Sept. 12, 1933. E. ANDERSON 1,926,025

ELECTRICAL PRECIPITATION APPARATUS

Filed Dec. 29, 1930 2 Sheets-Sheet 1

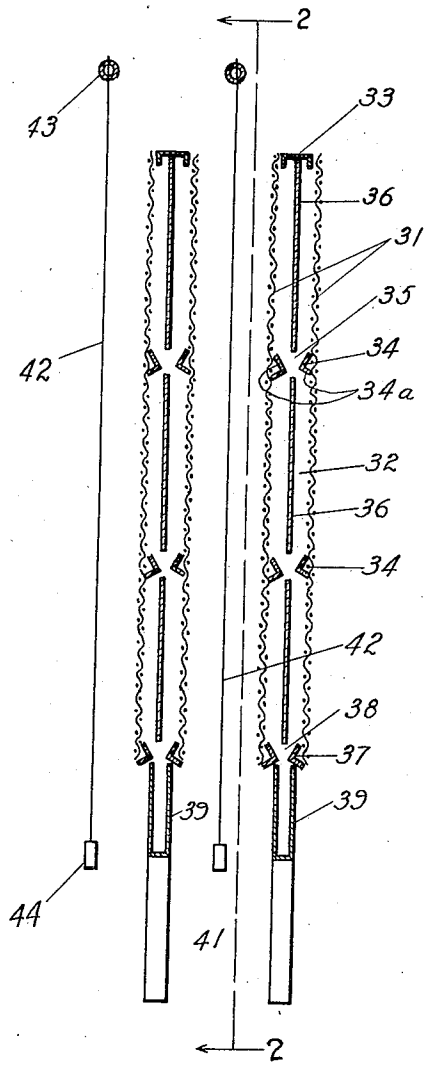


Fig. 1.

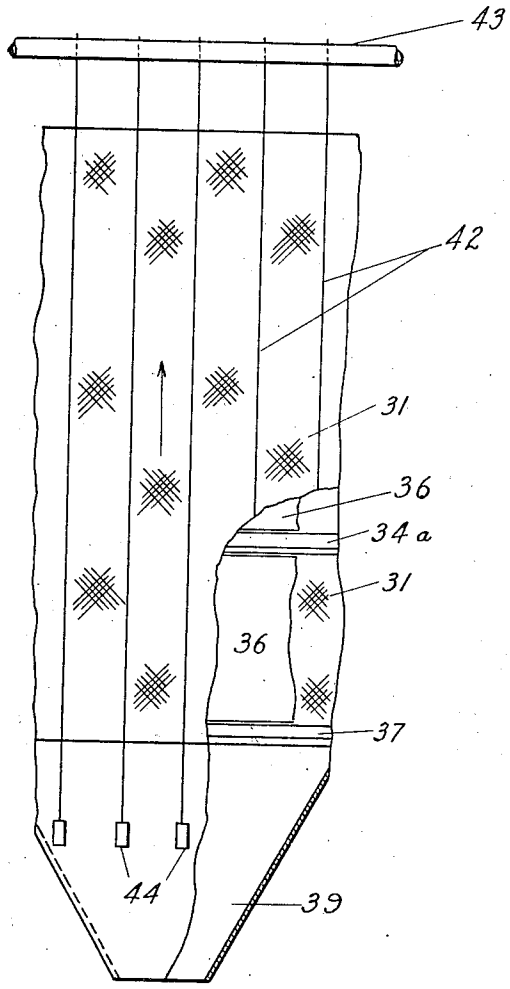


Fig. 2.

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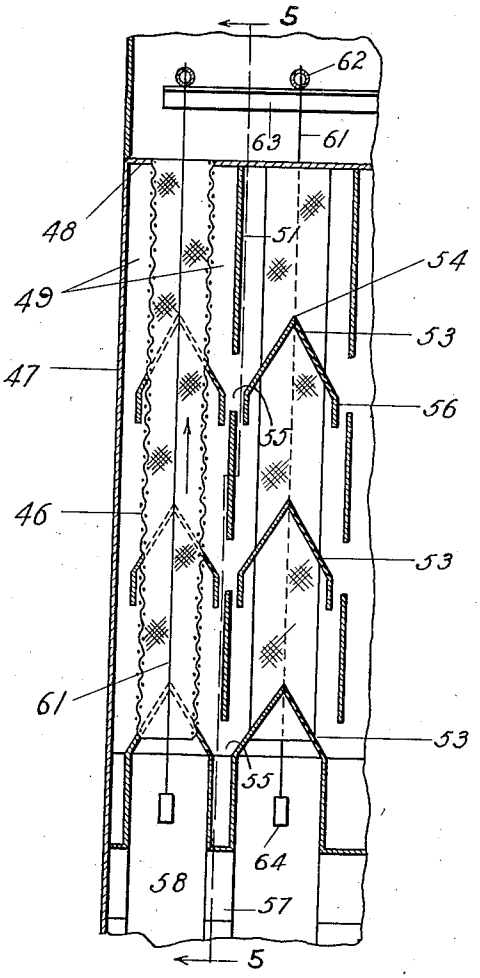


Fig. 4.

