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MEANS FOR REMOVING PARTICLES OF SUSPENDED MATTER FROM BODIES OF GAS OR FLUID.

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1,119,469. Patented Dec. 1, 1914.

Fig. 1.

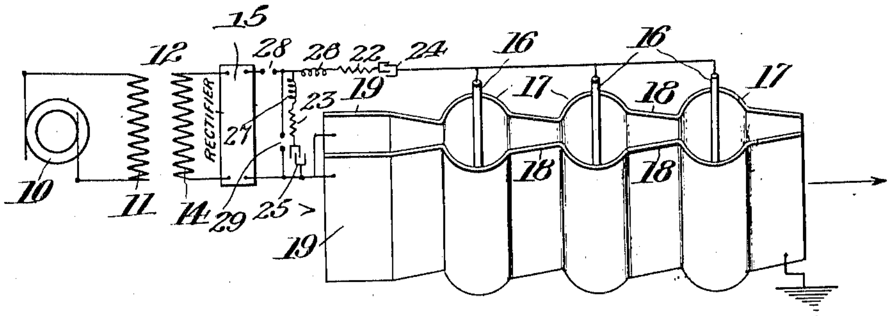


Fig. 2.

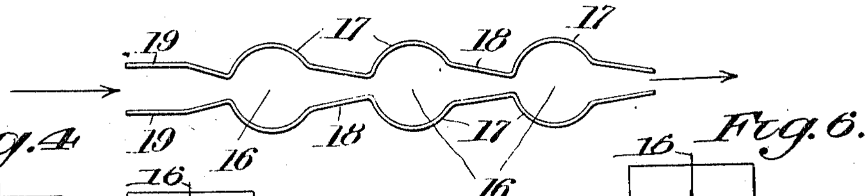
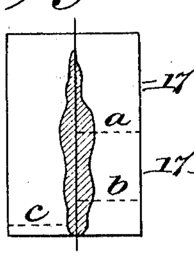


Fig. 4.



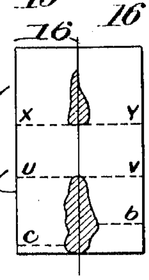


Fig. 5.

Fig. 6.

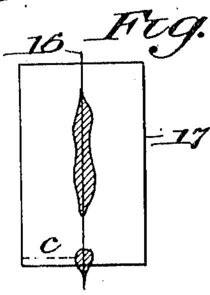
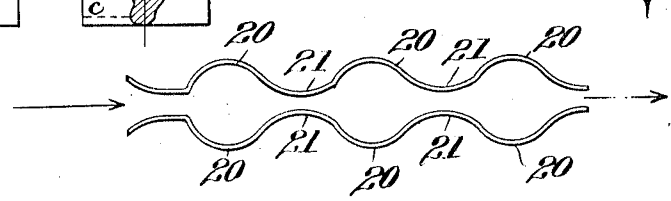


Fig. 3.



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MEANS FOR REMOVING PARTICLES OF SUSPENDED MATTER FROM BODIES OF GAS OR FLUID.

1,119,469. Specification of Letters Patent. **Patented Dec. 1, 1914.**

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To all whom it may concern:

Be it known that we, William W. Strong and Arthur F. Nesbit, citizens of the United States, residing at Pittsburgh and Wilkinsburg, respectively, in the county of Allegheny and State of Pennsylvania, have invented new and useful Improvements in the Means for Removing Particles of Suspended Matter from Bodies of Gas or Fluid, of which the following is a specification.

This invention relates to improved means for removing particles of suspended matter from bodies of gas or fluids, by the application of electrical discharges to the said bodies.

Heretofore electrical discharges have been employed for the purpose of removing suspended matter from fluids, etc., which discharges may consist of brush discharges, the electrical wind, the corona discharge, etc. The nature of these discharges is not well known, but they involve among other phenomena, secondary ionization of the fluid medium, which may be due to the collision of the ions with the fluid particles, or it may be due to electromagnetic pulses or waves. It is known, however, that electrical discharges of this kind result in a copious production of ions. Any discharge can be effected only by the use of one or more electrodes placed in or near the fluid medium, and the electrical discharge may be caused to take place from one electrode which is designated as the active electrode. In the art of removing matter from fluids the electric field may be made very concentrated near the active electrode in order that the luminous, heat and ionization effects may be localized in the neighborhood of the said electrode. The secondary ionization produced in this region results in the production of a large number of positive and negative ions. The ions having charges dissimilar to that of the active electrode are attracted toward it and are said to give up their charge to this electrode as ions of the said sign of charge. Ions possessing a sign of charge that is the same as that of the active electrode are repelled from it and if the necessary ionization is sufficiently intense and continuous, this flow of ions will be designated as a stream of ions, or an electric current.

The object of the present invention is to utilize these phenomena in removing suspended matter from fluids, by passing the fluids containing the matter to be removed between an active and a grounded electrode, the latter being shaped to secure the peculiar advantages desired.

