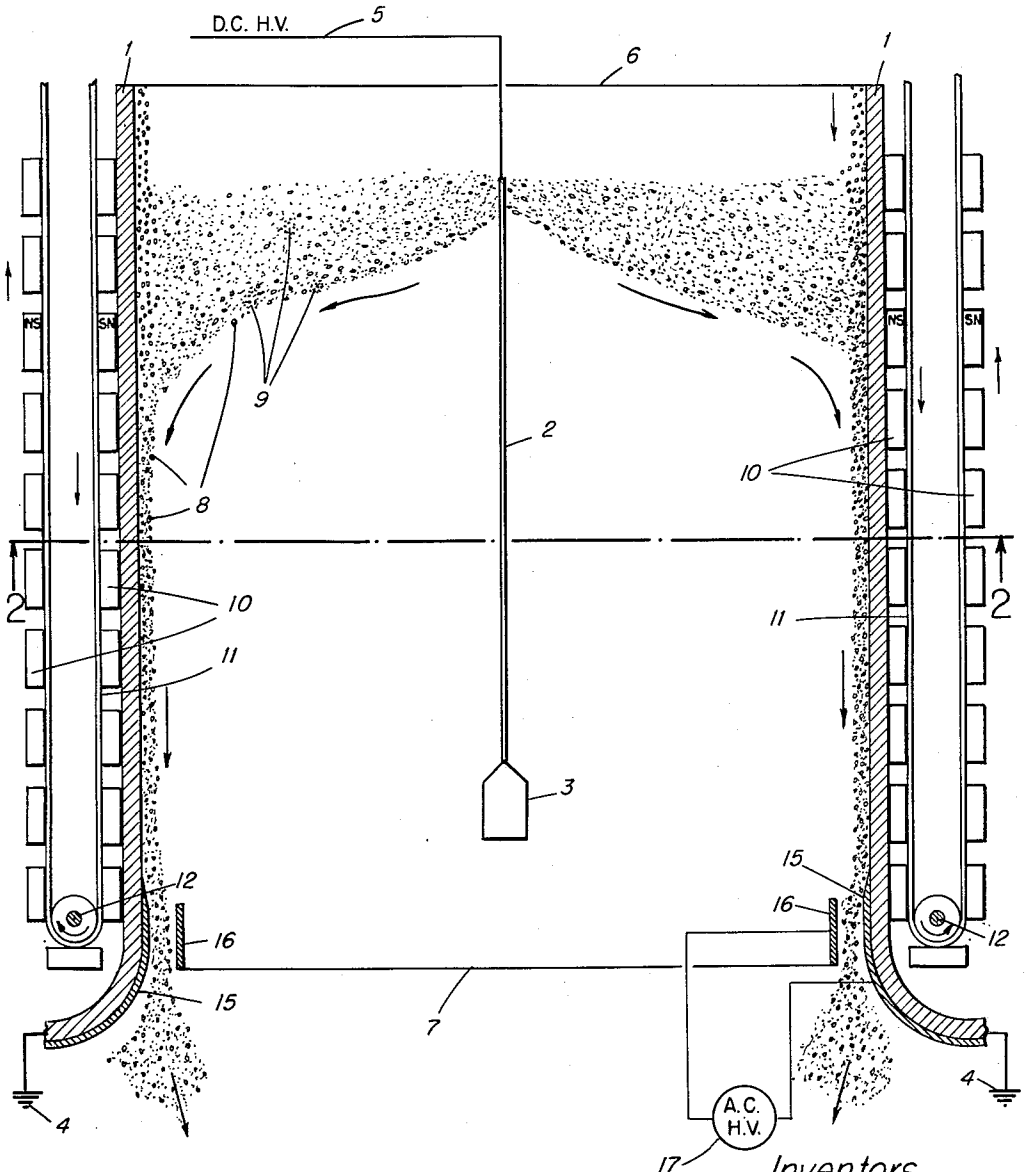
Dec. 18, 1962 C. G. BALZER ET AL 3,068,628

