This invention relates to gas distributing apparatus, and particularly to an enclosure such as a plenum chamber, in which a stream of gas is changed in velocity and direction and is distributed to meet the requirements of a gas handling or treating problem.

The invention has as a principal object the provision in a plenum chamber of means comprising baffles or the like for reducing the velocity and changing the direction of a supply stream of gas and causing the gas to move evenly in generally rectilinear flow over an enlarged area preparatory to entering gas treating apparatus, particularly electrical precipitators of the Cottrell type.

Another object of the invention is to provide gas directing means which can be made of lead or other structurally weak but corrosion resisting materials: further, to so shape and position the gas directing means that they will not decrease appreciably in usefulness when used with dirty gases.

Still another object of the invention is to provide gas distributing means which can be readily altered in size and position and adapted to the different conditions which are to be found, for instance, in installations of electrical precipitators used in cleaning industrial gases. Sludge-like material must be periodically washed from electrical precipitators in many chemical plants and the baffle devices of the present invention permit such washing with minimum of interference.

Another object of the invention is to provide gas distributing means of the type to be described which can be used adjacent high voltage structures, such as the discharge electrode systems of Cottrell electrical precipitators, with a minimum of short circuiting and other troubles that may result from collected material causing electrical shorts between portions of the apparatus.

The invention will be illustrated by describing its application to an electrical precipitator used for cleaning flue gases from calcining furnaces. The gases contain sulphur compounds including sulphuric acid and, after being cooled in a water spray washer, carry dust, fume and mist particles to the precipitator which removes the suspended particles by the well-known process of electrical precipitation. The precipitator used is of the pipe and wire type, the pipes being made of lead and positioned vertically. The dirty gases, after being cooled to a temperature below the melting point of lead, flow horizontally into a plenum chamber or bottom header beneath the rest of vertical lead pipe collecting electrodes.

A horizontal header plate spaces the pipes and serves as a barrier to gas flow between the pipes but it is well above the lower end of the pipes. In such an installation, without the baffles of the present invention, the gases flow strongly to the far end of the plenum chamber and then eddy about, approaching the pipes above at various velocities and from various directions. This results in low efficiency in precipitator performance and warping of the lead pipes. The latter effect probably occurs when gases are first turned into the precipitator or at times of sudden increases in temperature. The gases are not hot enough to appreciably soften the lead but they are hot enough to bring about appreciable expansion of the lead and, with the gases approaching many of the pipes from one side only, these expand unevenly and do not return to their original shape. The crooked pipes prevent proper alignment of the discharge electrodes within them—another factor in the low efficiency in precipitator performance.

In providing baffles in the plenum chamber in the bottom of the precipitator, the baffles must be made of acid-resisting material and, if made of lead, require a reinforcing frame structure. Flat, and preferably vertically positioned, baffles are used. The baffles cannot be positioned close to the discharge electrodes or the tensioning weights attached thereto because spark-overs to these parts would result, and care must be taken that electrical "shorts" do not occur when the electrically collected sludge drops from the bottoms of the pipe electrodes.

Supporting the distributing means from the floor of the chamber avoids difficulties from these sources. The sludge tends to harden, especially during periods of high temperature or, if the apparatus is left not operating for long periods.

This sludge will coat and clog small, curved, flow directing vanes and make inoperative many of the devices which have been suggested for distributing clean air.

The problems presented in the situation discussed above are satisfactorily solved by installing gas distributing means in the plenum header or plenum chamber in accordance with the teachings of the present invention. Typical preferred embodiments of the invention will be described in conjunction with the accompanying drawings in which:

Fig. 1 is a fragmentary, vertical, cross-sectional view of an electrical precipitator comprising the present invention;
Fig. 2 is a horizontal section of the apparatus shown in Fig. 1, taken at 2-2;
Fig. 3 is side elevation of the gas distributing baffles shown in Figs. 1, and 2, and
Fig. 4 is an end view of the baffle shown in Fig. 3.

