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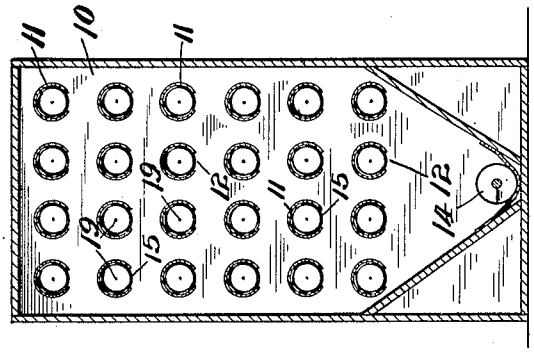
ART OF ELECTRICAL SEPARATION OF PARTICLES FROM A FLUID STREAM.

APPLICATION FILED MAY 31, 1907.

916,746. Patented Mar. 30, 1909.

Fig. 2.



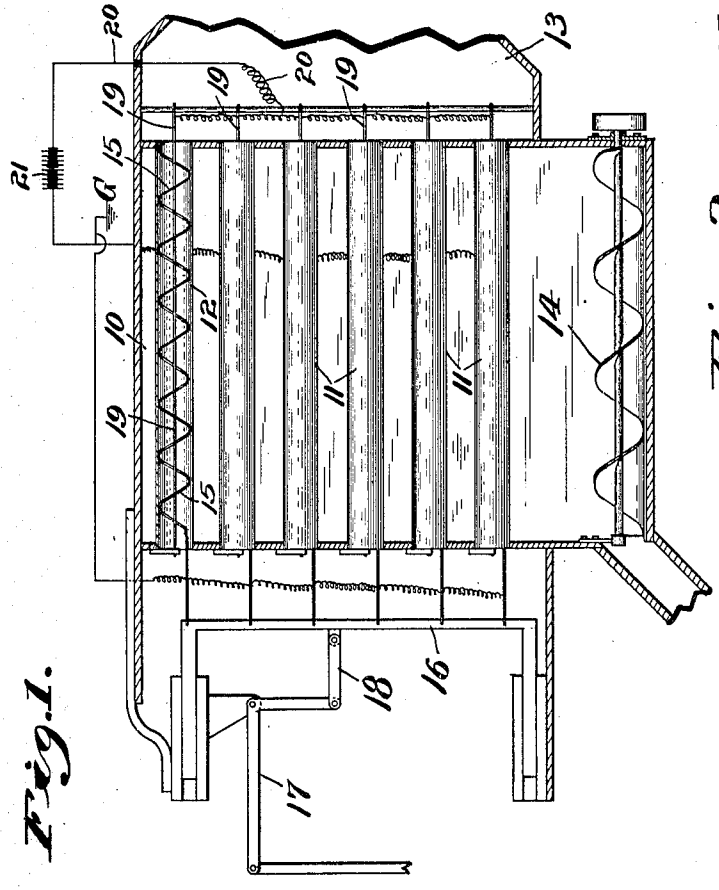
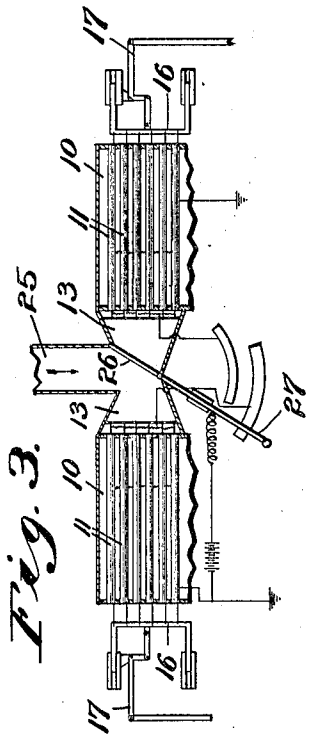


Fig. 1.

Fig. 3.



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ART OF ELECTRICAL SEPARATION OF PARTICLES FROM A FLUID STREAM.

No. 916,746. Specification of Letters Patent. Patented March 30, 1909.

Application filed May 31, 1907. Serial No. 376,720.

To all whom it may concern:

Be it known that I, LAWRENCE N. MORSCHER, a citizen of the United States, residing at Enterprise, in the county of Dickinson and State of Kansas, have invented certain new and useful Improvements in the Art of Electrical Separation of Particles from a Fluid Stream, of which the following is a specification.