MAGNETIC CLEANING MEANS FOR ELECTRODES OF ELECTROSTATIC PRECIPITATOR

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FIG. 1



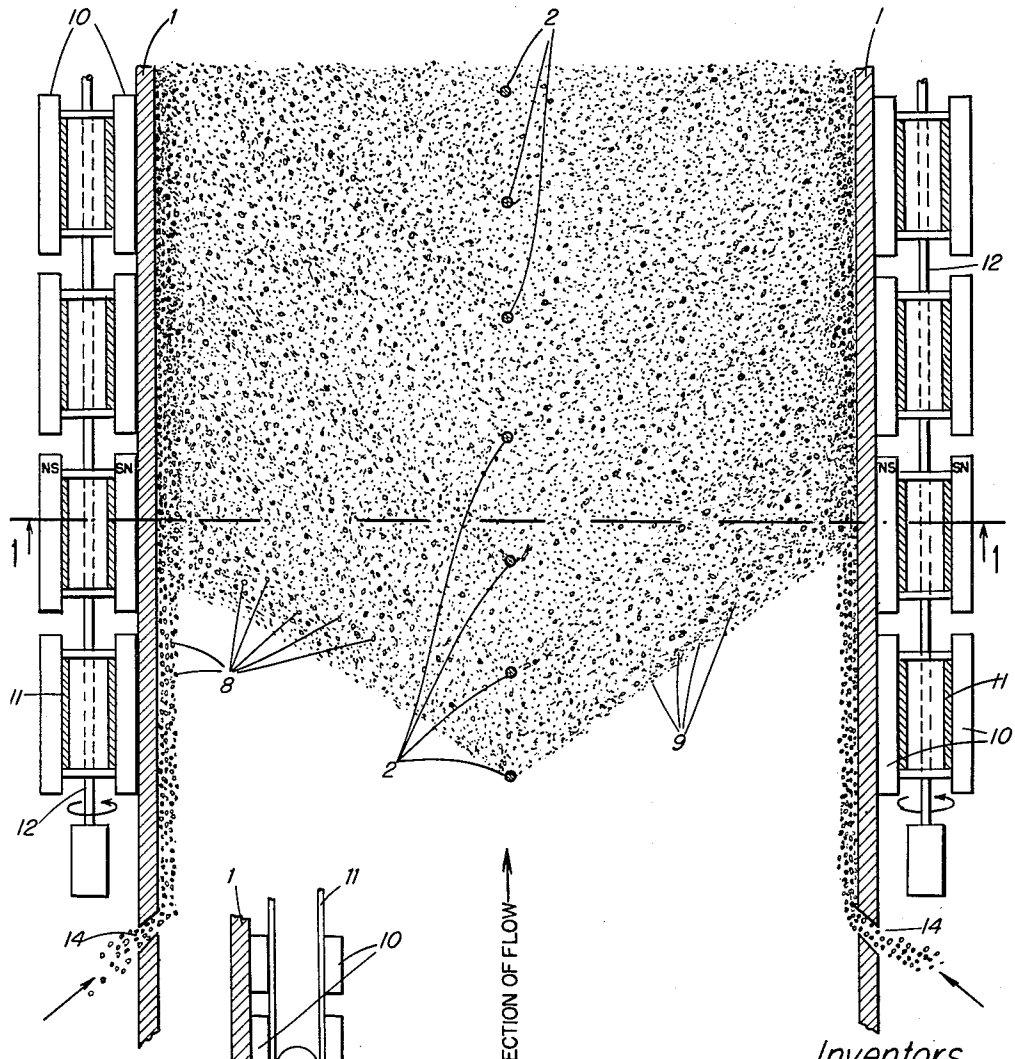
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FIG. 2



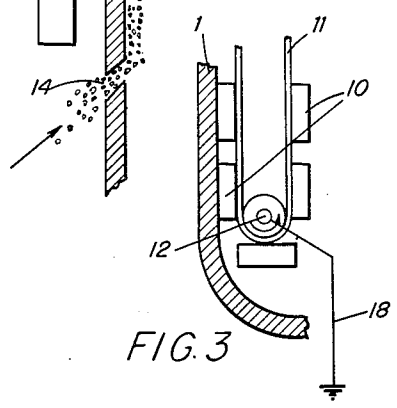


FIG. 3

DIRECTION OF FLOW

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MAGNETIC CLEANING MEANS FOR ELECTRODES OF ELECTROSTATIC PRECIPITATOR

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8 Claims. (Cl. 55—100)

