

June 29, 1937.

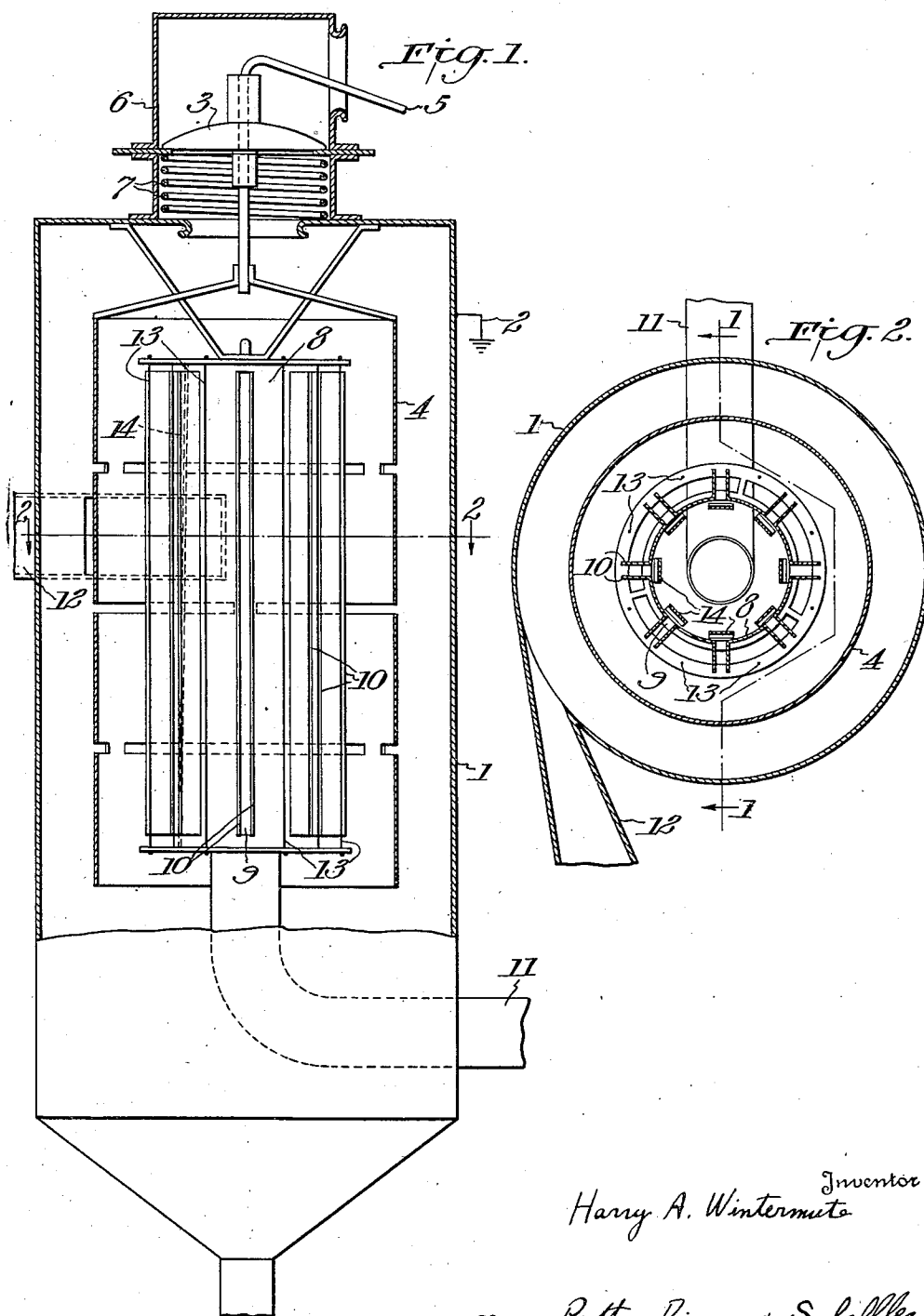
H. A. WINTERMUTE

2,085,349

ELECTRICAL PRECIPITATION

Filed Feb. 28, 1935

3 Sheets-Sheet 1



Inventor:
Harry A. Wintermute

By Potter, Pierce + Scheffler
Attorneys.