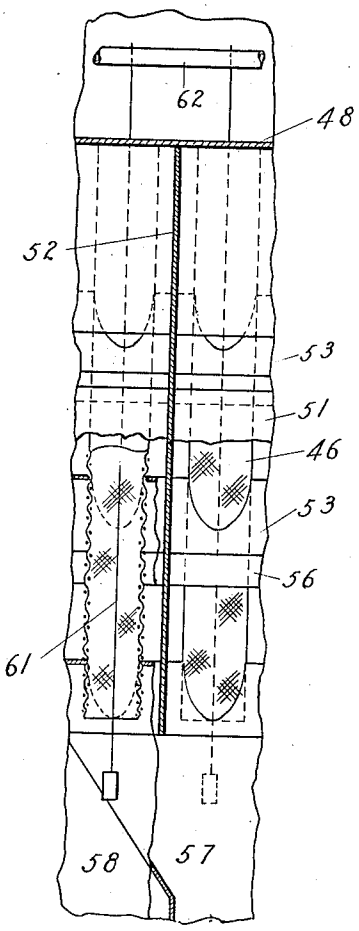


Fig. 5.

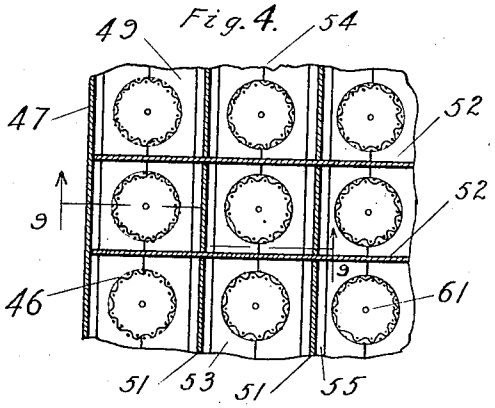


Fig. 3.

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Patented Sept. 12, 1933 1,926,025

UNITED STATES PATENT OFFICE

1,926,025

ELECTRICAL PRECIPITATION APPARATUS

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Application December 29, 1930
Serial No. 507,903

8 Claims. (Cl. 183—7)

This invention relates to apparatus for the electrical precipitation of suspended materials from gases and particularly to apparatus of the type in which a screen or pervious member is employed as a collecting electrode and in which means are provided defining a material receiving space or pocket at the opposite side of said collecting electrode from the region of the electric field, or in other words at the opposite side from the discharge electrode means. An advantage of this type of apparatus is that a considerable portion at least of the suspended particles which are precipitated toward the collecting electrode by the action of the electric field pass through the openings of the screen into said material receiving space or pocket where they are permitted to settle in a region removed from the electric field and more or less isolated from the main gas stream. It has been found, however, that where the gas is permitted to travel for a considerable length past a collecting electrode of this type, there is a tendency for an appreciable portion of the gas stream to be diverted through the openings of the screen and travel in the material receiving space or pocket rather than through the region of the electric field, thus removing the suspended material carried by this portion of the gas from the action of the electric field and also interfering with the free gravitative settling of the material within said space or pocket.

It will be understood that the term "screen" or "pervious member" as used herein includes not only a screen of woven wire, but any equivalent thereof, and in general, any member having an extended plane or curved surface and provided with a multiplicity of openings distributed closely adjacent one another over its surface.

The principal object of this invention is to improve the efficiency and economy of operation of a precipitator of this type, and particularly to provide means acting to minimize or largely prevent diversion of the gas stream into and along the material receiving space, so as to permit the material entering said space to fall freely therein by gravity and to be collected. It is important that the means provided for this purpose should be of such a nature as not to interfere with the free passage of the precipitated material through the openings of the collecting electrode screen or with the free settling of such material to the collecting means which are provided at the bottom of such space.

