

Nov. 22, 1927.

1,650,097

W. A. SCHMIDT

ELECTRICAL PRECIPITATOR

Filed Sept. 9, 1925

2 Sheets-Sheet 1

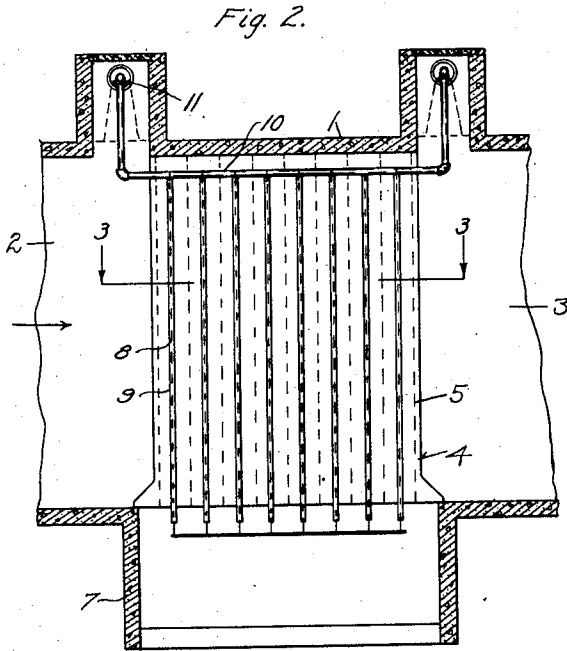
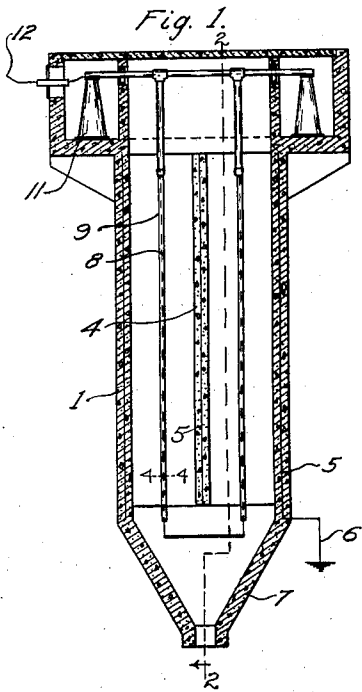
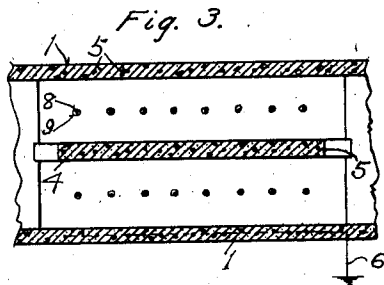


Fig. 4.



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2 Sheets-Sheet 2

Fig. 5

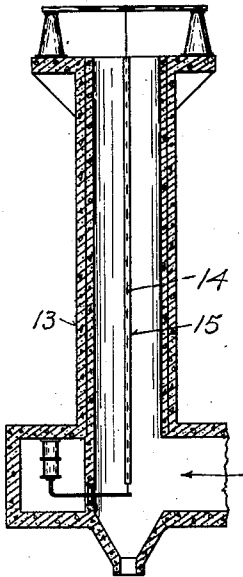


Fig. 6

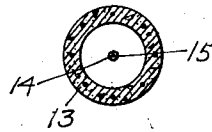


Fig. 7

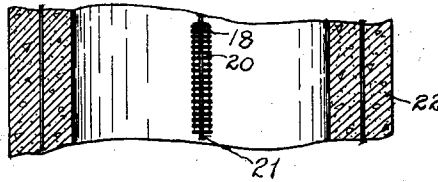
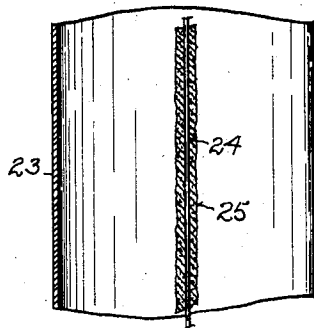


Fig. 8



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# UNITED STATES PATENT OFFICE.

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## ELECTRICAL PRECIPITATOR.

Application filed September 9, 1925. Serial No. 55,383.