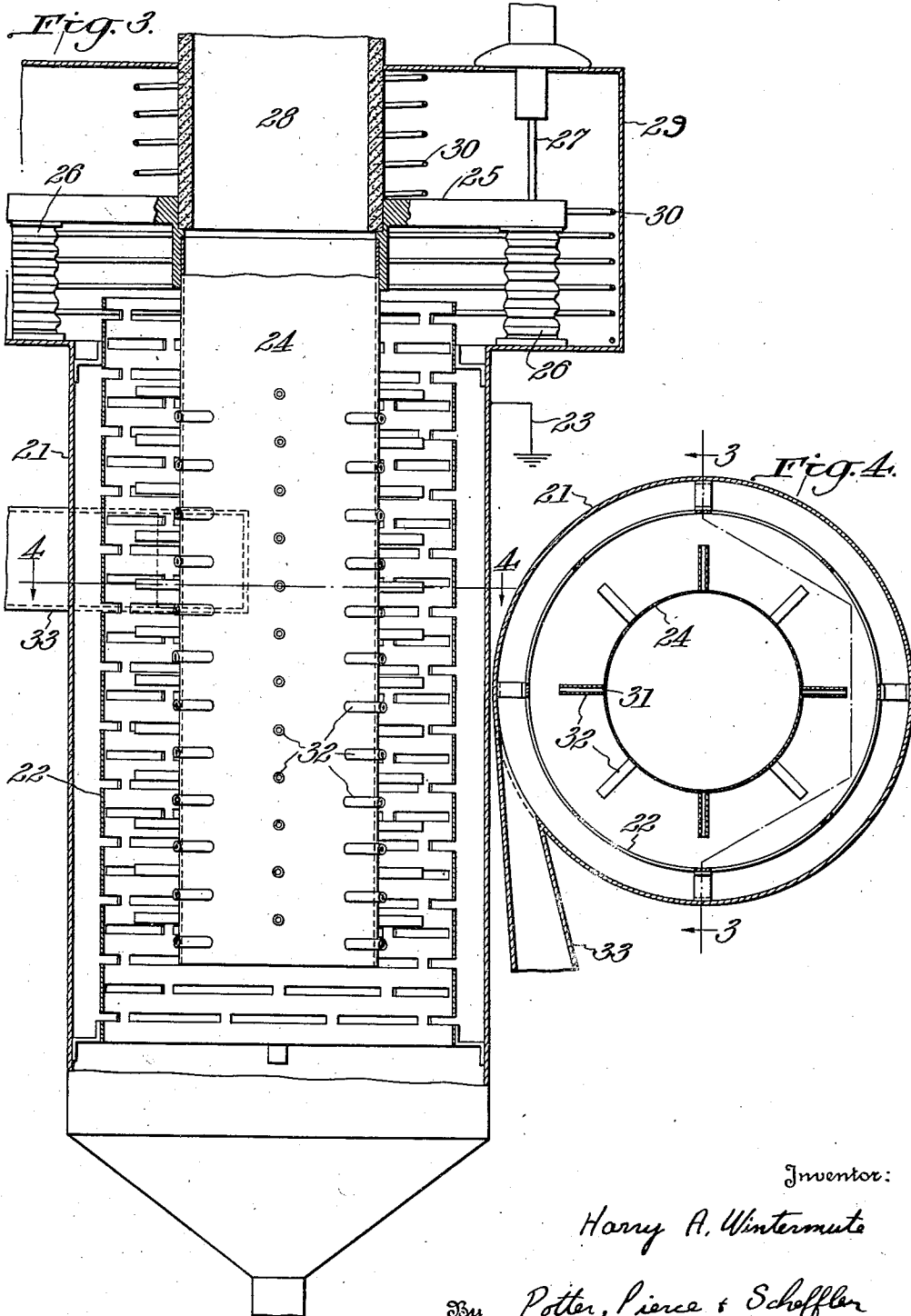
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3 Sheets-Sheet 2