To Figs. 1 and 2, numeral 10 identifies the bottom section of a cylindrical vertical casing which provides the housing of an electrical precipitator. The casing has a bottom 11 protected by a brick covering 12, a horizontal header sheet 13, through which vertical pipe collecting electrodes 14 project and an inlet flue 17 through which the gases to be treated in the precipitator enter the casing horizontally. A discharge electrode 15 is suspended from a supporting frame (not shown) in an axial position in each pipe electrode 14, and a weight 16 is attached to the bottom of each discharge electrode to keep the latter taut. Wing dampers 19 which swing about vertically aligned pivots 18 can be variously positioned to distribute the gas stream in a horizontal plane as it enters the bottom portion P of casing 18. The portion P of the casing serves as a plenum chamber, one purpose of which is to simultaneously turn the gas and cause it to flow in an upwardly directed and to distribute it evenly over the total cross-section of the casing immediately under the lower ends of the pipes 14 so the gas enters these pipes at equal velocity. Other purposes of the plenum chamber are to provide space for the lower ends of discharge wires 15 and weights 16 because these are maintained at a potential many thousands of volts above the ground potential of the pipes and precipitator generally, and must be spaced from these parts, and to provide space where an operator or maintenance man can move about while inspecting and adjusting the precipitator or washing it free of accumulated material removed from the treated gas. Door 25 is for the ingress of the operator, and floor opening 26 is indicative of the drainage system, not shown in detail, through which the collected material and wash water, as may be required, leaves the precipitator.

One or more baffles or vanes 20 for directing and distributing the gas stream passing through the plenum chamber are now mounted on floor 12 of the chamber. Referring to Figs. 3 and 4, these baffles are preferably made of a welded frame of steel pipe comprising horizontal pieces 21, vertical side pieces 22, and longitudinal feet 23, all covered with lead, the pieces 21 and 22 supporting, at their edges, a sheet of lead 24 perforated with holes 25. When the positions of the baffles are decided upon they are mounted upon the floor 12 of the plenum chamber, preferably with base pieces 23 embedded in the acid proof brick of which the floor is made.

It is not necessary to make baffles 20 of lead in every installation. Many gases which require cleaning are free from acids or other corrosive substances and can be handled with equipment made of steel or other common structural material. The present invention does lend itself to difficulties and provides a solution to the problem mentioned—the removal and collection of acid-containing slimes from water cooled culminating furnace gases, where lead is indicated as a suitable material if lead baffles could be maintained in the shapes and positions required for gas distribution. A baffle of the type illustrated permits a lead sheet to be held in a vertical position, to be supported in a frame mounted on the floor of the plenum chamber and to be reasonably unaffected by dropping acid or sludge or by the movements of maintenance men who may work about and between the baffles while inspecting and cleaning (usually by washing) the apparatus.

In the preferred embodiment illustrated, the bottom of baffle sheet 24 and the lower supporting cross bar 21 are positioned far enough off the floor so as not to obstruct drainage of the sludge toward drain 26. By mounting the baffles on the floor there is a minimum of difficulty in arranging the baffles in positions where they most effectively distribute the gas, taking into account the requirements mentioned in the text. A technician can move the baffles about while a fan propels air (not the furnace gases) through the system until proper distribution is realized.

If tilting or bending the baffles is an anticipated requirement, dummy baffles of wood or other material permitting rapid changes in shape can be utilized until the number, shape and position of the baffles are ascertained. The test baffles can then be replaced with permanent baffles, as indicated by the tests, before the precipitator is put into operation. It is obvious that such experiments are particularly valuable in those installations which require that lead or other corrosion resisting material be used. Lead covered vanes suspended from lead covered framework or from acid-proofed brick walls lend themselves to alteration in shape or position; and, when changes are made in such structures, there is the likelihood of getting grounded parts too close to the members which are maintained at high potential.

From can be seen that there has been provided, in an electrical precipitator of the type described, gas flow distributors in the plenum chamber of the precipitator comprising at least one vertical plate member positioned in the plenum chamber between the gas inlet and the treating chamber, and means supporting the plate member in a position spaced from the floor and walls of the plenum chamber. The invention is not limited to the particular electrical precipitator arrangement shown in the drawings by way of illustration, but may be used with other types of gas treating apparatus, such as horizontal flow electrical precipitators with parallel plate collecting electrodes, and, in general, is useful in the distribution of gases in a wide variety of gas treating operations.

We claim:

1. In an electrical precipitator comprising a treating chamber including spaced complementary electrodes, a plenum chamber opening into the treating chamber, a gas inlet into said plenum chamber, gas flow distributors in said plenum chamber comprising a vertical plate member positioned in the plenum chamber between said gas inlet and said treating chamber, and relatively narrow leg means supporting said plate member in a position spaced from the floor and walls of said plenum chamber, said supporting means being attached solely to the floor and providing a minimum of obstruction beneath said plate member.

2. In an electrical precipitator comprising a treating chamber including spaced complementary electrodes, a plenum chamber opening into the treating chamber, a gas inlet into said plenum chamber, gas flow distributors in said plenum chamber comprising a vertical plate member positioned in the plenum chamber between...
said gas inlet and said treating chamber, and means supporting said plate member in a position spaced from the floor and walls of said plenum chamber, said supporting means comprising a horizontal foot member engaging the floor and a vertical leg member supporting said vertical plate member on said foot member.

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