in boiler plants as a means of smoke abatement. The same principle has been used in equipment developed for air cleaning in air conditioning without generating ozone in intolerable quantities. The air stream in a precipitator passes first through a relatively high-tension electric field, known as the ionizing field, and then through a secondary field where the precipitation of the dust occurs. The arrangement is as shown in Fig. 1.

In a typical case, a potential of 12,000 volts may be used to create the ionizing field, and some 5000 volts between the plates upon which the precipitation of dust occurs. These voltages, which are capable of shock to personnel similar to that of a spark plug, necessitate some safety measures. A typical arrangement provides means for automatically making the unit inoperative when a door to the precipitator is opened. To resume operation the procedure necessitates closing the door and turning an electric switch, the latter of which should be located at a reasonable distance from the equipment. The voltages necessary for the operation of the precipitator are usually obtained from an alternating current building service line by means of a step-up transformer. Precipitation with alternating current is possible, but is not nearly so effective, so the current is usually rectified by means of vacuum tubes. The transformer and tubes are collectively termed the power pack.

The precipitators of this type offer negligible resistance to air flow and, therefore, care must be exercised in arranging the duct approaches on the entering and leaving sides of the precipitators in order that the air flow may be distributed uniformly over the cross-sectional area. The efficiency of the precipitator is very sensitive to air velocity, and the device itself has much less tendency to rectify the air stream than filters which have much higher resistances. In most systems, resistance is deliberately added in the form of a perforated plate attached to the air approach side of the precipitator in order to obtain a uniform distribution of air. Such plates, however, are only partially effective. The plate also serves to prevent lint agglomerates, paper, and similar foreign material from reaching the precipitator proper.

Electric precipitators of the ionizing type are available in both automatic and non-automatic types. The plates of non-automatic precipitators are commonly coated with a light oil as an adhesive. Cleaning is accomplished with a water hose and, for this reason, the bottom of the equipment is made water tight and provided with a drain. In one automatic type, the grounded groups of precipitation units are mounted on chains, and are alternately dipped in oil and exposed to the air stream with an action similar to that of an automatic impingement filter. The charged precipitator plates are mounted stationary in the air stream. These plates collect only a minor portion of the total dirt. They are cleaned and recoated with adhesive by means of a wiping device attached to the revolving chain.

Charged Media Electrostatic Precipitators

The charged media type precipitator consists of a dielectric filtering medium, usually arranged in pleats as in typical dry filters. No ionization means are employed. The dielectric filtering medium may consist of glass fiber mat, cellulose mat or other similar material, and is supported on or in contact with a gridwork consisting of alternately grounded and charged members, the latter usually being held at a potential of 12,000 volts d.c. An intense and non-uniform electrostatic field is thus created through the dielectric medium. Airborne particles approaching the field are polarized and drawn toward filaments or fibers of the media. The general arrangement illustrating this type of filter is shown in Fig. 2.

The precipitator of this type offers resistance to air flow, when clean, on the order of 0.10 in. of water at 250 fpm for velocity and, unlike the ionizing type, the resistance of the charged media type electrostatic precipitator rises as dust is accumulated on the media. Because of these characteristics the filter tends to equalize the air distribution over the face of the filter. Like typical replaceable media mechanical filters, the charged media precipitator is serviced by replacing the filtering medium.

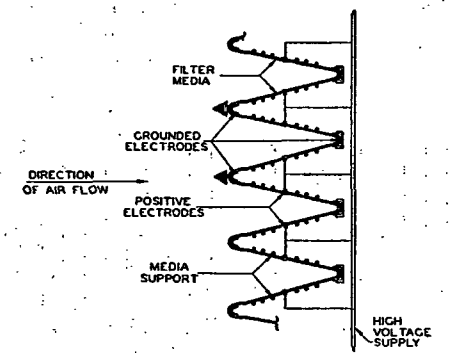

FIG. 2. CROSS-SECTION DIAGRAM OF CHARGED MEDIA TYPE ELECTROSTATIC PRECIPITATOR

AIR FILTER PERFORMANCE AND TESTING

Air filters are generally rated in terms of the total air flow for which they are designed, expressed in cubic feet per minute. Face velocity is defined as the average velocity of the air entering the filter, and it is determined by taking the air flow and dividing it by the area of the duct connection to the cleaner in square feet. Filters are often rated at a face velocity in the range of 250 to 500 fpm. Resistance to air flow is usually measured in inches of water column. The resistances of filters when new and clean, and when operated at rated capacity, are generally available from the manufacturer (see *Catalog Data Section*). A suitable allowance should be made in system design for increase of filter resistance due to the accumulation of dust.

The ability of air cleaners to clean air is called the efficiency or the arrestance, and may be denoted by the symbol E. The efficiency of an air cleaner differs with the size and nature of the dust on which the cleaner operates. The efficiency of an air cleaner, algebraically expressed, is

$$E = \frac{D_1 - D_2}{D_1} \qquad (1)$$

where

D_1 = amount of dust per unit volume in uncleaned air.
D_2 = amount of dust per unit volume in cleaned air.

Several methods have been investigated for evaluating D_1 and D_2. The