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Harry A. Wintermute

By Potter, Pierce & Schaffler

Attorneys

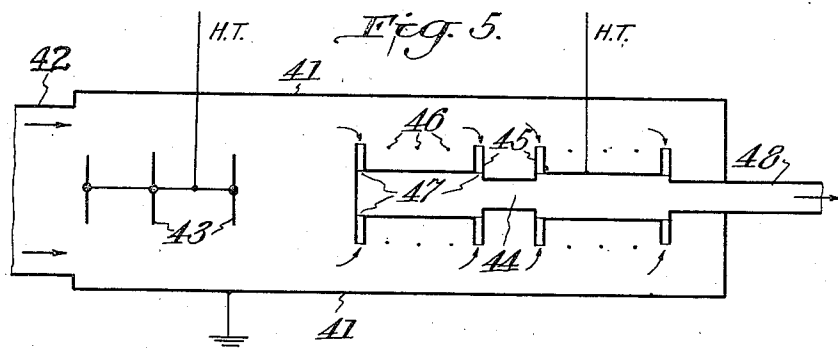
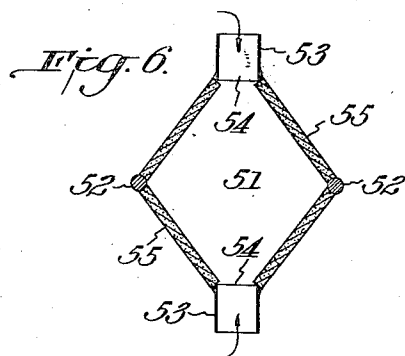
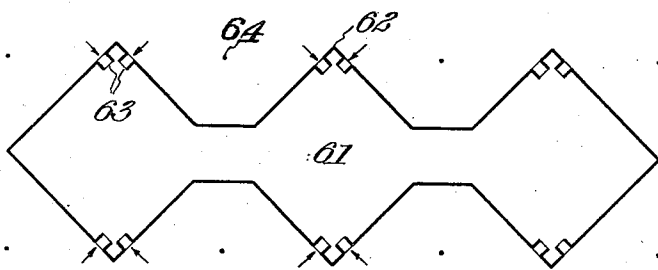
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3 Sheets-Sheet 3



Inventor:
Harry A. Wintermute

By Potter, Pierce & Scheffler
Attorneys.

UNITED STATES PATENT OFFICE

2,085,349

ELECTRICAL PRECIPITATION

Harry A. Wintermute, Plainfield, N. J., assignor
to Research Corporation, New York, N. Y., a
corporation of New York

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22 Claims. (Cl. 183—7)

The invention relates to electrical precipitation and is more particularly directed to means for the electrical precipitation of suspended particles from a fluid by means of corona discharge in an electrical field wherein the fluid is caused to pass through an electrical field toward and into discharge electrode members which constitute conduits for the removal of the fluid from the electrical field.

The precipitation of suspended particles from fluids has been successfully practiced by subjecting the fluids to the action of an electric field maintained between opposing electrodes. The electrodes are, in part, members of extended surface known as collecting electrodes. Opposed or complementary to the collecting electrodes are electrode members providing edges, points or portions of high radius of curvature which facilitate the formation of corona discharge. These electrodes are known as discharge electrodes. In practice the discharge electrodes are negatively charged at a relatively high potential while the collecting electrodes are grounded. However, the discharge electrodes may be positively charged, and the collecting electrode may be maintained at high potential and the discharge electrode grounded, or both electrodes may be at a high potential with respect to ground, the essential feature being the maintenance of a relatively high potential difference between the electrodes. In any such arrangement the corona discharge proceeds from the discharge electrodes and the suspended particles are precipitated upon the collecting electrodes.

A purpose of the invention is to provide an electrical precipitator wherein the fluid undergoing treatment will be removed directly from the treating zone through a discharge electrode constituting a conduit for the removal of fluids.

A further purpose of the invention is the removal of the fluid being treated at or adjacent points from which corona discharge emanates.

A further purpose of the invention is the provision of a discharge member as a conduit for the removal of the fluid undergoing treatment, and particularly such a discharge member wherein the withdrawal of fluid is effected uniformly through the treating zone.

Another purpose of the invention is to provide an electrical precipitator wherein all of the fluid being treated passes through corona discharge near its point of origin.

