W. A. SCHMIDT.

MEANS FOR SEPARATING SUSPENDED MATTER FROM GASES.

APPLICATION FILED MAR. 5, 1913.

1,343,285. **Patented June 15, 1920.**

Fig. 1.

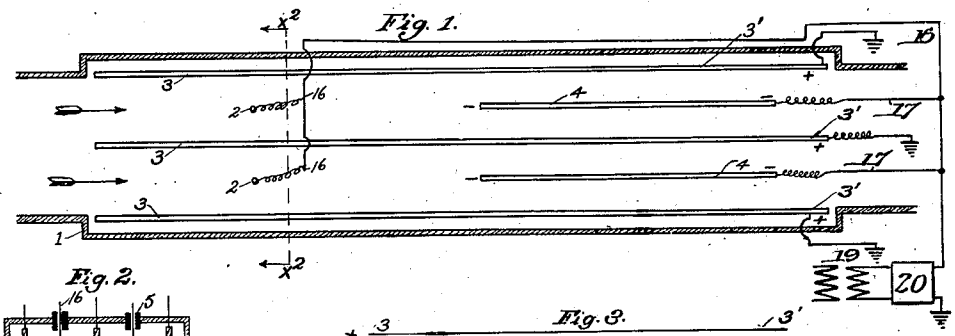


Fig. 2.

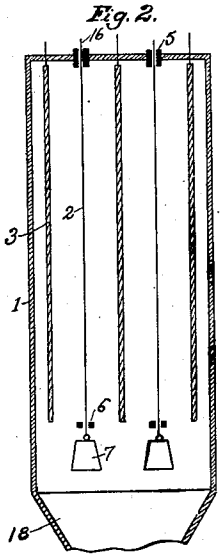


Fig. 3.

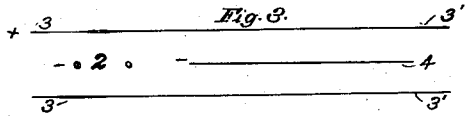


Fig. 4.

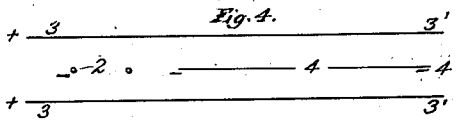


Fig. 5.

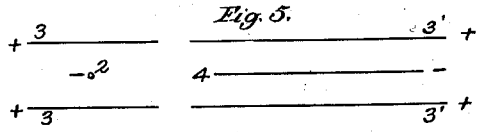


Fig. 6.

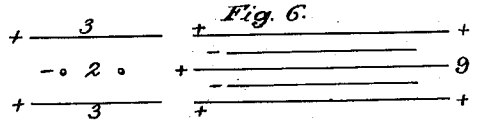


Fig. 7.

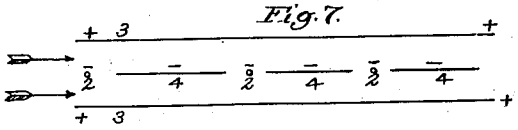


Fig. 8.

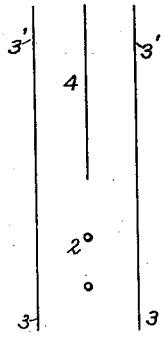


Fig. 9.

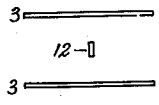


Fig. 10.

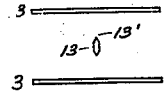
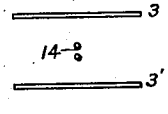


Fig. 11.



WITNESSES

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BY Arthur P. Knight

his ATTORNEY

UNITED STATES PATENT OFFICE.

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MEANS FOR SEPARATING SUSPENDED MATTER FROM GASES.

1,343,285. Specification of Letters Patent. Patented June 15, 1920.

Application filed March 5, 1913. Serial No. 751,995.

To all whom it may concern:

Be it known that I, WALTER A. SCHMIDT, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Means for Separating Suspended Matter from Gases, of which the following is a specification.