The shape of the grounded electrode may vary according to the character of the work to be done, depending upon the conditions under which the fluids containing the suspended matter are to be treated. The different conditions are well illustrated in the problems encountered in the precipitation of smoke produced in round houses, railroad tunnels, and in general wherever incomplete combustion takes place; the precipitation of fumes and dust from blast furnaces of various types, etc. The velocity of the fluid or fluids to be treated, the space available for the precipitation chambers, and the possible methods of cleaning differ widely, depending upon the particular problem under consideration, and the results to be effected.

The invention will be hereinafter fully set forth and particularly pointed out in the claims.

In the accompanying drawing:—Figure 1 is a perspective view, partially diagrammatic, illustrating our invention. The electric circuits in the high potential side of the transformer may consist of resistances, inductances, and capacities distributed in series or parallel groupings in any form most convenient for the results to be effected. The resistances may be partly or wholly in the form of spark gaps. Fig. 2 is a horizontal sectional view. Fig. 3 is a similar view of a slightly modified form. Figs. 4, 5 and 6 are diagrammatic views illustrating the action of the electrodes.

Referring to the drawing, 10 designates a generator of any suitable or preferred type, and 11 is the primary low potential coil of a transformer 12. The high potential coil 14 of the transformer is connected with a suitable rectifying device 15, the same being utilized for maintaining the potential of the active electrode 16 unipolar. It will be understood, however, that we do not desire to limit ourselves to the use of a unidirectional current, or to the use of a rectifier, although I prefer to employ the same.

In Figs. 1 and 2 the grounded electrode is illustrated as comprising a series of approximately semicircular concavo-convex portions 17 united by converging flat portions 18, there being two oppositely disposed grounded electrodes forming between them a passage way of irregular or wave-like form. An entrance conduit or guide is formed by two parallel plates 19. It will be noted that there is one active electrode 16 for each of the approximately circular cells formed by the portions 17, said electrodes 16 being centrally disposed in said cells and extending longitudinally therethrough.

In Fig. 3 we have shown a slight modification which consists in connecting the concavo-convex portions 20 forming the circular cells by contracted walls 21 which are curved inwardly instead of being straight as in Fig. 2.

During the operation of the apparatus the bodies containing the suspended matter enter between the plates 19, in the direction of the arrow and pass successively through the circular cells and contracted portions until discharged. In their passage through the space between the grounded electrodes the suspended particles may adhere to the said grounded electrodes or be precipitated into a deposition chamber, the bodies containing said matters passing progressively into the influence of the successive active electrodes. It is obvious that if desired, the fluid bodies could be made to travel in a direction parallel with the active electrodes 16.

In practice, irrespective of what the direction of travel may be, the fluids, subjected to the action of the ionic currents are wholly or partly cleaned of their solid and liquid matters held in suspension, the latter being deposited upon the inside surface of the grounded electrodes or precipitated into the deposition chamber. When sufficient matter has been deposited upon the surface of one or both electrodes to provide for a gap for a disruptive discharge to pass, sparking takes place, and this causes more or less of the deposited matter upon or adhering to the electrodes to be loosened from the same. The portions of the deposited matter thus loosened may fall down through the cell and be collected in the deposition chamber. In this method of cleaning the electrodes it is necessary to have certain predetermined relations between the capacity, self induction, and resistance factors of the high tension circuit so that the discharge is disruptive when the distance between the electrode 16 and the deposited matter is less than the disruptive potential of the gases. For the purpose of producing disruptive or oscillatory discharges various suitable conditions may be imposed upon the electrical circuits connected to the active and grounded system of electrodes. For the purpose of illustration beside the resistance, capacity and self-induction of the transformer itself, we have shown in Fig. 1 certain combinations of resistances 22, 23, capacities, 24 and 25, self-inductances, 26 and 27, and spark gaps 28 and 29, distributed in the secondary circuit, so that under working conditions electromagnetic oscillations of the proper frequency and damping factor are produced. These resistances, capacities, self-inductances and spark gaps are placed in whatever parts of the circuit found most suitable or desirable for the results desired, and for obvious reasons we do not limit ourselves to the precise arrangement illustrated. Among other conditions may be included the use of a number of phases of current or electromotive force; the frequency of these phases may have any suitable value and need not be of the same value. Thus one phase may have the values of its capacity, self inductance and resistance such that a discharge due to this phase would be disruptive or oscillatory in nature, while the discharges of the other phases could be of a flamator or arc-like character. The impression of these electromotive forces and current waves need not be simultaneous and may be effected by independent electrical circuits. In a like manner the phase relation between the current and electromotive force waves of any circuit may be regulated so as to produce disruptive or oscillatory discharges, and by this means effect the removal of matter contained in the fluids subjected to the action of the electrodes. It is obvious, however, that the deposited matter may be removed from the electrodes by causing the latter to vibrate, for instance, by striking them with a hammer, or the like.