The object of my invention is to provide an improved process for the separation of particles from a poorly conducting fluid stream, said process consisting primarily of driving the particle-laden fluid stream through the electrostatic field between two members charged to electrical potentials differing greatly in their voltage, the construction and arrangement of said conductors being such that one will discharge into the fluid stream with much greater ease than the other, and without producing vibration of the particles in the field.

The process comprises further, the treatment of the fluid stream in such manner that collecting spaces are provided adjacent the less freely discharging conductor but in free communication with the space traversed by the fluid stream, which collecting spaces are shielded from the force of the scouring action of the fluid stream, and further in so treating the fluid stream that mechanical separating forces are created therein, which mechanical forces act cumulatively in conjunction with the electrical forces, to produce the desired separation.

By poorly conducting fluid stream I mean a stream of fluid of such high resistance that it is ordinarily considered as an insulator, so that the particles suspended within it have but slight electrostatic shielding action, dry air being an example of such a fluid of poor conductivity. By greatly differing potential I mean a difference of potential such as is developed by an ordinary glass induction machine, or induction coils, and I do not mean to include the voltaic or electrolytic effects, this process being confined to elctrostatic surface effects.

I have found by experiment that, where a unidirectional electrostatic field without reversals tending to produce fluctuations is established between two parallel surfaces of considerable area, and a particle-laden fluid stream passes between such charged conductors, many of the fine and very buoyant particles will be set into violent vibration and hence cannot be readily separated from the fluid stream. If, however, one of the conductors be directed toward a depression or concavity in the other conductor; or if, in any other manner, one of the conductors be rendered more resistant to the escape of its charges into the fluid stream; or if a heavier rate of discharge from one conductor than from the other be maintained, violent vibrations of the particles are not produced. One practical way of making use of this principle is to pass the fluid stream between two conductors charged to greatly differing potentials, one conductor presenting a more or less concave surface to the other conductor, the said latter conductor being so formed as to present a shape toward the concave parts of the coöperating conductor, as for instance a series of points, sharp edges, or other form, facilitating rapid discharge. On the other hand, any other well known method of producing greater ease of electrical discharge from one conductor than from the coöperating one may be used, such for instance as heating one conductor or treating it to a constant bath of violet rays or other emanation which facilitates the discharge of electrical charges into an insulating fluid, or contrariwise, the surface of the opposing conductor may be rendered very resistant to the discharge of electrical discharges of high potential.

There are many well known methods of controlling electrical discharges and in my invention advantage is taken of the fact that, in a poorly conducting fluid, suspended particles of solids or liquids will not vibrate, because of the electrical forces between the surfaces of two conductors of greatly differing electrical potential, if one of said conductors discharges more easily than the other into the suspending medium but, on the other hand, said particles will be urged constantly toward one of the conductors. The same is true where the greater discharge takes place toward a depression or concavity. In view of these facts I provide, adjacent the conductor to which the particles tend, concave collecting chambers or spaces which are more or less protected from the force of the fluid stream. I also deem it advisable to so treat the fluid stream that, while passing through the electrical field, mechanical forces will be produced

within the mass by means of successive and cumulative deflections acting to assist the electrical forces in impelling the particles to be segregated into the protected spaces or pockets.

My improved method is, of course, most suitably and economically practiced with the assistance of a special apparatus designed for that purpose, and in the accompanying drawings I show such an apparatus which is especially designed for the treatment of dust-laden air currents, as for instance from a flour mill, but it is to be understood that neither the apparatus illustrated, nor the process, is limited to that particular use.

Of the drawings Figure 1 is a central vertical section of the apparatus referred to; Fig. 2 a transverse section, and Fig. 3 a sectional view of a desirable form of automatic cut out mechanism.

