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J. W. DRENNING

3,357,159

DUST CONCENTRATOR

Filed Sept. 6, 1966

2 Sheets-Sheet 1

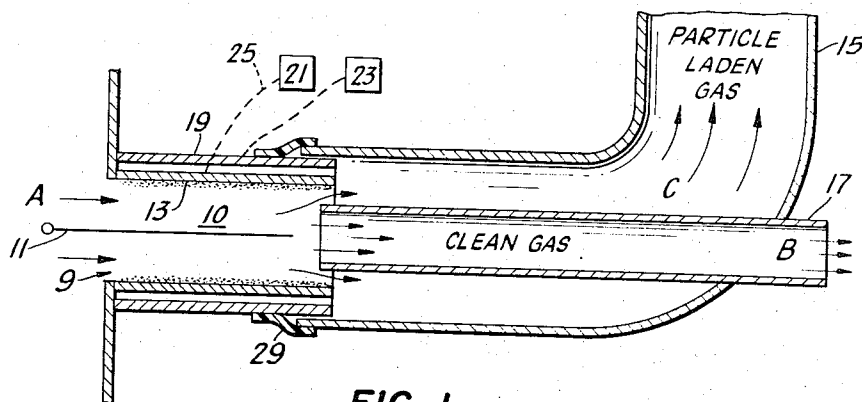


FIG. 1

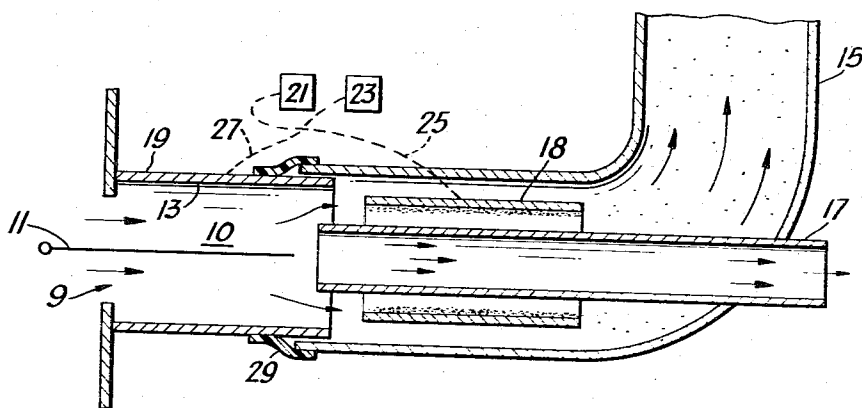


FIG. 2

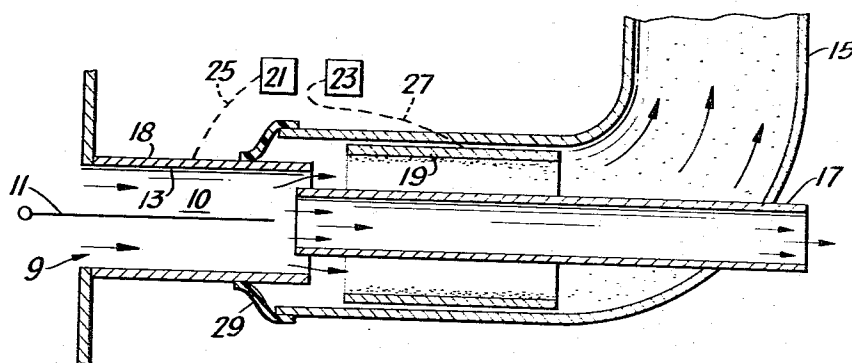


FIG. 3

INVENTOR
JOHN W. DRENNING

BY
Oscar B. Brumback
his Attorney

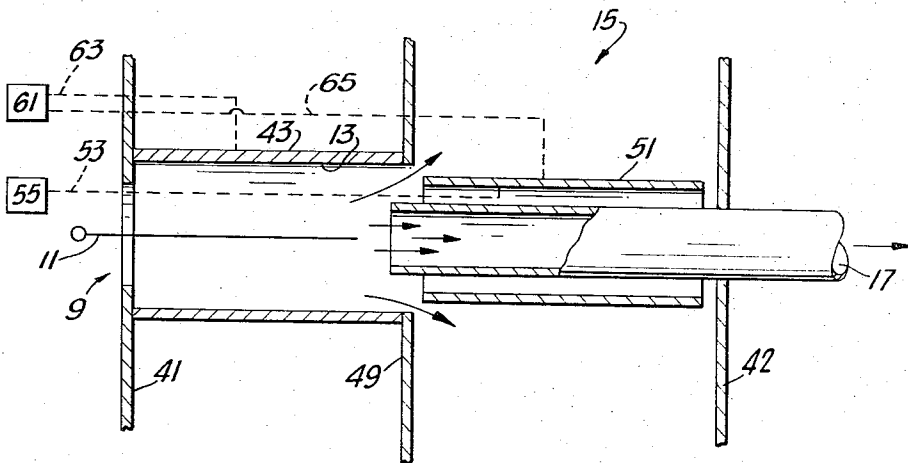
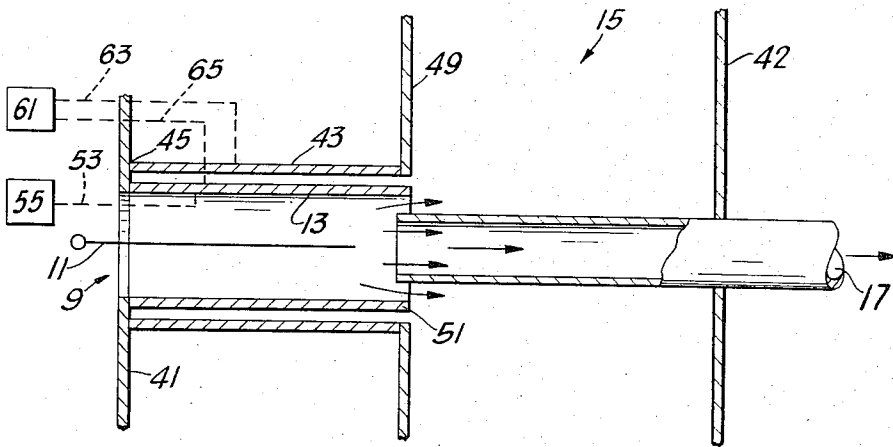
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Cheas B Brumback
his Attorney

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John W. Drenning, Baltimore, Md., assignor to Koppers Company, Inc., a corporation of Delaware
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5 Claims. (Cl. 55-112)

ABSTRACT OF THE DISCLOSURE

Electrostatic precipitator apparatus for removing particles from a gas stream by way of a discharge electrode which charges the particles passing by it so that the particles migrate toward a collector electrode is improved by forming the collector electrode as two concentric tubes which surround the discharge electrode and providing means for selectively using one of the tubes as a collecting electrode while previously deposited particles are being removed from the other tube.

This invention relates to the separation of solid particles from gaseous streams.

Separating a particle-laden gas stream into two streams while using an electrostatic charge to concentrate the particles that are carried in a gaseous stream into the one stream which is a minor portion of the total gas volume and thus removing the particles from the other stream which is the major portion of the gas volume is described in Lagarias Patent No. 2,906,369. In such apparatus, the total gas volume is flowed at high velocity in an ionizing chamber past a discharge electrode where the particles receive an electrostatic charge and migrate toward a collector electrode. The gas stream is divided into the two streams, one of which is a major portion of the gas volume and the other is a minor portion of the gas volume. Due to the particles' movement toward the collector electrode, the major