This invention relates to apparatus for separation of suspended particles from gases by electrical action and particularly to the form of such apparatus in which the gases containing the particles are passed between electrodes maintained at a high potential difference and so constructed as to produce an electrical discharge from certain of said electrodes, resulting in charging of the suspended particles and the deposition of charged particles on the electrodes and particularly on the electrodes opposing the discharge electrodes.

The main object of the present invention is to provide in an electrical precipitator of this character, means for increasing the efficiency and capacity of the precipitator by increasing the amount of electrical discharge therein. Another object of the invention is to provide for distributing the electrical discharge more effectively throughout the body of gas being treated so as to result in a more efficient precipitation.

In electrical precipitators there is a tendency for concentration of the electrical discharge at certain portions of the electrodes leading to certain disadvantageous results. By reason of such concentration of the electrical discharge in such portions of the electrodes there is liable to be a large portion of the gas being treated which is not subjected to the action of such electrical discharge and consequently such portions of the gas may pass through the electrical precipitator without being subjected effectively to the electrical precipitating action. In order to ensure contact of all portions of the gas with the electrical discharge it has generally been necessary to make the gas velocity extremely slow or to make the conduit or gas treating space between the electrodes sufficiently long to ensure that all of the gas will be subjected to electrical action at some time in its passage through such space. Furthermore, by reason of such concentration of electrical discharge there is liable to be breaking down of the dielectric resistance of the gas to such an extent as to cause arcing or disruptive discharge which seriously decreases the efficiency of the treater by limit-

ing the potential difference which may be maintained between the electrodes, and by otherwise interfering with the operation of the precipitator.

It has been found that by making the so-called collecting electrodes of semi-conducting or high resistance material so as to interpose a considerable resistance to the passage of current, concentration of the electrical discharge at any one portion or a relatively limited number of portions of the collecting electrodes may be prevented. I have found, however, that in connection with a collecting electrode of this character there is a tendency to diminution of electrical discharge due to the spreading out of the electrical field, and I have found that in order to realize the full benefit of the greater uniformity of electrical field it is advantageous to provide a discharge electrode adapted to facilitate a more or less uniform and copious discharge from all portions thereof at a potential difference below the critical potential difference or so-called arcing voltage between the electrodes. For this purpose I may coat or surround the discharge electrodes with a material which facilitates the electrical discharge, for example a porous dielectric, which by reason of its facilitating ionization within the pores of such material tends to produce emanation of ions more or less uniformly from all parts of the surface thereof. The provision of a discharge electrode provided with the means as above described for facilitating electrical discharge is also of advantage in connection with a metallic or highly conducting collecting electrode.

The accompanying drawings illustrate embodiments of my invention and referring thereto:

Fig. 1 is a vertical transverse section of one form of my invention.

Fig. 2 is a section on line 2—2 in Fig. 1.

Fig. 3 is a section on line 3—3 in Fig. 2.

Fig. 4 is a horizontal section of a discharge electrode on line 4—4 in Fig. 1.

Fig. 5 is a vertical section of a tubular or so-called pipe treater embodying my invention.

Fig. 6 is a horizontal section through the tubular treator chamber shown in Fig. 5.

Figs. 7 and 8 are partial vertical sections of modified forms of my invention.

5 Referring to Figs. 1 to 3 the embodiment of my invention shown therein comprises a casing or conduit 1 having inlet 2 and outlet 3 for the gas to be treated and provided with any desired number of vertical partition walls 4 subdividing the interior of said  
10 conduit into a plurality of passages. The walls of the flue 1 and the partition 4 constitute the collecting or so-called passive electrodes and may consist of any suitable semi-conducting or high resistance material presenting sufficient conductivity for carrying the precipitating current but presenting sufficiently high resistance to substantially prevent or largely reduce excessive concentration of the precipitating current at a point or points of said electrodes. For this purpose said electrode members 1 and 4 may consist of re-enforced concrete or similar material consisting for example of concrete walls of Portland cement and suitable aggregate and having vertical re-enforcing bars or rods 5 which are arranged in spaced parallelism, for example, vertically and are connected together and to ground by wires or  
20 conductors 6. Suitable means such as hopper 7 may be provided below the flue 1 for receiving the material precipitated upon the collecting electrodes and removed therefrom by the action of gravity or in any other suitable manner.