This invention relates to improvements in the art of separating suspended particles from gaseous bodies by electric means and is applicable, for example, to the separation from the gaseous bodies of such suspended matter as dust, smoke, acid mist, chemical fumes, etc. It is well known that such suspended particles can be separated from the gases carrying the same by subjecting the gaseous bodies to the action of a high potential electrical discharge. This operation usually consists in passing the gases through an apparatus in which are contained electrodes or series of electrodes of two distinctly different kinds. The electrodes of one kind are of such a nature as will facilitate electric discharge from the electrode into the gases, while the electrodes of the other kind are of such form as not to cause a discharge to take place from their surfaces. These two kinds of electrodes are usually placed opposite to each other, so that under a high potential stress an electric discharge passes from one electrode to the other, the direction of flow of the ions, composing this discharge, being from the electrode facilitating discharge from its surface to the non-discharging electrode. When a gaseous body containing suspended particles is passed through this discharge, the suspended particles are first given an electrostatic charge from the impact of the ions upon the particles. These charged particles then being in an electric field are caused to migrate in the direction of the electric field and can be made to precipitate upon the electrode.

The apparatus heretofore used for carrying on this operation contains electrodes of the two kinds above described and placed in juxtaposition to each other, so that the electric field in which the discharge takes place is utilized first for charging the suspended particles carried by the gases under treatment, and second to cause these charged particles to migrate to the electrodes, there to be precipitated.

This invention relates to improvements both in the means of obtaining the discharge for charging the suspended particles and in providing separate means for removing these charged particles from the gases under treatment.

One object of the invention is to provide improved means for obtaining the discharge for charging the suspended particles.

Another object of the present invention is to provide distinct or separate means or systems for effecting the charging of the suspended particles and for removing the charged particles from the gases under treatment, so that each of such operations may be performed under the most efficient conditions.

The electrodes heretofore used to facilitate electric discharge have been given sharp points, such as metallic points, or a large number of extremely fine points as in pubescent electrodes, or else a series of very thin edges as in scaly electrodes, such as electrodes made of serrated mica with frayed edges.

In utilizing pointed, pubescent or serrated scaly electrodes, such as have heretofore been employed, the electric field intensity at the points is readily raised to the critical intensity above which ionization of the gas adjacent to the point, takes place. I have found that by using a plain wire or other conducting filament of sufficiently small diameter and by maintaining sufficient electric stress between the electrodes that the electric field intensity at the surface of the wire can be raised above the critical intensity and that it is, therefore, possible to obtain a satisfactory discharge from the electrodes under the operating conditions of the apparatus when the pointed, pubescent or scaly electrodes are replaced by fine wire or filamentary electrodes. By utilizing an electrode of this character a very uniform discharge, over the entire length of the wire, can be obtained. As the entire surface of the wire is discharging it is also possible to obtain a much greater current flow off of the electrode than could be obtained with isolated points as in an ordinary pointed electrode. Electrodes of this character also have

the decided advantage of being cheaper in first cost and also that they can be more readily installed.

I have found that in some cases it is a rather easy matter to electrically charge the suspended particles, but that it is more difficult to cause these charged particles to precipitate upon the electrodes. Under these conditions the particles may pass entirely through the apparatus, as electrically charged particles, passing through a succession of electric fields, such as above described, without being forced on to the electrodes. In such cases I have found that an electrostatic field formed by extended surfaces is of great value. By using two extended surfaces, neither of which facilitates electric discharge, a very intense electrostatic field can be maintained between the electrodes. If now the charged particles be passed through this electrostatic field they will be subjected to a sufficiently strong electric field for a sufficient length of time to cause them to be forced over to the electrodes.

Electrodes of this latter character are also of great value for removing charged particles from gases, whether they be charged in the same or different apparatus, or whether they be charged as above described or by any other means. They might even be charged through ionization caused by flames, by incandescent solids, X-rays, and so forth.

In the ordinary procedure for separating suspended particles from gaseous bodies, with the aid of my invention, the action is as follows: The gases are passed through an apparatus containing two distinct series of electrodes, which for convenience may be termed charging electrodes and precipitating electrodes. The gases first pass through the electric field produced by the charging electrodes. These may consist of ionizing electrodes and non-discharging electrodes. In passing between these charging electrodes, the gases are subjected to the influence of the electric discharge taking place between the electrodes, and the particles suspended in the gases become electrically charged. These charged particles then migrate in the electric field between the electrodes. Some of the charged particles may be caused to precipitate upon the electrodes, while some may be carried out of the influence of the electric field by the advancing gases before they reach the electrodes. These particles are then carried along by the gases as charged particles, and the gases containing these charged particles are then passed through strong electrostatic fields set up by the precipitating electrodes and here the charged particles are all forced on to the electrodes and there precipitated.

