

UNITED STATES PATENT OFFICE.

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DIELECTRIC SEPARATOR.

No. 888,432.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, HENRY M. SUTTON, WALTER L. STEELE, and EDWIN G. STEELE, citizens of the United States, residing at Dallas, in the county of Dallas and State of Texas, have invented certain new and useful Improvements in Dielectric Separators, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to an apparatus for separating substances of different dielectric capacities and comprises a division of our application filed September 24, 1904, Serial No. 225,852 embodying the form thereof where a continuous convective charge or current is used.

The invention has for an object to provide means for conveying the material to be separated into component particles into the field of means for producing in the material dielectric hysteretic impedance or a lag of charge in connection with means for collecting the separated particles of material according to the difference in time that said particles maintain their polarity due to the impedance generated therein. This effect may be produced by any desired means as, for instance, feeding the material to an extremely unbalanced electro static field. Such a condition is established whenever a series of metallic points or a sharp edge is connected to a source of static or high tension electricity so as to produce a convective current and the latter is allowed to escape across the intervening space to a surface of conducting material which is grounded to the earth or connected to the opposite pole of the electric source of energy to that connected to the points or sharp edge. This produces a very highly concentrated electro static field, and when the commingled mass of particles is fed into such a field the particles are unable to seek a perfect equilibrium as the conducting surface over which they are fed has absolutely no power of repulsion, and the points or sharp edge have absolutely no power of attraction. The fact that the particles adhere to such a conducting surface is due to the residual charge imparted to these particles by the passage of electricity from the points or sharp edge to the grounded surface and only occurs in a line approximately opposite the points. If a sharp point

be attached to the charged surface of a static machine and a plate of conducting material grounded to the earth be placed a short distance from such point there will be a constant convective flow of electricity from the point to the plate in contradistinction to a disruptive discharge produced by a round surface. It is impossible under these conditions to charge the point with its full potential as it is discharged as fast as the current is being delivered to it from the machine. In fact, the point is receding from the full potential instead of approaching it, and by this means an unbalanced electro static field is established. Now if a particle of any substance be movably suspended between the plate and point of the conductor it will be attracted to the plate and adhere indefinitely to it so long as this convective charge is maintained as there will be no equilibrium established in which the substance charged can reach a potential that will enable it to be attracted to the point or be repelled from the grounded surface even if such surface be connected to the opposite pole of the static machine from that of the point. It will thus be seen that dielectric hysteretic impedance is generated in any substance to a more or less extent when that substance is subjected to an unequal electro static stress or strain. This impedance or lag of charge may be produced by various characters of current, for instance, an alternating, pulsating or varied static charge as set forth in our Patent #813,063, dated February 20th 1906, or by the means herein disclosed where a continuous convective current of one polarity is used and the material brought adjacent to the charging point and there charged with electricity of the same sign as that escaping from the point thus establishing in the material opposite electrical conditions upon its surfaces if the grounded conducting surface be disposed adjacent to the material.

Other and further objects and advantages of the invention will be hereinafter set forth and the novel features thereof defined by the appended claims.

In the drawings:—Figure 1 is a perspective with parts in section illustrating the electrical connections, and Fig. 2 is a vertical cross section of the separator.

Like numerals refer to like parts in the several figures of the drawing.

The letter A designates a hopper which is mounted in any desired manner, for instance, upon a frame constructed in accordance with the requirements of the machine. The material to be separated is fed from the lower portion of the hopper by means of the spout A³ into the shaker pan A⁴ which is pivotally supported by hangers A⁵ and connected to the eccentric D' upon the shaft D by means of the strip D². This by its reciprocatory motion feeds the material upon the spreader tray F. This tray is preferably formed of metal and has its bottom fluted or ribbed, as shown at F' in Fig. 1, the delivery edge thereof being left perfectly smooth as indicated at F². This tray is given a side shake by means of the eccentric F³ mounted on the shaft F⁴ and connected to the tray by means of the strip F⁵ said tray being mounted to reciprocate on the rods F⁶ by means of the bearings F⁷ upon the bottom of the tray. The tray is also given a downward inclination toward the conducting surface, which in the present instance is shown as a metallic roller G. This roller G may be constructed of metal or good conducting material, and both it and the spreader tray F are electrically connected to the ground by means of the line C (Fig. 1) so that they are incapable of sustaining a charge of electricity which may be imparted to them, as such charge would be immediately grounded. This connection may be any desired means, for instance, the wire C' from the tray to the wiper C² bearing on the shaft G' of the roller.