25 Within the flue space between the walls 1 and the partition means 4 are provided discharge electrodes 8 consisting for example of wires, rods, or other conductors so constructed as to facilitate electrical discharge therefrom, said wires or conductors 8 being suspended from a supporting frame 10 which is mounted on insulators 11 in the usual manner of electrical precipitators of this character. For the purpose of facilitating discharge therefrom, the discharge electrodes may be provided or coated with any suitable discontinuous dielectric indicated at 9, for example, a porous, solid dielectric, such as more or less finely divided  
30 glass, or sand, or diatomaceous earth, or asbestos, glass wool or other fibrous dielectric, mixed with any suitable binder, if necessary, such for example as silicate of soda solution, plaster of Paris, Portland cement, lime, or other hydraulic binder or with small quantities of bitumen, rosin, or other binder which may be softened by the action of heat. In either case the amount of binder used is sufficiently small as to not impair seriously the porosity or discontinuity of the material. I prefer to arrange the discharge electrodes in parallelism to the re-inforcements 5 in the collecting electrodes and opposite the spaces  
35 between said re-enforcements, so as to equal-

ize the electrical field intensity throughout the surface of the collecting electrode, as set forth in patent to E. Anderson, No. 1,541,677, dated June 9, 1925.

The operation is as follows:

70 A high potential difference preferably unidirectional is applied to the electrodes by connecting the high tension system carrying the discharge electrodes 8, through a wire 12 to any suitable source of high tension rectified alternating current, for example in the manner set forth in the U. S. patent to F. G. Cottrell, No. 895,729, dated August 11, 1908. Thus a strong electric field is produced between the electrode 8 and the opposing electrode with the result that electrical discharge takes place mainly from the electrode 8 on account of the relatively limited cross-section and correspondingly sharp curvature and also on account of the fact of the coating 9 facilitating such discharge. This coating has a further effect of distributing the discharge more or less over the entire surface of the collecting electrode so as to produce a discharge or ionization which is presented to all parts of the gas passing between the electrodes. As a result of the uniform distribution of electrical discharge, corona, or ionization throughout the body of gas passing between the electrodes a more rapid and complete electrical charge of the suspended particles in the gas is secured with resulting rapid and complete electrical precipitation of the suspended particles, such precipitation taking place by translation of the electrical particles under action of the electrical field toward the collecting electrodes, it being understood that the particles will be electrically charged in the same sense as the discharge electrodes and will therefore be forced by the action of the electrical field away from the discharge electrode and toward the collecting electrode. By reason of the semi-conducting nature of the collecting electrode it is possible to produce such extended or distributed discharge from all or a large part of the surface of the discharge electrodes without danger of undue concentration of electrical discharge at any part of the collecting electrodes such as would otherwise be liable to lead to a break-down of the dielectric resistance of the gases. The potential difference between the electrodes may therefore be maintained sufficiently high to ensure such extended or distributed discharge from the discharge electrodes without causing disruptive discharge to any serious extent. By reason of the large amount of electrical discharge produced as above described and its more or less uniform distribution in contact with the gas passing between the electrodes, a correspondingly large amount of gas can be treated effectively in a precipitator of relatively limited size. The material deposited on the collecting electrode  
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may eventually fall from the same by the action of gravity or may be otherwise removed into the receiving means 7, from which it may be removed as desired.

5 My invention may also be applied to precipitators of the tubular or pipe type as shown in Figs. 5 and 6, the casing 13 in that case being tubular and preferably vertical and being for example of re-enforced concrete and discharge electrode 14 being  
10 mounted on suitable insulating means and being coated with or surrounded by discontinuous or porous dielectric indicated at 15 as above described. The operation of this  
15 form of my invention is the same as that of the plate type precipitator shown in Figs. 1 to 3 and it will be understood in practice that any suitable number of vertical flues or pipes may be connected in parallel ar-  
20 rangement in the usual manner of the multiple pipe electrical precipitators.