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

Figure 1 is a plan view of one form of the invention.

Fig. 2 is a vertical section thereof, on line X^2—X^2.

Figs. 3 to 8 are diagrams showing other arrangements of the electrodes.

Figs. 9 to 11 are horizontal sections of the charging electrodes showing modifications of the ionizing electrode.

Referring to Figs. 1 and 2, a suitable chamber or conduit 1 is provided through which the gas to be treated is forced or conducted. Supported in this conduit are one or more electrodes 2 adapted, when charged to suitable electric potential, to produce ionization in the gas adjacent thereto and to electrically charge the suspended particles in such gas. Opposite the charging electrodes, 2, are electrodes 3, which aid in maintaining the electrostatic tension and the resultant ionization adjacent to electrodes 2. Electrodes 2 and 3 are positioned so that the gas to be treated passes between them, as indicated by the arrows. In Fig. 1 the electrodes 3 are shown as extended, forming precipitating portions 3′, between which are arranged electrodes 4 which are charged oppositely to electrodes 3 so as to maintain a strong electrostatic field between said electrodes, these electrodes being so positioned that the gas to be treated, after passing between the electrodes 2 and 3 is received between the electrodes 4 and 3′ and the charged particles in such gas are, by reason of the electrostatic field between said electrodes, 4 and 3′, caused to migrate or move toward electrode portions 3′. Electrodes 3 may be grounded, the electrostatic field being maintained between the grounded and charged electrodes 2 and 4. Suitable connections, for example, by means of wires 16 and 17, are made to the electrodes 2 and 4 from a suitable source of unidirectional high potential current so as to maintain a high potential difference between said electrodes and the electrodes 3 and 3′, the electric charges on the electrodes being, for example, as indicated by the signs + and —. Said source may comprise a step up transformer 19 connected to receive current from any alternating current supply circuit, and a rectifier 20 in the connections from the secondary of said transformer to wires 16 and 17, said rectifier being also provided with ground connections to complete the circuit through electrodes 3.

Electrode 2 is of such a nature or form as to facilitate or promote ionization, and the discharge of electricity therefrom into the adjacent gas and to the suspended particles in the gas. A form of electrode which I have found especially suitable for this purpose is shown in Fig. 2, consisting of a fine

wire, for example, one-twentieth inch or less in diameter, which is suspended from suitable supporting means, said wire being plain or bare so as to be exposed directly to the gas surrounding the same.

In place of a fine wire, it is also possible to use any conducting filament, sufficiently fine. This filament may be round or of any other cross section presenting a continuous sharp or narrow edge adapted to facilitate discharge; for example, it may be a flat filament, as shown at 12 in Fig. 9, having its edges presented toward the other electrodes 3; or as shown at 13 in Fig. 10 the ionizing electrode may be a flat strip having sharp edges 13′ presented toward the opposite electrodes 3. Two or more of the fine wires or filaments may be placed near together in a plane extending transversely to the opposite electrodes 3, as shown at 14 in Fig. 11, the effect being then similar to that of a flat strip, presenting more intense discharging action at the edges or portions facing the opposing electrodes 3. Whenever the material under treatment is, in itself, conducting, as for instance when the treatment consists of precipitating sulfuric acid mist, the filament can then consist of a non-conducting material, as the precipitated material will form a conducting film over the surface of the electrode.

Electrodes of this character can be supported in any convenient manner and can be held in any convenient or advantageous position. They can be held taut either by the use of a tensioning weight or tensioning spring or any similar method. I have found it most convenient to place the electrode in a vertical position, the electrode being supported at the top, passed through an insulated spacer 6 at the bottom and held taut by a weight, 7, fastened at the lower end of the electrode. I have, however, used springs for tensioning the electrodes and have held and fastened the electrodes in numerous different ways, all of which fall within the scope of this invention. The insulated spacer 6 constitutes retaining means for preventing lateral movement of the electrode wires 2.