Adjacent to the roller G are one or more thin metallic rods H each provided with a series of metallic points H' directed toward the surface of the roller by which a flow of current is maintained through the rods. Any other desired means may be used for producing such a current at the charging point. The charging means is connected to one pole of the electro static generator C³ or to any other source that is capable of supplying static electricity, and the current is conducted therefrom to the charging means by line C¹⁰ through which a constant charge of one polarity is conducted.

The material to be treated is fed from the tray upon the roller electrode, as just described and in passing the points or charging means from which the convective current of electricity is constantly passing to the roller a dielectric hysteretic impedance or lag of charge is set up in certain particles of the mass, while others remain unaffected. These unaffected particles drop upon the division plate I by centrifugal force due to the motion of the roller as it revolves in the direction of said plate from which they are discharged into the chute I' and conducted to a receptacle. The particles which have small dielectric impedance are drawn closer to the face of the roller and thus pass above the division

plate and drop into chute I², while those which have the greatest impedance would remain adhered to the roller and are thus carried past the adjustable plate I⁴ so that they may be discharged into the chute I³, and this disposition of the material adhering to the roller may be accomplished by releasing means, preferably, an electrically charged rod or terminal H² disposed at the back of the roller and connected by the line C⁴ with a source of static electricity whose polarity is opposite to that supplied to the charging means, for instance, to the opposite side of the generator C³, as shown in Fig. 1.

To effect a continuous or constant charge on the rod H² and regulate the charge, a regulator O is shown inserted in line C⁴ provided with the pointed discharge terminal O' adjustable in its base O² relative to a rounded terminal O³ opposite thereto. This regulator determines the amount of charge supplied to the particles as the amount of current flowing therethrough proportionately determines the degree of supply at the points because circuit is established from the points through the separating electrode and releasing rod to the regulator. The necessary amount of current may be thus governed relative to the material to be separated. In order that the division plate I disposed adjacent to the roller shall not retain the charge of electricity it is preferably formed of proper conducting material and grounded to the earth by means of the line C⁵ extended therefrom and this forms a shield determining the extent of the surface of the roller G to be exposed to the charge; while the grounded feed tray F also performs a similar function at the top of the roller. It has been found desirable to heat the tray and for that purpose the electrical heater N, is shown in Fig. 2 which may be connected by lines N' and N² with any source of power for that purpose. The heating of the material causes any residual charge thereon to be dissipated and renders the material more susceptible to the new charge which is imparted thereto while heated from the charging electrode.

In order to define the circuit through the regulator and its relation in controlling the amount of current, it is assumed that the current flows from the positive pole of the static machine C³ to the pointed electrode H and across the intervening space to the separating electrode G. This will cause an equal amount of negative electricity to flow out of the separating electrode across the gap by a series of disruptive discharges to the rod H² and thence through the line wire C⁴ and regulator O to the negative side of the static machine. It therefore follows that for every unit of positive electricity delivered to the line C¹⁰ an exact equivalent amount of negative electricity is drawn up from the earth through the ground line C or straight across

the electrode G as this ground line can be omitted without materially changing the results. As there cannot exist more of one polarity of electricity than another in a given circuit, if a resistance be interposed at the regulator O, it is substantially the same as if placed in line C¹⁰, and thereby regulates the amount of current which may pass through the circuit. The ground line C is of service to the extent that it will ground out currents that occur from leakage or that may develop in the process of installation. There is no means for the current to return from this ground line to the negative side of the generator as it is not grounded, and the only current that line C can carry would be that which leaks from line C¹ which in some cases is quite appreciable.

