shows an example of the field between a conductor and a ground plane, the film being so placed as to secure a cross-section of the field normal to the conductor axis. On this record the discharge paths are seen to follow the electrostatic flux lines from the conductor surface to the plane.

# CHAPTER V

## SPARK-OVER

By spark-over is generally meant the disruption of a gaseous dielectric from one conductor to another conductor. Strictly speaking it is the name applied to the initial discharge and not the arc that follows, as was discussed earlier (see page 47, Chap. III). In this chapter it is only the factors affecting the initial complete breakdown that will be discussed, so that the term spark-over only will be used.

**Parallel Wires.**—If impressed voltage is gradually increased on two parallel wires placed a considerable distance apart in air, so that the ratio $S/r$ is above a certain critical value, the first evidence of stress in the air is visual corona. If the voltage is still further increased, the wires become brighter and the corona has the appearance of extending farther out from the surface. Finally, when the voltage has been sufficiently increased, at some chance place a spark will bridge between the conductors. When the spacing is small, so that $S/r$ has a critical ratio, spark and corona may occur simultaneously, or the spark may bridge across before corona appears. If the spacing is still further reduced so that $S/r$ is below the critical ratio, the first evidence of stress is complete spark-over and visible corona never appears (see page 28).

Extensive tests have been made.[1] The method of conducting tests was to start at the smaller spacings with a given value of $r$ and measure the spark-over voltage. Unless otherwise stated the frequency used was 60 $\sim$. When the spacings were above the critical ratio of $S/r$, and corona formed before spark-over, the corona voltage was noted first. The voltage was then increased until spark-over occurred. The spark-over point is not as constant or consistent as the corona point and is susceptible to change with the slightest dirt spot on the conductor surface, any unsteady condition in the circuit, humidity, etc. At the beginning of the tests it was found necessary, in order to get consistent results, to put water tube resistances in series with the

[1] See "Law of Corona II," *Trans. A.I.E.E.*, p. 1051, 1912.