The electrodes 3, and more particularly the portions 3′ thereof which are used as the dust collecting means, are preferably such as to present extended surfaces, consisting, for example, of metal plates, and the electrodes 4 are also preferably extended surfaces such as metal plates approximately parallel to the electrode portions 3′, so as to produce a uniformly distributed field of great intensity without discharging action. Means such as hopper 18, may be provided for receiving the precipitate from the precipitating electrodes.

The operation is as follows:—

The gas to be treated is conducted through the space between the electrodes 2 and 3, the electrodes 2 being charged to sufficient potential to produce ionization in the surrounding gas, so as to charge the particles suspended in the gas. The gas then passes into the space between the electrodes 4 and 3′ and is there subjected to a strong electrostatic field, forcing the charged particles toward the electrodes 3′ and causing them to be separated from the gas and precipitated on electrodes 3′.

Should the first series of charging electrodes not be sufficient to charge all of the suspended particles, or should all of the suspended particles not be removed by the first series of charging electrodes and precipitating electrodes, several series of either kind may be used, the series following one another, or any number may be employed and so arranged that the gases and the suspended particles are alternately subjected to the influence of the charging field and the precipitating field, all of which arrangements fall within the scope of this invention. An arrangement of electrodes suitable for producing such repeated action in the gas is shown in Fig. 7, wherein ionizing electrodes 2 and non-discharging precipitating electrodes 4 are arranged alternately in the path of the gas; with opposing electrodes 3 of opposite polarity.

Any desired number of ionizing electrodes 2 may be provided for each set of charging electrodes, Fig. 3 illustrating an arrangement wherein two ionizing electrodes 2 are provided acting successively on the gas before it passes to the precipitating electrodes 4. Similarly the precipitating electrodes 4 may be divided as shown in Fig. 4.

The electrode portions 3 and 3′ may, if convenient, be made of separate plates or extended conductors, as shown in Fig. 5, said plates being connected to receive electric potential similar in sign. The charges on the plates 3 and 3′ are in this case not necessarily of the same potential.

As shown in Fig. 6 the stream of gas after passing a single set of charging electrodes, may be divided so as to pass through a plurality of electrostatic fields arranged in parallel; and in that case, the electrode or electrodes 9, which are in the line of flow from the ionizing electrodes 2, may be charged oppositely to said ionizing electrodes.

Any of the above arrangements of the electrodes may be positioned for a horizontal flow of the gas, as shown in Figs. 1 to 7, or for a vertical flow, as illustrated in Fig. 8.

As will be evident, there is formed about each charging electrode what may be termed a discharge zone, and that when a series of such electrodes are used, there will be established within the flow path of the fluid or gaseous stream, a succession of similar indi-

vidual discharge zones extending parallel to each other in directions intersecting the flow path of the stream, each of which zones has substantially similar discharge characteristics throughout its length.

What I claim is:

1. In an apparatus for the separation of suspended particles from gases by electric means, an electrode for discharging electricity into the gases, to charge said particles, said electrode being a rectilinearly extended bare conductor whose discharging portion is substantially straight in the direction of linear extension of said member and which has a sufficiently sharp curvature transverse to such linear extension, to produce ionization in the adjacent gas, under operating conditions of the apparatus.

2. In an apparatus for the separation of suspended matter from gases by electric means, charging electrodes comprising a discharging electrode and a non-discharging electrode, said discharging electrode being a linearly extended member having a discharging surface continuous in the direction of linear extension of said member, and presenting sharp curvature transverse to such direction and a non-discharging electrode presenting an extended surface parallel to the direction of extension of said discharging electrode.

3. In an apparatus for the separation of suspended particles from gases by electric means, a charging electrode consisting of a conducting filament sufficiently fine to maintain, under operating conditions of said apparatus, an electric field intensity at its surface, sufficient to cause ionization of the gas adjacent to such electrode, thereby causing a discharge of electricity from the electrode into the surrounding gas.

4. In an apparatus for the separation of suspended particles from gases by electric means, a charging electrode consisting of a conducting wire of a sufficiently small diameter to maintain, under operating conditions of said apparatus, an electric field intensity at the surface of said wire, sufficient to cause ionization of the gas adjacent to such electrode, thereby causing a discharge of electricity from the electrode into the surrounding gas.