In the drawings, 10 indicates a suitable dead air chamber through which pass a plurality of tubes or other stream-defining means 11, each of said tubes, in the present form, being incomplete so as to be each provided with a longitudinal slit 12 in its underside, these slits forming the only communication between the supply duct and the chamber 10. Leading to the several tubes 11 is a supply duct 13 and mounted in the bottom of chamber 10 is a conveyer 14, by means of which the accumulated separated material may be withdrawn. The tubes 11 should preferably be of some material capable of receiving an electrostatic charge of high potential, and mounted in each of said tubes is a spiral cleaner 15 which lies closely adjacent the interior of its tube and is preferably a conductor capable of receiving the same potential as its tube. The spirals 15 are capable of axial movement through the tubes a distance substantially equal to the pitch of the spiral, and the several spirals are connected to a reciprocating frame 16 which may be reciprocated by any suitable means, as for instance lever 17 and link 18. Passing axially through each spiral 15 is a conductor 19, said conductor being connected by a wire 20 with a source 21 of high potential. The other side of source 21 is grounded at G and tubes 11 and spirals 15 are also grounded.

In operation the dust-laden air or other particle-laden fluid stream is driven through duct 13 and from thence through the several tubes 11. The conductors 19 being charged from the source 21 to a sufficiently high potential to maintain a constant discharge, the fluid stream passes through the electrostatic field between said conductors and the tubes 11 and spirals 15 and, the conductors 19 presenting practically an edge effect in every direction while the tubes and spirals present a concave surface, the suspended particles within the fluid stream will be first charged with the potential of the same sine as the conductors 19 and then repelled thereby to the conductors 11 and 15 without material vibration, owing to the concavity of said last mentioned conductors and the fact that they are discharging less freely. The spirals produce shallow pockets within the tubes 11 which pockets are partially protected against the scouring action of the fluid currents and therefore, when a particle has been once repelled from the conductor 19 and driven to the wall of the coöperating tube 11 it will more readily be retained in those shallow pockets. The spiral members 15 also serve to deflect portions of the stream from the normal stream line and these deflections are continuous and cumulative in effect during the translation of the stream and thus assist the movement of the particles in a separating direction toward the tubes 11. When the sheltered spaces on the inner surfaces of the tubes 11 have acquired a considerable quantity of the separated particles, the fluid current is stopped and the electrical circuit broken. Thereupon frame 16 is reciprocated so as to shift the spirals 15 axially in the tubes, thus scraping the inner walls of the tubes so as to cause the collected particles to drop through the slits 12 into the chamber 10 from whence they are discharged by the conveyer 14. It will of course be understood that the scrapers 15 need not be conductors but it is more convenient to make them out of metal wire.

In order to make the practice of the process continuous I find it convenient to provide an apparatus such as that shown diagrammatically in Fig. 3, where there are two devices such as shown in Fig. 1, the conduits 13 thereof being connected to a single feed conduit 25 with a valve 26 arranged between said conduit and the conduits 13 so that by swinging said valve from one position to another the flow of the fluid stream may be alternated first through one apparatus and then through the other. In this construction it will be convenient to provide the valve with a switch 27 which will serve to open and close the electric circuits of the two separators at the same time that the flow of the fluid stream is shifted.

I claim as my invention:

1. That improvement in the art of separating particles from a poorly conducting fluid, comprising the maintenance of a current of the particle-laden fluid transversely across a path of undirectional convective electric discharge, and centrifugally deflecting the particles into spaces beyond the influence of the fluid current.

2. That improvement in the art of separating particles from a poorly conducting fluid, comprising the maintenance of a current of the particle-laden fluid transversely

across a path of undirectional convective electric discharge, centrifugally deflecting the particles into spaces beyond the influence of the fluid current, and periodically removing the so-separated particles.

3. That improvement in the art of separating particles from a poorly conducting fluid, comprising the maintenance of a current of a particle-laden fluid transversely across a path of undirectional convective electric discharge in front of a concave conductor, and centrifugally deflecting the particles into pockets beyond the influence of the fluid current.

4. That improvement in the art of separating particles from a poorly conducting fluid; comprising the maintenance of a current of a particle-laden fluid transversely across a path of undirectional convective electric discharge in front of a concave conductor, centrifugally deflecting the particles into pockets beyond the influence of the fluid current, and periodically removing the so-separated particles.

In witness whereof, I, have hereunto set my hand and seal at Enterprise, Kansas, this 22d day of May, A. D. one thousand nine hundred and seven.

LAWRENCE N. MORSCHER. [L. S.]

Witnesses:
GEO. W. MERILLAT,
W. R. WEEKS.