According to this invention, the above objects are accomplished by providing baffle means extending within said material receiving space or pocket, extending transversely to the direction of travel of the gas in the electric field, and disposed at suitable intervals along the length of said space or pocket in the direction of gas flow. Said baffles interpose such a relatively high resistance to passage of gas along within the material receiving space or pocket that the flow of the main gas stream is confined substantially wholly largely to the region of the electric field. The direction of gas flow is vertical or substantially so, and the baffles extend horizontally or substantially so, or at least in a direction transverse to the vertical, so that it is necessary to provide openings permitting the precipitated material to fall through or between the baffles. Such openings, however, are of restricted size so as to minimize the passage of gas therethrough and are furthermore, for the same reason, preferably located at portions of the baffle members which are relatively removed from the collecting electrode screens.

The invention may be applied to electrical precipitation apparatus of various types of construction, for example, to apparatus of either the plate type or the pipe type.

The accompanying drawings illustrate the application of my invention to both of these types of precipitators and referring thereto:

Fig. 1 is a partial vertical section of a plate type precipitator adapted for vertical gas flow.

Fig. 2 is a partial section on line 2—2 in Fig. 1, with the collecting electrode screen and the side wall of the material receiving means partly broken away.

Fig. 3 is a horizontal section of a pipe type precipitator embodying my invention.

Fig. 4 is a vertical section on line 4—4 in Fig. 3.

Fig. 5 is a section on line 5—5 in Fig. 4, partly broken away.

In the apparatus shown in Figs. 1 and 2 each collecting electrode comprises two screens 31 extending in parallel vertical planes and spaced apart to provide a material receiving space or pocket 32 therebetween. The upper end of said

space or pocket is closed by a horizontally extending top plate or baffle 33, which vertically spaced horizontally extending intermediate baffle members 34 are also provided at suitable intervals, said intermediate baffle members having openings 35 therein for permitting downward passage of precipitated material therethrough. Such openings 35 are relatively restricted so as to minimize gas flow therethrough and are furthermore preferably located at the central portions of the baffles, midway between the two screens 31. Such openings are, therefore, relatively removed from the main gas passages outside the collecting electrodes and this, together with the small size of such openings, reduces to a minimum the amount of gas permitted to pass through the baffle members. Each of the baffle members 34 may conveniently be formed by two angle bars 34a disposed as shown, so that the upper surface of each baffle member tapers downwardly and inwardly toward the opening 35 for facilitating passage of precipitated material into and through said opening. I may also provide vertical partition members 36 extending midway between the screens 31 of each collecting electrode and dividing the space 32 into two parts, such partition members preferably terminating a short distance above and below the respective openings 35, as shown, so as to permit free passage of material through said openings. However, if desired, these partition members may be entirely omitted.

A baffle member 37 is also provided at the lower end of each collecting electrode, which may be substantially the same as the intermediate baffle members 34 above described, and which is similarly provided with an opening 38 permitting precipitated material to fall therethrough. It will be understood that in a vertical flow precipitator the gas must either enter or leave through the space below the level of the bottom ends of the collecting electrodes, and in order to prevent the material falling from the collecting electrodes from coming into contact with the gas in this space I have shown the provision of material receiving ducts or passages 39 disposed beneath the respective collecting electrodes and providing spaces 41 therebetween for inflow or outflow of the gas. It will be understood that said ducts or passages 39 may open at their lower ends into any suitable receptacle or hopper means for the precipitated material.

The discharge electrodes 42 are shown as extending vertically in planes midway between the respective collecting electrodes and supported at their upper ends by means of bars 43 and provided with tensioning weights 44 at their lower ends.

Another form of apparatus adapted for vertical gas flow is illustrated in Figs. 3 to 5 inclusive, the collecting electrodes in this case being of the pipe type. Each of said collecting electrodes comprises a vertically extending screen 46 of cylindrical or other suitable shape, all of said screens being mounted within a suitable housing indicated at 47 and connected at their upper ends to a top header plate 48. The space 49 around and between the collecting electrode screens and within the housing 47 constitutes a material receiving space or pocket, and said space may, if desired, be subdivided by means of two perpendicular sets of vertical partition plates 51 and 52 into rectangular spaces individual to the respective collecting electrodes, although it will be understood that if desired one or both of these sets of partition plates may be omitted.