5. In an apparatus for the separation of suspended particles from gases by electric means, a charging electrode consisting of a conducting filament sufficiently fine to maintain, under operating conditions of said apparatus, an electric field intensity at its surface, sufficient to cause ionization of the gas adjacent to such electrode, thereby causing a discharge of electricity from the electrode into the surrounding gas, and means for tensioning said filament to hold it taut.

6. In an apparatus for the separation of suspended particles from gases by electric means, a charging electrode consisting of a smooth surfaced conducting filament sufficiently fine to maintain, under operating conditions of said apparatus, an electric field intensity at its surface, sufficient to cause ionization of the gas adjacent to such electrode, thereby causing a discharge of electricity from the electrode into the surrounding gas, and means for passing the gases carrying the suspended particles past said charging electrode to utilize said discharge to electrically charge the suspended particles to be separated.

7. In an apparatus for electrical separation of suspended particles from gases, a collecting electrode having a substantially plane surface and a discharge electrode consisting of a filament extending parallel to said plane surface of said electrode.

8. In an apparatus for electrical separation of suspended particles from gases, a collecting electrode having a substantially plane surface and a discharge electrode consisting of a fine metallic wire extending parallel to said plane surface of said electrode.

9. In an apparatus for electrical separation of suspended particles from gases, a collecting electrode having a substantially vertical surface, a support, a discharge electrode consisting of a fine wire hung from said support so as to extend parallel to said surface, and a weight on said wire to tension the same and an insulated retaining member engaging said wire to hold the same from lateral displacement.

10. In an apparatus for electrical separation of suspended particles from gases, a collecting electrode having a substantially plane vertical surface, a support, a discharge electrode consisting of a fine wire hung from said support so as to extend parallel to said surface, and a weight on said wire to tension the same.

11. In an apparatus for electrical separation of suspended particles from gases, a vertically extending collecting electrode, a support insulated therefrom, an ionizing electrode formed as a filament suspended from said support, a weight on the lower end of said filament, and retaining means engaging said filament to prevent lateral movement.

12. An apparatus for electrical separation of suspended particles from gases, comprising a set of charging electrodes, a set of precipitating electrodes, means for applying unidirectional potential difference to the electrodes of each set, and means for passing the gases to be treated, first through the set of charging electrodes and then through the set of precipitating electrodes; the set of charging electrodes comprising a discharge electrode adapted to facilitate discharge and an opposing electrode adapted

to minimize discharge, so as to charge the particles of the gas with charges similar to that of the discharge electrode; and the set of precipitating electrodes comprising opposing electrodes, all adapted to minimize discharge so as to produce a non-discharging electrostatic field for precipitation of the charged particles passing thereto from the charging electrodes.

13. An apparatus for the separation of suspended particles from gases, comprising a set of charging electrodes, a set of precipitating electrodes, means for applying unidirectional potential difference to the electrodes of each set, and means for passing the gases to be treated, first through the set of charging electrodes and then through the set of precipitating electrodes, said set of charging electrodes comprising discharging electrodes formed as fine wires and non-discharging electrodes formed with substantially plane surfaces; and said set of precipitating electrodes comprising opposing electrodes formed with substantially plane surfaces.

14. In an apparatus for the separation of suspended particles from gases by electric means, a set of opposing non-discharging electrodes and means for applying high potential difference to the opposing non-discharging electrodes, for producing an electrostatic field between such opposing non-discharging electrodes and means for conducting the gases carrying electrically charged suspended particles through such electrostatic field.

15. In an apparatus for the separation of suspended particles from gases by electric means, electrodes having extended surfaces, placed approximately parallel to each other, means for applying high potential difference to such opposing electrodes for producing an electrostatic field and means for conducting the gas carrying electrically charged suspended particles through such electrostatic field.

16. In an apparatus for the separation of suspended particles from gases by electric means, the combination of a charging electrode, a set of opposing electrodes having extended surfaces and placed approximately parallel to each other, means for applying high potential difference to the opposing electrodes of said set for producing an electrostatic field independent of the charging electrode, and means for conducting the gases carrying the suspended particles past the charging electrode and then through the electrostatic field.