Another purpose of the invention is to provide an electrical precipitator wherein suspended matter is removed from fluids by simultaneously

and successively subjecting the fluids to centrifugal action and to the influence of a high potential electrical field.

Other purposes and advantages of the invention will be apparent from the following description wherein the invention is described for the purpose of illustration with reference to the accompanying drawings in which:

Fig. 1 is a partial vertical section of one embodiment of the invention;

Fig. 2 is a horizontal section on line 2—2 of Fig. 1;

Fig. 3 is a partial vertical section of a different embodiment of the invention;

Fig. 4 is a horizontal section on line 4—4 of Fig. 3;

Fig. 5 is a diagrammatic representation of a still further embodiment of the invention; and

Figs. 6 and 7 are diagrammatic representations of discharge electrodes embodying the principles of the invention.

In Figs. 1 and 2, 1 is the outer shell of the precipitator which is grounded at 2. Suspended within the shell 1, and insulated therefrom by bushing 3, is a collecting electrode member 4. This collecting electrode member may be a solid cylindrical member, but it is preferably perforated or divided into separate sections as shown. The collecting electrode member 4 is maintained at high potential with respect to the shell by means of lead 5. A flushing action may be provided, if desired, for example by means of sprays positioned to supply a liquid film to the inner surface of the shell. The insulating bushing 3 and adjacent members are advantageously maintained in a dry condition by means of housing 6 and heating coil 7.

Suspended from the shell and electrically connected thereto, but insulated from the collecting electrode, is discharge electrode-educator member 8. This electrode is provided with a plurality of vertical intake slots 9, provided at their edges with corona discharge emanating elements 10. The electrode 8 is closed at the top and at the bottom communicates with pipe 11. Thus the discharge electrode provides an eduction member for withdrawal of the fluid from the treating zone.

Spaced from the discharge electrode 8, but electrically connected thereto, are provided a plurality of auxiliary discharge elements 13. These elements prevent the "pithball" effect or rapid vibration of the precipitated material which occurs between two non-discharging surfaces under certain conditions.

The fluid to be treated is supplied to the precipitator through inlet pipe 12, which preferably enters the shell tangentially, thus inducing a vortical flow of the fluid between the shell and the collecting electrode thereby subjecting the suspended particles to centrifugal force under the simultaneous action of the non-ionizing electrical field maintained between electrode 4 and shell 1.

The fluid then passes through the perforations or slots in the collecting electrode, or through the ends of the same into the space between the collecting electrode 4 and discharge electrode 8, where it is subjected to the action of corona discharge emanating from elements 10 and auxiliary electrodes 13.

The fluid then passes out of the treating zone through slots or orifices 9, being subjected at the point of withdrawal to the concentrated corona discharge from elements 10. In this way the fluid in its cleanest condition is subjected to a final intensive cleaning action at a point in the cleaning zone where there is no precipitated material to be picked up and swept out of the chamber by the fluid.

The flow of the fluid through orifices 9 is advantageously equalized between the various orifices and along the length of the orifices by means of baffle members 14 fixed or adjustably positioned inside the discharge electrode opposite the openings.

It will be seen that this construction and method of operation has a number of important advantages. The fluid contains the highest concentration of suspended particles when it is adjacent the collecting electrode surfaces, thus providing a relatively short distance for the bulk of the particles to travel in their deposition. It eliminates escape of precipitated particles from the collecting electrodes by creepage along the surface, as, in order to escape, it would be necessary for the particle to leave the collecting surface and pass entirely across the electrical treating zone in opposition to the electrical forces. Also, as has been stated before, the fluid is subjected to intensified treatment at the point of removal from the treating zone.

A further advantage is that this construction and method of operation make it possible to operate under higher impressed voltages without "break-down" or arcing, which results in a higher efficiency of precipitation. It has been found, particularly when treating gases, that the voltage at which corona discharge breaks down into arc discharge is materially higher when there is, as in the invention, a strong fluid current flowing toward the point of emanation of the corona discharge.

When this apparatus is used to treat gases carrying particles of liquid in suspension another desirable result will be secured, namely, liquid particles precipitated on the collecting electrode member by the corona discharge from the discharge electrode will pass by electrical action onto the outside shell. As this collecting electrode and the outer shell are at different polarities there will be an attraction between them, and as the drip reaches a break in the collecting electrode member it will pull away from the collecting member and spray off and over to the outer shell member. Such action is advantageous in that in no case will it be necessary to dispose of the entire liquid as a drip from the bottom of the collecting electrode member.