portion is freed of the particles, and the stream that is the minor portion of the gas volume flows past the collector electrode at such rate as to carry the particles beyond the collector electrode. Thus, the burden of particles in this minor portion is increased and this portion is flowed on to a secondary gas removing apparatus for the cleaning of this stream. Accordingly the particles are not deposited on the collector electrode as they are in a conventional electrostatic precipitator.

Despite the high velocity of the gas and the scouring action due to the high velocity of the gas, it has been found that in actual operation, a tendency still exists for the particles to accumulate on the collector surface. While this tendency is slight, nevertheless the deposition does decrease the efficiency of the unit.

This invention, therefore, is an improvement upon the apparatus of Patent No. 2,906,369 in the provision for cleaning the collector electrode surface. However, the invention is also advantageously employed with gas cleaning apparatus where the velocity of the gas is not so great as to have unusual scouring action. In this latter application, the collected particles are mechanically removed.

In accordance with this invention, the collector electrode is comprised of two surfaces. When the particles accumulate on a first surface, this first surface with any accumulated particles thereon is removed from association with the discharge electrode and replaced with a second surface, meanwhile the first surface is cleaned. In applications involving gases which are flowing at high velocity, the surfaces are cleaned by being subjected to the scouring action of the high velocity gas. In other applications, the surfaces are mechanically cleaned. Subsequently the first and second surfaces are reversed and the cycle repeated.

The above and further objects and novel features of the

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invention will appear more fully from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are not intended as a definition of the invention but are for the purpose of illustration only.