17. In an apparatus for the separation of suspended particles from gases by electric means, the combination of a charging electrode, a set of opposing electrodes having largely extended surfaces as compared with the charging electrode, means for applying high potential difference to the opposing electrodes of said set for producing an electrostatic field, and means for conducting the gases carrying the suspended particles past the charging electrode and then through the said electrostatic field.

18. In an apparatus for the separation of suspended particles from gases by electric means, the combination of a charging electrode, a set of opposing, non-discharging electrodes and means for applying high potential difference to such opposing, non-discharging electrodes for producing an electrostatic field independent of the charging electrode, and means for conducting the gases carrying the suspended particles past the charging electrode to electrically charge the suspended particles, and then through the said electrostatic field to remove the charged particles from the gases.

19. In an apparatus for the separation of suspended particles from gases by electric means, the combination of a number of charging electrodes and a set of opposing, non-discharging electrodes and means for applying high potential difference to such opposing, non-discharging electrodes for producing electrostatic fields independent of the charging electrodes, and means for conducting the gases carrying the suspended particles past the charging electrodes and through the said electrostatic fields, the electrodes being so arranged that the gases along with the suspended particles are alternately subjected to the influence of the charging electrodes and the electrostatic fields.

20. An apparatus for electric separation of suspended matter from gaseous fluids, comprising a charging electrode having a flexible ionizing part, means for tensioning said ionizing part, and a collecting field-surface member.

21. In an apparatus for electric separation of suspended matter from gaseous fluids, a charging electrode, the ionizing part of which consists of a wire, and means for maintaining said wire under tension in its longitudinal direction.

22. The method of separating suspended particles from gases which consists in subjecting the gas to an ionizing discharge of electricity while in a relatively weak electrostatic field, to charge the suspended particles, and then passing the gas through a relatively strong electrostatic field.

23. The method of separating suspended particles from gases which consists in subjecting the gas to an ionizing discharge of electricity while in a relatively weak electrostatic field, to charge the suspended particles, to remove the larger and coarser particles, and then passing the gas through a relatively stronger electrostatic field, to remove the smaller and finer particles.

24. The method of separating suspended

matter from gases, which consists in subjecting the gas to the action of a relatively weak electrostatic field, discharging electricity into said gas to charge the suspended particles while in said field, and then subjecting the gas to the action of a relatively strong electrostatic field.

25. An improvement in means for removing suspended particles from gaseous and fluid bodies comprising spaced apart grounded electrodes, and an active electrode placed between the grounded electrodes and provided with a plurality of spaced apart attenuated electrode members so grouped as to direct the electro-magnetic waves toward the oncoming particle laden gaseous or fluid stream.

26. That improvement in the art of producing electrical precipitation of particles from fluid or gaseous streams which consists in establishing an ionization field within the flow path of a stream, with the field formed of a succession of similar individual, electrical discharge zones extending parallel to each other in directions intersecting the flow path of the stream, each zone having substantially similar discharge characteristics throughout its length.

27. In the art of producing electrical precipitation of particles from fluid or gaseous streams, the combination of opposing electrode systems including collecting and discharge electrodes, said discharge electrode having a longitudinally extending discharge producing edge, a cross-section of said discharge electrode having said edge corresponding to the apex of an angle.

28. In the art of producing electrical precipitation of particles from fluid or gaseous streams, means for producing an ionizing field, said means including an element having a discharge-producing edge extending in a single plane, a cross section of the element having said edge corresponding to the apex of an angle.

29. In the art of producing electrical precipitation of particles from fluid or gaseous streams, means for producing an ionizing field, said means including an element having a discharge-producing edge extending in a single plane, a cross section of the element having said edge corresponding to the apex of an angle not greater than a right angle.

30. That improvement in the art of producing electrical precipitation of particles from fluid or gaseous streams which consists in establishing a plurality of individual ionizing zones in the flow path of a stream with the zone length intersecting the flow path, each zone being substantially continuous in its length and having a constant distance between its electrodes.

31. That improvement in the art of producing electrical precipitation of particles from fluid or gaseous streams which consists in establishing an ionization field within the flow path of a stream, with the field formed of a succession of individual ionization zones extending angular to the direction of flow of the stream, each zone having substantially similar characteristics throughout its length.