Transverse baffle members 53 are provided at suitable intervals intermediate the height of the collecting electrode screens, said baffle members extending in general transversely with respect to the direction of gas flow. Each of said baffle members is shown as comprising an inverted V-shaped channel having its length disposed horizontally, with the apex or ridge 54 along the line of centers of a row of cylindrical screens and with the upper surface thereof sloping downwardly and outwardly toward openings 55 located substantially midway between adjacent rows of screens, for permitting downward passage of collected material. As before, said openings are of restricted area as compared to the horizontal cross-sectional area of the space 49 and are located at parts of said space which are relatively removed from the tubular screens 46. In order to minimize the tendency for clogging of said openings, the partition plates 51 which extend parallel to the length of the baffle members may be broken away for a short distance above and below the openings 55, and auxiliary baffle members 56 may be provided if desired, depending to a suitable distance below the lower edges of the baffle members 53 for the purpose of minimizing the circulation of gas between the cylindrical collecting electrode members. As in the form of the invention shown in Figs. 1 and 2, separate material receiving ducts or passages 57 may be provided communicating with the openings 55 between the lowermost baffle members 53, so as to carry off the material falling therethrough and prevent such material from reentering the gas in the header space 58 below the lower ends of the collecting electrodes, such header space serving to conduct the gas to or from said collecting electrodes. The walls of the ducts or passages 57 also serve as closure means for the lower ends of the material receiving spaces 49 so as to prevent entrance of gas thereto.

It will be understood that the discharge electrode means and the collecting electrode means may be connected in the usual manner to any suitable source of high voltage electric power, either unidirectional or alternating, but preferably unidirectional current obtained, for example, by rectification of alternating current. The voltage so supplied must be sufficient to maintain effective electrical discharge from the discharge electrodes 42 or 61 respectively, and the electrical field between said discharge electrodes and the collecting electrodes is of sufficient intensity to cause charged particles within said field to move toward the collecting electrodes.

The discharge electrodes are shown as comprising wires or small rods 61 extending axially within the respective tubular screens and through the entire length thereof, said discharge electrodes being supported at their upper ends on supporting bars 62 mounted on suitable frame means 63 and being provided at their lower ends with tensioning weights 64 for holding the same in centered position within the screens.

In the operation of either of the two forms of the invention described, the gas is passed vertically through the space between the discharge and collecting electrodes, for example in an upward direction as indicated by the arrows in Figs. 1, 2 and 4. The electric discharge from the high tension or discharge electrodes 42 or 61 respectively, in conjunction with the electric field between said discharge electrodes and the collecting electrode screens, serves to effect charging of suspended material contained in the gas and

migration or precipitation of such material toward and upon said screens, and it will be understood that a considerable portion of the material so precipitated will be caused to pass through the openings of the screens and into the material receiving spaces 32 or 49. Such passage of material through the screens may be caused either by the momentum of the precipitated particles, or by the effect of electric wind, or by precipitation of the surfaces of the screens followed by creeping of the precipitated material around to the inner side thereof. It will be understood, of course, that some of the precipitated material may remain on the outer face of the screen until it falls therefrom by gravity, but it has been found in the operation of precipitators of this type that a very appreciable portion, and in some cases the major portion, of the precipitated material reaches the interior of the electrode and falls within the material receiving space therein rather than outside the electrode. That portion of the material which passes through the screens and into the spaces 32 or 49 falls downwardly within such spaces and through the openings 35 and 38 or 55 and into the ducts or passages 39 or 57. The baffle members 34 or 53 serve to minimize the flow of gas within the material receiving spaces of the collecting electrodes and confine the gas stream substantially wholly to the region of the electric field between the discharge and collecting electrodes, so as to eliminate the above mentioned disadvantages which would result if the gas were permitted to be diverted out of the electric field and into these quiescent material receiving spaces. Due to the restricted area of the openings 35 and 55 respectively, and also to the fact that said openings are disposed at positions relatively removed from the collecting electrode screens, the upward flow of gas permitted through said openings is reduced to a minimum, and the transverse baffles are therefore enabled to perform their desired function of substantially preventing or minimizing vertical flow of gas in the material receiving spaces behind the collecting electrode screens.

The above mentioned advantages arising from the provision of transverse baffle means within the material receiving pockets, intermediate the ends of the collecting electrode members with respect to the direction of gas flow, may therefore be realized with either of the types of apparatus above described, and it is evident that the principles of this invention may be applied to a wide variety of constructions, those above described being given merely by way of examples.