It is desirable in the successful working of the apparatus that the roller or other conducting means for the material should be grounded to the earth so that zero potential may be maintained to render the roller inactive electrically so that it is absolutely non-repulsive. The particles having been strongly polarized by the continuous convective charge remain clinging to the surface by virtue of their residual charges and retain such contact as long as these charges exist. As there is a difference in the period of time the particles maintain their polarity it is thus possible to make a large number of separations upon one roller for as the materials lose their polarity they can be dropped into different compartments during the rotation of the roller.

The construction of separating machine in connection with the interrupter for producing a varied charge or current has been specifically described and is claimed in our application Serial No. 225,852 so that further description of the construction and operation thereof is not given herein, as the present divisional application presents a continuous or constant convective charge of one polarity but regulated through the return circuit to the generator taken from the discharging rod disposed immediately adjacent to the roller electrode.

One means for producing dielectric hysteric impedance or lag of charge in the material to be treated has been shown herein, but the invention contemplates the use of any means for this purpose and is not confined to that herein shown nor to any particular form of feeding and collecting elements for that purpose.

Having described our invention and set forth its merits, what we claim and desire to secure by Letters Patent is:—

1. The combination with the electrodes of an electro static separator, of means for producing a continuous convective current from one electrode to the other, means for feeding comminuted material between said elec-

trodes and through said current, and means for separately collecting the separated particles.

2. The combination with the electrodes of an electro static separator, of means for producing a continuous convective current from one electrode to the other, means for feeding comminuted material to said latter electrode, a regulator in circuit with one of the electrodes and having a member adapted to deliver a continuous convective charge there-through, and means for separately collecting the separated material.

3. The combination with a separating electrode and a pointed electrode, of a source of energy, means for supplying the pointed electrode with a continuous current of one polarity, means for feeding comminuted material between said electrodes, means in circuit with the source and one electrode for regulating the supply of said current, and means for separately collecting the separated particles.

4. The combination of a separating electrode and a charging electrode, of means for producing a constant convective current from said charging electrode to the separating electrode, means for feeding comminuted material between the electrodes through the path of said current, and means for separately collecting the separated particles.

5. The combination with a separating electrode and a pointed charging electrode, of a source of energy, means for supplying the pointed electrode with a continuous current of one polarity, means for feeding comminuted material between said electrodes, and means for separately collecting the separated particles.

6. In an electro static separator, the combination with a separating electrode and a pointed charging electrode, of a static machine having one pole connected directly to said pointed electrode, means for feeding comminuted material between said electrodes, means disposed at the discharging side of the separating electrode connected to the opposite pole of the static machine, and means for separately collecting the separated particles.

7. In an electro static separator, the combination with a separating electrode and a pointed charging electrode, of a static machine having one pole connected directly to said pointed electrode to supply a continuous current thereto, means for feeding comminuted material between said electrodes, a terminal disposed at the discharging side of the separating electrode and connected to the opposite pole of the static machine, means for separately collecting the separated particles, and a regulator disposed in the connection between the static machine and the said terminal at the discharge side of separating electrode.

8. The combination with the electrodes of an electro static separator, of means for producing a continuous convective current from one electrode to the other, means for feeding 5 comminuted material between said electrodes and through said current, means for separately collecting the separated particles, and means for heating said material and feeding it through said current while heated.
- 10 9. In an electro static separator, the combination with a separating electrode and a pointed charging electrode, of a source of continuous supply in circuit with said charging electrode, means disposed adjacent to the 15 separating electrode and in circuit with the source of supply for regulating the supply of current thereto, means for feeding comminuted material between said electrodes, and means for separately collecting the separated 20 particles.
10. In an electro static separator, the combination with a separating electrode and a pointed charging electrode, of a source of continuous supply in circuit with said charging electrode, a terminal disposed adjacent 25 to the separating electrode and in circuit with the source of supply, means for feeding comminuted material between said electrodes, means for separately collecting the separated particles, and a regulator disposed 30 in circuit between the source of supply and one electrode and comprising opposite terminals one being pointed and adjustable relative to the other.
- In testimony whereof we affix our signatures in presence of two witnesses. 35
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