A somewhat different embodiment of the invention is illustrated in Figs. 3 and 4. In this con-

struction a perforated cylindrical collecting electrode 22 is supported by and electrically connected to shell 21 which is grounded at 23.

Discharge electrode eductor 24 is suspended concentrically within collecting electrode 22 from member 25 which is supported on insulating bushings 26. The discharge electrode is maintained at high potential through lead 27. The discharge electrode eductor 24 is connected at its upper end with an exit pipe 28 of non-conductive material. The bushings 26 and exit pipe 28 are maintained in a dry condition by means of housing 29 and heating coils 30.

The discharge electrode and eductor member is provided with a plurality of orifices 31 fitted with inlet tubes 32, the outer ends of which form corona-emanating elements.

The fluid to be treated is introduced into shell 21 through tangential inlet pipe 33, passes vortically between shell 21 and collecting electrode 22, where it is subjected to centrifugal force, and then passes through the perforations of the collecting electrode into the field between the collecting electrode and discharge-eductor 24, where it is subjected to the action of corona discharge emanating from the ends of tubes 32. The fluid then passes into eductor 24 through tubes 32, after passing through the concentrated corona discharge at the outer ends of the tubes, and thence out of the treater by way of exit pipe 28.

In this construction the collecting electrode member 22 may be omitted, if desired, in which case the shell 21 serves as collecting electrode.

A still different form of the invention is diagrammatically illustrated in Fig. 5. In the apparatus illustrated by this figure the sides 41 of the precipitator are grounded and form collecting electrodes. The fluid to be treated enters the precipitator at 42 and passes between preliminary or ionizing discharge electrodes 43 and the collecting electrodes. In this zone the suspended matter in the fluid is started moving toward the collecting electrode surfaces 41 and thus the burden on the final treating zone is materially reduced. The fluid then enters the field between discharge electrode-eductor 44 where it is subjected to the corona discharge from the ends of tubes 45 and from auxiliary electrodes 46, having the same function as auxiliary electrodes 13 in the apparatus of Fig. 1, and is withdrawn from the treating zone into the eductor-electrode 44 through orifices 47. From the eductor-electrode it passes out of the apparatus through exit pipes 48.

Figs. 6 and 7 illustrate other forms of eductor-discharge electrodes embodying the principles of the invention. In Fig. 6 the eductor-electrode 51 comprises supporting and conductive members 52 and corona-emanating discharge elements 53 adjacent orifices 54 leading into the eductor. The discharge elements 52 are supported by semi-conductive members 55 of Transite board or the like, mounted on supporting members 52. The semi-conductive members 55 equalize the corona discharge from the various discharge elements.

In Fig. 7 the eductor-electrode 61 is provided with discharge elements 62 near, but not at, the orifices 63, for the withdrawal of fluids from the treating zone into the eductor. Auxiliary electrodes 64 assist in maintaining suitable conditions for smooth and efficient precipitation of suspended particles. In use, of course, the eductor-electrodes of Figs. 6 and 7 are positioned in opposition to suitable collecting electrodes main-

tained at a substantial potential difference therefrom.

I claim:—

1. Apparatus for the electrical treatment of fluids comprising a collecting electrode, an electrode spaced therefrom having corona-emanating discharge elements associated therewith, said second named electrode providing a conduit for the removal of fluids from the space between said electrodes and having orifices for the passage of fluid thereinto from substantially the whole of said space adjacent said second-named electrode, means for conducting fluids into said space, and means for impressing a high potential difference across said electrodes.

2. Apparatus for the electrical treatment of fluids comprising an electrode member of extended surface, a complementary electrode member having corona-emanating elements associated therewith, said second named electrode providing a conduit for the removal of fluids from the space between said electrode members and having orifices for the passage of fluid thereinto from substantially the whole of said space adjacent said second-named electrode, means for conducting gases into said space, and means for impressing a high potential difference across said electrodes.