In the drawings wherein like parts are marked alike:

FIGURE 1 illustrates partially in schematic fashion a section of a unit of an electrostatic precipitator incorporating an embodiment of the invention;

FIGURE 2 illustrates the apparatus of FIG. 1 in the condition where the particles which have accumulated on a first surface are removed while particles accumulate on a second surface;

FIGURE 3 illustrates the apparatus of FIG. 1 where the particles which have accumulated on the second surface are being removed while the particles are accumulating on the first surface;

FIGURE 4 illustrates partially in schematic fashion another embodiment of an electrostatic precipitator having an embodiment of the invention incorporated therein; and

FIGURE 5 illustrates a second condition of the embodiment of the precipitator of FIG. 4.

Referring now to FIG. 1, the total gas stream A as is described in the aforementioned Patent No. 2,906,369 flows through inlet 9 into a generally cylindrical ionizing chamber 10. A discharge electrode 11, which is a wire, imparts an electrostatic charge to the particles carried in the gas stream. These particles then migrate toward the cylindrical collector electrode surface 13. The outer annular portion of the gas stream thus becomes richer in particles while the inner annular or core portion of the gas stream is freed of particles.

The gas volume, itself, is divided into two streams by conduits 15 and 17. The clean gas stream B, which is relatively free of particles, flows in conduit 17 and the particle-laden gas stream C flows in conduit 15. The gas stream flows at high velocity and tends to scour the particles from the collector electrode denoted generally 13. The gas stream C, which is richer or more concentrated as far as the amount of particles when compared with the burden of gas stream A, is flowed through conduit 15 to a further or secondary particle removing system (not shown) such, for example, as a cyclone separator. The relatively clean gas in conduit 17 may, for example, be flowed onto the discharge stack.

While the velocity of the gas tends to keep the collector electrode 13 clean nevertheless a layer of particles can build up on this electrode and decrease the efficiency of the particles' removal. In accordance with this invention, the collector electrode 13 comprises two cylinders 18 and 19. These cylinders are movable so the surfaces of these cylinders are movable relative to each other and to the clean gas duct 19, this movement being accomplished by power means 21 and 23 which may, of course, be the schematically illustrated electric motors and mechanical connections 25 and 27. A suitable resilient boot 29 provides a seal between duct 15 and the collector electrode arrangement.

As particle-laden gas A flows past electrode 11, an electrostatic or ionizing charge is imparted to the particles and the particles migrate towards collector electrode 13. By the time a quantity of gas reaches the outlet end of ionizing zone 10, a particle rich annular portion of gas and a clean core of gas have formed. The clean gas then flows through duct 17 and the concentrated particle-laden gas flows through duct 15.

After the unit of FIG. 1 has been in operation, a layer of particles has tended to accumulate on electrode 13 which at this time is the inner surface of cylinder 18.

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The electrode surface selection is then changed to provide a new collector electrode surface. Motive means 21 is actuated to render the surface of cylinder 18 ineffective as a collector electrode. Thus the cylinder 18, which formed electrode surface 13, is moved to the position illustrated in FIG. 2, and the surface of cylinder 19 is now rendered effective to act as the collector electrode 13. The surface of cylinder 18, now being removed from the presence of discharge electrode 11, is shielded by conduit 17 and not subjected to the electrostatic field which existed when it was in the position illustrated in FIG. 1. Accordingly, the particles which have collected on the surface of cylinder 18 are readily removed then by the scouring action of the concentrated particle stream.

After these particles have been removed from the surface of cylinder 18 by this scouring action of the concentrated particle-containing gas and other particles from the incoming gas have tended to accumulate on the collector electrode surface of cylinder 19, motive means 21 is actuated and the cylinder 18 is again moved to its position as illustrated in FIG. 3 and motive means 23 is actuated so that the cylinder 19 is moved to a position remote from the discharge electrode 11 so that any particles which have accumulated on the surface of cylinder 19 are removed by the scouring action of the concentrated particle-laden gas stream.

Although the particle-laden gas stream, itself, is usually sufficient for removing any accumulation of particles on the electrode surface when the surface is remote from the discharge electrode; this removal may be aided, if desired of course, by mechanical actions such as a rapping of the electrode. The cycle of use of the first and second collector electrode may be repeated as often and as frequently as desired.

An embodiment of the invention for use with a mechanical arrangement for removing the particles from the collector electrode is illustrated in FIGS. 4 and 5. This arrangement is particularly useful where the velocity of the gas flowing into the precipitator is not great enough to generate an effective scouring action. When the velocity is relatively low, particles carried by the gas deposit on the collector electrode. The particles are then removed mechanically from the electrode. As illustrated in FIGS. 4 and 5, the precipitator is comprised generally of a discharge electrode 11, a collector electrode 13, a particle-laden gas duct 15, and a clean gas duct 17. The excitation for the discharge electrode may be supplied by a conventional commercially available excitation arrangement.