32. That improvement in the art of producing electrical precipitation of particles from fluid or gaseous streams which consists in establishing an ionization field within the flow path of a stream, with the field formed of a succession of individual electrical discharge zones extending parallel to each other in directions intersecting the flow path of the stream, each zone having substantially similar discharge characteristics throughout its length.

33. That improvement in the art of producing electrical precipitation of particles from fluid or gaseous streams which consists in establishing an ionization field within the flow path of a stream, with the field formed of a succession of individual electrical discharge zones of high electrical potential extending parallel to each other in directions intersecting the flow path of the stream, each zone having substantially similar discharge characteristics throughout its length.

34. That improvement in the art of producing electrical precipitation of particles from fluid or gaseous streams which consists in establishing an ionization field within the flow path of a stream, with the field formed of a succession of individual electrical discharge zones extending parallel to each other in directions intersecting the flow path of the stream, each zone having substantially similar and constant discharge characteristics throughout its length.

35. That improvement in the art of producing electrical precipitation of particles from fluid or gaseous streams which consists in establishing an ionizing field between opposing electrode systems, the discharge electrode system producing individual ionizing zones within the field with the zones of definite length and of similar characteristics throughout their length, and passing a stream successively through such zones.

36. The method of removing particles from fluid streams which consists in ionizing the stream contents, and then passing the stream while still ionized through another ionization field, in collecting and separating the particles from the stream.

37. The method of removing particles from fluid streams which consists in ionizing the particles to be removed with a charge sign similar to the sign of the discharging electrode of an ionization field, and then introducing the stream contents while still ionized into and through said ionization field, in separating and removing the particles from the stream.

38. That improvement in the art of pro-

ducing electrical precipitation of particles from fluid or gaseous streams which consists in establishing a succession of individual ionizing zones in the flow path of a stream with the zone length extending angular to the flow path, each zone being substantially continuous in its length and having a constant distance between its electrodes.

39. That improvement in the art of producing electrical precipitation of particles from fluid or gaseous streams which consists in establishing a succession of individual ionizing zones of similar characteristics in the flow path of a stream with the zone length extending angular to the flow path, each zone being substantially continuous in its length and having a constant distance between its electrodes.

40. That improvement in the art of producing electrical precipitation of particles from fluid or gaseous streams which consists in establishing an ionization field within the flow path of a stream, with the field formed of a succession of similar individual ionization zones extending angular to the direction of flow of the stream, each zone having substantially similar characteristics throughout its length.

41. That improvement in the art of producing electrical precipitation of particles from fluid or gaseous streams which consists in establishing a succession of individual ionizing discharge zones within the flow path of a stream.

42. That improvement in the art of producing electrical precipitation of particles from fluid or gaseous streams which consists in establishing a succession of individual ionizing discharge zones within the flow path of a stream, the zones extending in parallelism.

43. That improvement in the art of producing electrical precipitation of particles from fluid or gaseous streams which consists in establishing a succession of individual ionizing discharge zones within the flow path of a stream, the zones extending in parallelism, each zone having its direction of length extending angular to the direction of flow of the stream.

44. In the art of electrically producing precipitation of particles from fluid or gaseous streams, opposing electrode systems adapted to produce an ionization field therebetween, one of said systems comprising discharge-producing elements located on a common plane and operative within such field.

45. In the art of electrically producing precipitation of particles from fluid or gaseous streams, opposing electrode systems adapted to produce an ionization field therebetween, one of said systems comprising discharge-producing elements, said discharge system comprising a plurality of parallel discharge-producing elements opposing an electrode face of the opposing system.

46. In the art of electrically producing precipitation of particles from fluid or gaseous streams, opposing electrode systems adapted to produce an ionization field therebetween, one of said systems comprising discharge-producing elements, said discharge system comprising a plurality of parallel discharge-producing elements located on a common plane and opposing an electrode face of the opposing system.

47. An apparatus for electric separation of suspended matter from gaseous fluids, comprising a longitudinal ionizing part, a charging electrode and a collecting field-surface member having a field-surface substantially parallel to said longitudinal ionizing part.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 27th day of February, 1913.

WALTER A. SCHMIDT.

In presence of—
WM. N. DREW,
A. P. KNIGHT.