3. Apparatus for the electrical treatment of fluids comprising a collecting electrode, an eductor member spaced from said collecting electrode, provided with orifices for the passage of fluid thereinto from substantially the whole of said space adjacent said eductor member and with corona-emanating elements, means for conducting fluids to be treated into the space between the collecting electrode and the eductor member, and means for providing a high potential difference between said collecting electrode and said eductor member.

4. Apparatus for the electrical treatment of fluids comprising a collecting electrode, an eductor member spaced from said collecting electrode, provided with orifices for the passage of fluids thereinto and with corona-emanating elements adjacent said orifices, means for conducting fluids to be treated into the space between the collecting electrode and the eductor member at a plurality of points along said collecting electrode, and means for providing a high potential difference between said collecting electrode and said eductor member.

5. Apparatus for the electrical treatment of fluids comprising a collecting electrode, an eductor member spaced from said collecting electrode, provided with orifices for the passage of fluids thereinto and with corona-emanating elements adjacent said orifices and co-extensive therewith, means for conducting fluids to be treated into the space between the collecting electrode and the eductor member at a plurality of points along said collecting electrode, and means for providing a high potential difference between said collecting electrode and said eductor member.

6. Apparatus for the electrical treatment of fluids comprising a collecting electrode, an eductor member spaced from said collecting electrode, provided with orifices for the passage of fluids thereinto and with corona-emanating elements, baffle members positioned adjacent said orifices for controlling the flow of gas therethrough, means for conducting fluids to be treated into the space between the collecting electrode and the eductor member, and means for providing a high

potential difference between said collecting electrode and said eductor member.

7. Apparatus for the electrical treatment of fluids comprising a collecting electrode, an eductor member spaced from said collecting electrode, provided with orifices for the passage of fluids thereinto and with corona-emanating elements adjacent said orifices and co-extensive therewith, baffle members positioned adjacent said orifices for controlling the flow of gas therethrough, means for conducting fluids to be treated into the space between the collecting electrode and the eductor member, and means for providing a high potential difference between said collecting electrode and said eductor member.

8. Apparatus for the electrical treatment of fluids comprising a casing, an electrode member of extended surface in said casing and an eductor member spaced from said extended surface electrode provided with orifices for the passage of fluids thereinto and with corona-emanating elements; means for passing fluids successively into the space between said extended surface electrode and said casing and thereafter into the space between said extended surface electrode and said eductor member and means for providing a high potential difference between said extended surface electrode and said eductor member.

9. Apparatus for the electrical treatment of fluids comprising a casing, an electrode member of extended surface in said casing and an eductor member spaced from said extended surface electrode provided with orifices for the passage of fluids thereinto and with corona-emanating elements adjacent said orifices, means for passing fluids successively into the space between said extended surface electrode and said casing and thereafter into the space between said extended surface electrode and said eductor member and means for providing a high potential difference between said extended surface electrode and said eductor member.

10. Apparatus for the electrical treatment of fluids comprising a casing, an electrode member of extended surface in said casing and an eductor member spaced from said extended surface electrode provided with orifices for the passage of fluids thereinto and with corona-emanating elements; means for passing fluids successively into the space between said extended surface electrode and said casing and thereafter into the space between the said extended surface electrode and said eductor member and means for providing a high potential difference between said extended surface electrode and said eductor member and between said extended surface electrode and said casing.

11. Apparatus for the electrical treatment of fluids comprising a casing, an electrode member of extended perforated surface in said casing and an eductor member spaced from said extended surface electrode provided with orifices for the passage of fluids thereinto and with corona-emanating elements, means for passing fluids successively into the space between said extended surface electrode and said casing and thereafter into the space between the said extended surface electrode and said eductor member and means for providing a high potential difference between said extended surface electrode and said eductor member.

12. Apparatus for the electrical treatment of fluids comprising a cylindrical casing, an eductor member positioned within said casing and spaced therefrom, provided with orifices for the passage

of fluids thereinto and with corona-emanating elements, means for passing fluids tangentially into the space between said casing and said eductor member and means for providing a high potential difference between said casing and said eductor member.