As herein illustrated, the dirty gas duct 15 may be comprised of walls 41 and 42. A generally cylindrical duct 43 has one end 45 fastened to wall 41 in a suitable manner such, for example, as welding and the end 47 attached to a supporting lattice-work 49. Gas flows through opening 9 into the air separating chamber of the precipitator.

Concentric with cylinder 43 is another cylinder 51 which is mechanically supported within cylinder 43 by suitable mechanical means denoted as 53. It will be noted that the collector electrode surface 13 of FIG. 4 is the inner surface of cylinder 51 and the collector electrode surface of FIG. 5 is the inner surface of cylindrical tube 43. The axial movement of cylinder 51 between the positions illustrated in FIGS. 4 and 5 is effected by conventional motor 55. Both cylinders 43 and 51 are provided with a rapping means illustrated schematically by rapping motor 61 and mechanical connections 63 and 65 to a respective cylinder 43 and 51.

In the position illustrated in FIG. 4, the particle-laden gas flows past discharge electrode 11. The particles in the gas become charged and move toward collector electrode surface 13. If the flow of gas is relatively slow, most of the particles will collect upon electrode surface 13. However, those particles which do not collect thereon flow onwardly through the opening between duct 17 and cylinder 51 into the dirty air duct 15. This migration of the

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particles toward the collector electrode 13 has left a clean core of gas which then flows through duct 17.

After sufficient particles have collected upon cylinder 51 so that the efficiency of the surface is lowered, power means 55 is actuated to move the cylinder 51 away from the influence of discharge electrode 11 to the position shown in FIG. 5, at which position the surface of cylinder 51 is shielded by the clean air duct 17. Thereafter, the rapping mechanism 61 is actuated to mechanically dislodge the particles from the surface.

During the time the precipitator is in the condition shown in FIG. 5, the inner surface of cylinder 43 is operative as the collector electrode 13. When the surface of cylinder 43 has operated as collector electrode and sufficient particles have collected on this surface to cause the surface to have lost its efficiency, cylinder 51 is then moved to the position illustrated in FIG. 4. At this position, the surface of cylinder 43 is shielded from the discharge electrode 11 and the rapping mechanism 61 is actuated to mechanically dislodge the particles from cylinder 43. These particles at this time would be caught by the outer surface of cylinder 51. However, as the cylinder 51 moves to the position illustrated in FIG. 5 the flow of gas past the electrode will remove any particles lying on its outer surface.

One skilled in the art will understand from the foregoing that various combinations of mechanical rapping and gas scouring may be employed with the novel precipitator that sequentially provides clean surfaces for the collection of particles from a gas.

I claim:

1. An electrostatic precipitator apparatus for removing particles from a gaseous stream containing said particles through the action of a discharge electrode and a collector electrode, whereby as said gaseous stream flows past said discharge electrode, said particles are charged and are diverted radially toward the periphery of the stream whereby the particle concentration increases in the outer portion of the stream while the particle concentration decreases in the inner portion of the stream, the improvement comprising: said collector electrode being constituted of first and second cylinders of differing diameters concentrically disposed about said discharge electrode, said second cylinder being disposable within said first cylinder, means for separating said inner and outer stream portions into independent streams, and selection means for selectively employing a surface of said first and second cylinder as said collector electrode.

2. The apparatus of claim 1 wherein said selection means includes

means for moving said first cylinder to a position remote from said discharge electrode so that the surface of said second cylinder becomes a collecting electrode and the particle-laden outer gas stream scours the surface of said first cylinder to clean collected particles therefrom, and

further means for moving said second cylinder to a position remote from said discharge electrode so that particle-laden outer gas stream scours the surface of said second cylinder to clean collected particles therefrom.

3. The apparatus of claim 2 wherein said selection means moves said cylinders to a remote position from said discharge electrode by moving said cylinders downstream whereby the surface of a cylinder remote from said discharge electrode is shielded from said electrode by said separating means.

4. The apparatus of claim 1 including first cylinder being fixedly positioned, said second cylinder being mounted within said first cylinder for axial movement relative thereto, means for moving said second cylinder, and means for rapping said cylinders.

5. The apparatus of claim 1 wherein said means for separating said inner and outer portions of gas into independent streams is a tube coaxial with said cylinders

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and so positioned as to shield a cylinder surface from said discharge electrode.

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HARRY B. THORNTON, *Primary Examiner.*
D. TALBERT, *Assistant Examiner.*