I have found by actual experiment that the provision of transverse baffles intermediate the length of the material receiving space of a screen electrode of the general type above described produces a very marked increase in the precipitating efficiency thereof, and that, in general, increasing the number and decreasing the spacing of such baffles, further increases the efficiency. The following set of tests, for example, were made with a cylindrical screen electrode and vertical gas flow, with the same suspended material (a potash fume) at approximately the same concentration, and with substantially identical electrical conditions, the only important distinction between the conditions maintained being with respect to the number of baffles used. In all of the tests the gas was passed upwardly, and the upper end of the material receiving space outside the screen was closed. In the first two sets no other transverse baffle was provided. In the next two tests, a baffle was provided at the lower end of the material receiving space, and in the last two tests two baffles were provided, one at the lower end and one at the mid-height. The results obtained are shown in the following table:

Test No.	No. of baffles	Concentration of fume (mg. per cu. ft.)		Efficiency (percent collected)
		Inlet	Outlet	
1	0	41.2	6.81	83.5
2	0	39.5	8.6	78.2
Average	0			80.8
3	1	45.8	4.09	91.1
4	1	41.0	5.22	87.3
Average	1			89.2
5	2	41.9	2.72	93.6
6	2	55.3	2.80	94.9
Average	2			94.2

I claim:

1. In an apparatus for electrical precipitation of suspended materials from gases, a collecting electrode comprising a vertically extending screen, means defining a material-receiving space at one side of said screen, means substantially closing the upper end of said space, a plurality of vertically spaced baffle members extending horizontally within said space and transversely thereof, each of said baffle members being provided with restricted opening means permitting passage of collected material therethrough, said opening means in each baffle member above the lowermost being positioned to deliver collected material from the portion of said space above that baffle member to the portion of said space below that baffle member in such manner that all of the material collected in said space is delivered through the opening means in the lowermost of said baffle members, discharge electrode means spaced from said screen at the side opposite said material-receiving space, and means for passing gas substantially vertically between said discharge electrode means and said screen.

2. In an apparatus for electrical precipitation of suspended material from gases, a collecting electrode comprising a vertically extending screen, means defining a material-receiving space at one side of said screen and closing the upper end of said space, baffle means extending horizontally within said space and transversely thereof at a level intermediate the upper and lower ends of said space and provided with a restricted opening permitting passage of collected material therethrough from above said baffle means into the portion of said space below said baffle means, additional baffle means disposed adjacent the lower end of said screen and partially closing the lower end of said material-receiving space but provided with an opening permitting downward passage of collected material therethrough, means positioned to receive material falling through said last-mentioned opening, discharge electrode means spaced from said screen at the side opposite said material-receiving space, and means for passing gas substantially vertically between said discharge electrode means and said screen.

3. In an electrical precipitation apparatus, a collecting electrode comprising two screens spaced from one another and extending in substantially parallel vertical planes and providing a material receiving space therebetween, means substantially closing the upper end of said material receiving space, and horizontally extending baffle means disposed between said screens extending across said space intermediate the upper and lower ends

thereof said baffle means being provided with openings of relatively restricted area as compared to the cross-sectional area of said space and positioned substantially midway between said screens.

4. In an electrical precipitation apparatus, a collecting electrode as set forth in claim 3, and comprising in addition, a vertically disposed partition plate extending substantially midway between said screens and parallel thereto, said partition plate being broken away adjacent the position of said openings in said baffle means.

5. In an electrical precipitation apparatus, a collecting electrode comprising two screens spaced from one another and extending in substantially parallel vertical planes so as to provide a material-receiving space therebetween, means substantially closing the upper end of said material-receiving space, a plurality of vertically spaced baffle members extending horizontally within the space between said screens and transversely thereof and each provided with a restricted opening permitting downward passage of collected material therethrough, said restricted opening in each of said baffle members disposed substantially midway between said screens.

6. In an electrical precipitation apparatus, a collecting electrode consisting of a vertically disposed tubular screen, means for passing gas longitudinally through the tubular space within said screen, a discharge electrode member extending centrally within said tubular screen, means defining a material-receiving space outside said tubular screen, and a plurality of vertically spaced baffle members extending across said material-receiving space and transversely with respect to the length of said screen, each of said baffle members being provided with restricted opening means for passage of collected material therethrough, by gravity, from above said baffle member to below said baffle member, in such manner that all of the material collected in said receiving space is permitted to fall successively through the opening means in the respective baffle members and is discharged through said opening means in the lowermost baffle member.

7. In an electrical precipitation apparatus, a housing, a plurality of tubular screen collecting electrodes extending vertically within said housing, means for passing gas vertically through the interiors of said collecting electrodes, discharge electrode members extending centrally within the respective collecting electrodes, the interior of said housing outside said collecting electrodes constituting a material-receiving space, means substantially closing the upper end of said material-receiving space, and baffle means extending within said material-receiving space, between adjacent collecting electrodes and transversely with respect to the length of said electrodes, and provided with restricted openings for downward passage of material therethrough.

8. In an electrical precipitation apparatus, a construction as set forth in claim 7, and comprising in addition, vertically disposed partition means extending within said material-receiving space and between adjacent collecting electrodes.

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