13. Apparatus for the electrical treatment of fluids comprising a cylindrical casing, an eductor member positioned within said casing and spaced therefrom, provided with orifices for the passage of fluids thereinto and with corona-emanating elements adjacent said orifices, means for passing fluids tangentially into the space between said casing and said eductor member and means for providing a high potential difference between said casing and said eductor member.

14. Apparatus for the electrical treatment of fluids comprising a cylindrical casing, an electrode member of extended surface within said casing and concentrically spaced therefrom, an eductor member within said extended surface electrode member and concentrically spaced therefrom, said eductor member being provided with orifices for the passage of fluids thereinto and with corona-emanating elements, means for passing fluids into the space between said casing and said extended surface electrode and thereafter into the space between said extended surface electrode and said eductor member, and means for providing a high potential difference between said eductor member and said extended surface electrode.

15. Apparatus for the electrical treatment of fluids comprising a cylindrical casing, an electrode member of extended surface within said casing and concentrically spaced therefrom, an eductor member within said extended surface electrode member and concentrically spaced therefrom, said eductor member being provided with orifices for the passage of fluids thereinto and with corona-emanating elements, means for passing fluids into the space between said casing and said extended surface electrode and thereafter into the space between said extended surface electrode and said eductor member, and means for providing a high potential difference between said eductor member and said extended surface electrode and between said extended surface electrode and said casing.

16. Apparatus for the electrical treatment of fluids comprising a cylindrical casing, an electrode member of extended surface within said casing and concentrically spaced therefrom, an eductor member within said extended surface electrode member and concentrically spaced therefrom, said eductor member being provided with orifices for the passage of fluids thereinto and with corona-emanating elements, means for passing fluids tangentially into the space between said casing and said extended surface electrode and thereafter into the space between said extended surface electrode and said eductor member, and means for providing a high potential difference between said eductor member and said extended surface electrode.

17. Apparatus for the electrical treatment of fluids comprising a cylindrical casing, an electrode member of extended surface within said casing and concentrically spaced therefrom, an eductor member within said extended surface

electrode member and concentrically spaced therefrom, said eductor member being provided with orifices for the passage of fluids thereinto and with corona-emanating elements, means for passing fluids tangentially into the space between said casing and said extended surface electrode and thereafter into the space between said extended surface electrode and said eductor member, and means for providing a high potential difference between said eductor member and said extended surface electrode and between said extended surface electrode and said casing.

18. Apparatus for the electrical treatment of fluids comprising a cylindrical casing, an electrode member of extended perforated surface within said casing and concentrically spaced therefrom, an eductor member within said extended surface electrode member and concentrically spaced therefrom, said eductor member being provided with orifices for the passage of fluids thereinto and with corona-emanating elements, means for passing fluids into the space between said casing and said extended surface electrode and thereafter into the space between said extended surface electrode and said eductor member, and means for providing a high potential difference between said eductor member and said extended surface electrode.

19. Apparatus for the electrical treatment of fluids comprising a cylindrical casing, an electrode member of extended surface within said casing and concentrically spaced therefrom, an eductor member within said extended surface electrode member and concentrically spaced therefrom, said eductor member being provided with orifices for the passage of fluids thereinto and with corona-emanating elements adjacent said orifices and coextensive therewith, means for passing fluids into the space between said casing and said extended surface electrode and thereafter into the space between said extended surface electrode and said eductor member, and means for providing a high potential difference between said eductor member and said extended surface electrode.

20. A method for the electrical precipitation of suspended particles from fluids which comprises subjecting the fluids to centrifugal action under the simultaneous effect of an electrical field, immediately thereafter subjecting the fluids to the action of corona discharge in an electrical field, and withdrawing the fluids from said electrical field at points adjacent concentrated corona discharge.

21. A method for the electrical precipitation of suspended particles from fluids which comprises passing the fluid through an electrical field toward a source of corona discharge and in a direction opposite to the direction of said corona discharge and withdrawing the fluid from said electrical field at a point adjacent the source of corona discharge.

22. A method of removing suspended liquid particles from a gas which comprises passing the gas through an electrical field toward a source of corona discharge and in a direction opposite to the direction of the corona discharge and withdrawing the gas from said electrical field in a point adjacent the source of corona discharge.

HARRY A. WINTERMUTE.