In place of using a porous dielectric any other means may be provided for facilitating discharge from the discharge electrodes in  
25 connection with the semi-conducting collecting electrode construction for preventing concentration of the discharge in any part thereof. For example the discharge electrode may be coated with radio-active ma-  
30 terial such as uranium ore, or radium ore, or products thereof. Or, as shown in Fig. 7 the discharge electrode may comprise alternately arranged dielectric or non-conducting members 18, such as discs or plates of  
35 mica, or asbestos, or like material, and conductor members 20 formed for example of metal discs or plates, all supported on discharge electrode conductor 21 in such manner that the non-conducting elements constitute a discontinuous dielectric at the dis-  
40 charge surface tending to facilitate ionization and discharge. Any other means for providing for a discontinuous dielectric at the discharge surface may be employed provided it is such as to facilitate ionization  
45 throughout such discharge surface. The collecting electrode 22 may be similar to that shown in Fig. 5.

50 While I have described my invention as particularly applied in connection with electrical precipitators having collecting or passive electrodes formed of semi-conducting or high resistance material, it may also be applied in some cases with advantage to  
55 precipitators in which the collecting electrodes are of good conducting material such as metal. Such a construction is shown in Fig. 8, the collecting electrode 23 being shown as a conducting pipe of metal and the discharge electrode being shown as a metallic  
60 conductor 24 insulated from the collecting electrode and provided with a coating indicated at 25 and constituting a porous dielectric or discontinuous dielectric in the manner  
65 above described.

It will be understood that in the operation of the electrical precipitator such as above described there will be in general some deposition of electrically precipitated material on the surface of the discharge electrode, al-  
70 though the major portion of the electrical precipitation will take place on the collecting or passive electrode. In so far as there is deposition of non-conducting material on the discharge electrode, such deposition, pro-  
75 vided it is of porous or discontinuous nature will not interfere with the operation of the invention as it forms substantially an extension of the porous or discontinuous dielectric surface of the discharge electrode, it being  
80 understood that such deposited material will not in general be permitted to accumulate to a sufficient thickness to interfere with the flow of gas through the precipitator, or otherwise interfere with the operation of the  
85 precipitator, such deposit being removed by any suitable means such as rapping, scraping, or brushing, or by the action of gravity alone, in the usual manner in electrical precipitators of this character.

In each of the above described embodiments of my invention the discharge electrodes are shown as of relatively limited area and relatively sharp curvature and the collecting electrodes as presenting flat sur-  
90 faces or surfaces which are concave toward the electrical field, the effect being in either case to facilitate discharge from the discharge electrodes and to prevent or reduce  
95 discharge from the collecting electrodes, and such a construction of the electrodes tending to limit the discharge as far as possible to the discharge electrodes is a preliminary condition of the successful carrying out of my  
100 invention which provides for increasing and distributing the electrical discharge over the surface of the discharge electrodes in an electrical precipitator having the electrodes of the character described.

I claim:

1. An apparatus for separating suspended particles from gases by electrical action, comprising a collecting electrode having high resistance, and a discharge electrode insulated  
110 from the collecting electrode and consisting of conducting material covered with material facilitating uniform electrical discharge and means for maintaining said discharge  
115 and collecting electrodes at high potential difference.

2. An apparatus for separating suspended material from gases comprising a discharge electrode of conducting material and of relatively limited area surrounded with a po-  
120 rous dielectric adapted to facilitate ionization and electrical discharge throughout its surface, and a collecting electrode opposing said discharge electrode of relatively extended area and presenting high resistance  
125 throughout its area, so as to prevent con- 130

centration of electrical discharge at any part of its surface.

3. An apparatus for separating suspended particles from gases, comprising grounded collecting electrodes and discharge electrodes insulated from the collecting electrodes and means for maintaining said electrodes at high potential difference, each collecting electrode comprising concrete members of extended area, and metallic re-enforcements extending in parallelism and in spaced relation within said concrete member and connected to ground, and the discharge electrodes consisting of metallic members of relatively limited area, extending parallel to the re-enforcements in the collecting electrodes and opposite the spaces between said re-enforcements, and the discharge electrodes

being coated with material facilitating discharge from all parts thereof. 20

4. A construction as set forth in claim 3 in which the coating on the discharge electrode consists of a porous dielectric.

5. An apparatus for electrical precipitation of suspended material from gases comprising a discharge electrode of relatively limited area, and a collecting electrode of relatively extended area opposing said discharge electrode, said discharge electrode having its discharge surface provided with a porous dielectric adapted to facilitate uniform discharge therefrom. 25 30

In testimony whereof I have hereunto subscribed my name this 28th day of August, 1925.

WALTER A. SCHMIDT.