It has been found experimentally that when precipitating the so-called smoke from soft coal furnaces, there is considerable ash and tar carried along with the soot (or carbon) and on account of the high temperature of these ingredients, more or less adheres to the central or active electrode and also to the inner walls of the grounded electrode. The actual conditions which have been met may be illustrated by reference to Figs. 4, 5, and 6. In Fig. 4 the active electrode 16 is shown as having a deposit, which for the sake of illustration may be taken as about ⅜ of an inch in radial depth at the position *a* and at the positions *b* and *c*, somewhat less. As soon as the distance at the point *a* between the electrode 17 and the deposited matter has been reduced by accumulations upon the electrode 16, to such a value that a disruptive discharge takes place, a momentary spark passes, and simultaneously with the occurrence of this spark the deposit on the actual electrode between the planes $x\ y$ and $u\ v$ is violently dislodged and settles into the chamber below. (See Fig. 5.) At the same time a large patch of the comparatively thin deposit on the inner wall of the grounded electrode would become detached from the latter and breaking into small pieces also fall into the deposition chamber. The next disruptive discharge would in all probability take place in succession at such positions as *b* and *c* respectively. It has been our experience that such deposit might accumulate once in an hour, with very tarry smoke, and within perhaps a minute or two, the active electrode 16, throughout its entire length would have dislodged the deposit that had formed upon it. It has also been observed that the corona formation remains remarkably uniform, radially about the entire length of the active electrode, even though the radial depth of the deposit may vary as suggested in Fig. 4. At the points where the disrupted discharge is about to take place, the greater radial depth of the deposit tends to thin out the corona glow as observed by the eye, and at the same time causes no apparent diminution of the corona elsewhere along the electrode 16.

The peculiar property possessed by an electric arc, that the potential difference across its terminals increases as the current through it decreases, may be utilized to produce electrical oscillation.

The grounded electrode 17 is shown to be the collecting electrode, in the drawing, the object of making it such being to minimize the amount of insulation necessary for the bulky parts of the electrodes and at the same time properly control the flow of gases, etc., which may be admitted. The electrode 16 is called the active electrode because the electric field and consequent ionization is most intense at the surface of this electrode.

By converging the approaches to the bulging portions of the grounded electrode the flow of the gaseous or fluid bodies is directed against the active electrode, thereby bringing said bodies into the most intense part of the electric field, resulting in a more effective precipitation of the suspended matter, and also utilizing the sweeping action of the gaseous or other bodies in keeping the active electrodes clean of deposited material. This sweeping action of the bodies scours the walls of the grounded electrode tending also to clean said walls of deposited material.

Having thus explained the nature of our invention, and described an operative manner of constructing and using the same, although without attempting to set forth all of the forms in which it may be made, or all of the forms of its use, what we claim is:—

1. An improvement in means for removing suspended matter from bodies of fluid and the like comprising an active electrode, a grounded electrode provided with spaced apart bulging portions connected by intermediate walls, and means for maintaining said electrodes at a high difference of potential.

2. An improvement in means for removing suspended matter from bodies of fluid and the like comprising an active electrode, a grounded electrode provided with spaced apart bulging portions connected by intermediate straight walls, and means for maintaining said electrodes at a high difference of potential.

3. An improvement in means for removing suspended matter from bodies of fluids and the like comprising a grounded electrode formed of oppositely disposed members having bulging portions forming cells, an active electrode in each cell, and means for maintaining said active and grounded electrodes at a high difference of potential.

4. An improvement in means for removing suspended matter from bodies of fluid and the like comprising a grounded electrode formed of oppositely disposed members provided with spaced apart bulging portions forming approximately cylindrical cells, active electrodes centrally disposed in said cells, and means for maintaining said electrodes at a high difference of potential.

5. An improvement in means for removing suspended matter from bodies of fluid and the like comprising a grounded electrode formed of oppositely disposed members having bulging portions forming cells and walls connecting said bulging portions to form constricted passages, active electrodes in said cells, and means for maintaining said electrodes at a high difference of potential.

6. An improvement in means for removing suspended matter from bodies of fluid and the like comprising a grounded electrode formed of oppositely disposed members having bulging portions forming cells, said bulging portions being connected by intermediate converging straight walls to form constricted passages, active electrodes in said passages, and means for maintaining said electrodes at a high difference of potential.

7. An improvement in means for removing suspended matter from bodies of fluid and the like comprising a grounded electrode provided with a plurality of spaced apart cells connected by constricted passage ways, active electrodes in said cells, and means for maintaining said electrodes at a high difference of potential.

8. An improvement in means for removing suspended matter from bodies of fluid and the like, comprising a grounded electrode provided with a passage through which said bodies are caused to travel and having a tapered outlet, an active electrode within said grounded electrode, and means for maintaining said electrodes at a high difference of potential.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

WILLIAM WALKER STRONG.
ARTHUR F. NESBIT.

Witnesses:
THOMAS CAIN,
W. J. MOORE.