electrodes of various constructions, including corrugated plate, rod curtains or perforated plate. Air flow is usually horizontal, although special construction may permit vertical air flow. The earlier high voltage collectors were made in the form of vertical pipes, and are still used for high operating pressures and for *wet collector* designs where water continuously flows downward inside the pipe walls of the collector electrode. The negative discharge electrodes or rods are accurately centered between the usual 9 in. collector electrode spacing, the latter being of positive charge. Precipitation occurs in a single stage wherein ionization and collection are carried on simultaneously throughout the unit, and depend on high potentials of 60,000 to 75,000 volts. The two-stage type which has the added primary stage of ionizer and receiving electrodes, however, fulfills some needs better than the single stage type.

High efficiencies are obtained by allowing suitable time for contact in the collector zone, and by proper ratio of air flow velocity to that of transverse velocity of the negatively charged particles toward the positive charged collector plates. Air velocities vary from 4 fps to 8 fps with negligible pressure drops.

Attention should be directed to the prohibition of air recirculation to occupied spaces. High voltage cleaning equipment produces ozone in excessive quantities and, in addition, develops oxides of nitrogen.

Collector electrode cleaning is conveniently managed by a rapping device, either electrical or pneumatic, without interrupting operation. The dry plate surfaces release the dust readily into hoppers below the plates.

For longer than two decades, electrical precipitators of the heavy duty high voltage type have been used for the control of hazardous materials, and for nuisance abatement. They have been applied to flue gases from cement kilns, smelters and paper plants; to exhaust systems serving crushers, grinders and conveyors; to chemical and metal working plants; and to many pulverized-fuel, fly-ash applications. To date, precipitators have been used principally for elevated temperature installations, and dry products that are free of condensation or dampness.

Fabric Collectors

Dust collectors in this group, often known as *cloth dust arresters* or *cloth filters*, remove dust by passing air at low velocity through a filter material. Cotton cloth is the usual material, although wool, glass, asbestos, and metal screen are sometimes employed. Filter velocities depend on dust concentration, particle size, and permissible vibration interval. Normally at about 3 fpm, they often are reduced to 1 fpm or lower where heavy dust loads of very fine material are involved. Velocities in excess of 6 fpm are seldom used, except in automatically vibrated sectional collectors where velocities as high as 20 fpm are frequently employed.

Collection efficiency is high, even for low micron dust sizes, when the collector is properly maintained. As collected material builds up on filter surfaces, increasing the resistance to air flow, such a system must be stopped at 4 to 8 hour intervals so that the dust load can be vibrated from the filter surfaces to reduce the pressure loss.

Filter cloth is supported in the form of envelopes or bags in a suitable steel housing. Space requirements are quite large, generally necessitating an outdoor location. Pressure drop is normally 2 to 4 in. water column. Material is collected dry. Fabric arresters are limited to applications where air is above the dew-point, as condensation packs the collected

material with resultant high pressure drop, and prevents removal by vibration. Temperatures should not exceed 180 F for cotton, or 200 F for wool.

Wet Collectors

In a wet dust collector, the contaminant is brought into contact with a liquid, usually water, for removing the dust from the gas stream. The various available designs represent combinations of methods that make cataloging according to principles, pressure drop, or efficiency, difficult. Wet type dust collectors have the ability to handle high temperature and moisture laden gases. The collection of dust in a wetted form eliminates a secondary dust problem in disposal of collected material. However, the use of water may introduce corrosive conditions within the collector, and freezing protection may be necessary if collectors are located outside in cold climates. Space requirements are nominal. Pressure losses and collection efficiency vary widely with design.

1. *Static Washers*. These units, unlike most *air washers*, are designed to handle heavy concentrations of dust. Both scrubber and eliminator plates (each having flooding nozzles) are employed in addition to the bank of sprays ahead of the scrubber plates, and 2 banks of opposed sprays located ahead of the eliminators. A hopper-bottom tank with recirculating pump completes the assembly. Pressure drop is about ½ to ¾ in. of water. Spray towers can be placed in this same group, as they consist of a tower structure with various nozzle arrangements, and usually include an eliminator section at the top.

Wet glass cell washers have special sprays playing on filter cells filled with fiberglass or other filter media. Flooded eliminator plates are used to remove free moisture from the air stream. Pressure drop is about ¾ in. of water, and the length of the unit is comparable to that of a single stage air washer. Applications are usually limited to low dust concentrations.

2. *Packed Towers*. Collectors in this group are essentially contact beds through which gases and liquids pass, either concurrently, counter-currently, or in cross flow, and are used primarily for nuisance abatement of highly corrosive contaminants. The liquid usually enters at the top of the tower, while the gases may enter at the top, at the bottom, or through an open side.

Water flow rates of 5 to 10 gpm per 1000 cfm (70 F volume) are distributed frequently through V-notched ceramic or plastic weirs. High temperature deterioration is avoided by use of brick linings permitting 1600 F gases direct from furnace flues.

Air flow pressure loss for four-foot beds of irregular shaped materials, such as ceramic saddles or coke, range from 1½ to 3½ in. water, with respective face area velocities of approximately 200 to 300 fpm.

3. *Wet Centrifugal*. A number of designs utilize a combination of centrifugal force and water contact to effect collection. In designs of this group, the collector is cylindrical, either in shape of a tower or with the axis horizontal. Air is introduced tangentially, and frequently directed counter-current to flow of water by baffles or directional plates. Water may be brought into contact with the dust particles by keeping collector surfaces washed by spray nozzles, by induced water picked up by the air, or by fall of water due to gravity. Pressure losses range from 2½ to 6 in. water.

4. *Dynamic Precipitator*. This type uses water sprays within a fan housing, and obtains precipitation of the dust particles on the wetted surfaces of an impeller with special fan blade shape. No external pressure drop is involved, although mechanical efficiency is somewhat lower than the mechanical efficiency of standard exhaust fans.

5. *Orifice Type*. In this type, the air flowing through the collector is brought in contact with a sheet of water in a restricted passage. Water flow may be induced by the velocity of the air stream, or maintained by pumps and weirs. Pressure losses vary from 1 in. or less in water wall spray booth collector designs, to from 3 to 6 in. in most industrial collector arrangements. Pressure losses as high as 20 in. are used, with some collectors designed to collect very small particles.

6. *Disintegrator*. This type of unit generally consists of one or more stages, and is largely used for cleaning producer, blast furnace, or other gases where the gas is to be used in engines, and must be practically free of dirt. The spray is generally in