4 Mechanical design considerations for dry precipitators
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4.1 Introduction

The major operational components of any precipitator, as will be appreciated from chapter 3, are the discharge electrodes, which provide the necessary corona current for charging the particles, and the collectors or receiving electrodes, on which the charged particles are deposited. Once the particles have been deposited they will need to be removed, in order that precipitation will continue satisfactorily, either by mechanical rapping in the case of a dry precipitator, or by liquor washing if the application is wet.

These components are housed in a completely stable and gas tight casing, usually thermally insulated, the lower end of which is formed into hoppers or troughs for receiving the particulates removed from the collectors. In order that the discharge electrodes can be electrically energized, to the required voltage to produce the corona, they are isolated from the casing by some form of electrical lead through insulator arrangement, which is coupled to the transformer rectifier equipment providing the precipitator's voltage and current needs.

While the foregoing identifies the necessary components for precipitation, the design of the individual items have special requirements if the precipitator is to not only perform completely satisfactorily, but give long-term consistent performance with the minimum maintenance needs. This chapter will review the mechanical items of equipment in some detail, in order to meet these objectives.

4.2 Discharge electrodes

The basic requirement of any discharge element used in an electrostatic precipitator, is, when electrically energized, the field intensity adjacent to the element surface is such that the molecules in the vicinity have their work function raised to promote ionization of the gas, together with the release of some electrons. The production of these ions and electrons is covered in detail in chapters 3 and 8, so will not be discussed further in this section.

To produce the necessary field intensity at the surface of the electrode, it is essential that the radius of curvature of the element is small compared
with that of the positive collector electrode. In most practical applications this does not present any problem, since the collector, particularly for a plate precipitator, can be considered as having an infinite radius of curvature.

Over the years, the discharge electrode has taken many different forms, from a simple round, square or barbed wire, through to so-called controlled emission electrodes for specific duties, some units being claimed as ‘unbreakable’. As a modern power plant precipitator can contain the equivalent of 50 km of wire electrode, the cost, in a competitive bid situation, means that a simple readily available shaped material can offer an economic advantage, so a round wire formed into a spiral or twisted square section wires can often be found in many installations.

Some typical electrode profiles are illustrated in Figure 4.1; these can be split into two different categories, uncontrolled and controlled corona forms. In the controlled corona type, these have specific positions or areas where the emission develops, such as the spikes on electrodes 1A, or in the case of the spiral electrode 1B, the position closest to the collector, i.e. the point of maximum field intensity. For the square or round wire format, the corona develops somewhat randomly and, if observed, the highest or brightest corona points move around the electrode to coincide with the maximum field intensity which changes with dust conditions, either on the electrode system or in the gas phase itself.