This invention relates to electrostatic precipitators and more particularly to means for removal of dust particles collected on the side wall means of the precipitator. The removal of dust particles from dirty gas streams by electrostatic precipitators is ordinarily affected by means of emitting wire electrodes and collecting plate electrodes between which the moving stream of gas to be cleaned is passed. The collecting electrodes form walls near the sides of the ducts while the emitting electrodes are in the middle of the ducts. A high voltage rectified direct current is applied to the emitting electrode and grounded at the collecting electrode. The emitting electrode causes a corona which charges the dust particles negatively, and this direct current causes the charged dust particles to move to the collecting electrodes, thus precipitating them out of the gas stream onto the collecting electrode walls of the ducts. The particles of dust form a dust layer on the collecting walls which tend to cause arcs or breakdowns of the direct current corona. It is therefore important to keep the collecting electrodes clean. This is usually done by rapping on the collecting plates but this process is not wholly effective. The principal object of the present invention is to provide means for removing dust particles continuously from the collecting surfaces of the electrodes without rapping and it is characteristic of the present invention that precipitators made in accordance with the invention have moving magnets outside the side wall means defining the duct for drawing the collected dust down the interior of said side wall means and out of the way. Other features of the invention will be apparent from the description hereinafter given.

In the drawings, FIG. 1 is a diagrammatic view in elevation of one end of a preferred form of duct in an electrostatic precipitator made in accordance with the invention taken on the line 1—1 of FIG. 2, showing emitting electrode wires in the middle of the duct and a collecting wall electrode at each side and the moving novel magnets on each side outside the duct, only part of the gas stream being shown in the drawings.

FIG. 2 is an inverted diagrammatic plan view of the precipitator of FIG. 1 taken on the line 2—2 of that figure, showing the directions of flow of the gas stream and the particles.

FIG. 3 is a diagram of an alternative form of grounding the collecting electrode end of the direct current circuit in which the grounding is through the magnets.

In the embodiment shown in the drawings, the precipitator comprises a duct defined by side wall means and lying in a generally horizontal position, the fluid carrier for the dust, such for example as a gas stream, passing through the duct to be cleaned. The side wall means 1 of said duct serve as the collecting electrodes for the dust particles. Vertically suspended in the middle of the duct in a line extending lengthwise of the duct are emitting wire electrode means 2 each with a weight 3 at the bottom. The top of each emitting electrode means 2 is connected to a high voltage rectified direct current source 5. Each side wall means 1 may be grounded electrically as at 4 (see FIG. 1). The duct if desired can be enclosed as suggested diagrammatically by a top 6 and a bottom closure 7.

The dust may contain magnetic particles 8 and non-magnetic particles 9. The corona from the emitting electrode means 2 charges the particles and drives them toward the side wall means 1, i.e. the collecting electrode means, where said particles are deposited. Once the dust particles are on the side wall means they are in the magnetic field from a series of moving magnets 10. These magnets 10 are located on the outside of the duct adjacent the side wall means 1. They may actually be in sliding contact with the outer faces of the said side wall means if desired. They are carried by belt means 11, there being a plurality of magnets on each belt means. The belt means are endless and are driven by pulleys on shafts 12 so as to give the magnets a downward component of movement in the direction of gravity down the side wall means. In the embodiment illustrated, the only movement of the magnets is this vertical component of movement but obviously the magnets could be slanted downward, say, with another component in the direction of the gas stream flow. The magnets move downward when nearest the side wall means and return upward when removed therefrom at which time they exert no magnetic influence on the dust within the duct. If electromagnets are used, the current can be turned off each magnet during its upward journey. It will be seen that as each magnet turns around the lower shaft 12 on its belt means, it moves away from the side wall means 1 leaving the dust particles to the influence of gravity, free of the magnetic field. If electromagnets are used, the current can be shut off each magnet while it is returning to the top of the side wall means. Up to this point, the magnetic field not only has tended to hold the dust particles on the side wall means against inadvertent reentrainment by means of its limited magnetic field but has cleaned said side wall means as follows: The magnetic particles tend to follow the lines of force down the side wall means with the magnet. By physical contact or mechanical adhesion, the non-magnetic dust particles are pushed or scraped sufficiently loose from the side wall means to follow along with magnetic particles and in response to gravity to move down said side wall means which are kept clean continually as each magnet passes and the dust goes to the lower edge of the side wall means. Preferably said side wall means is composed of a plurality of walls each of which is equipped with magnets. Since the magnets need produce fields which are effective only in the proximity of the side wall means to hold particles thereon, only a short movement of a magnet away from said side wall means is required to free particles from magnetic influence.

As shown in FIG. 2, this removal of the collected non-magnetic dust from the wall can be made stronger by introduction of a steady stream of additional magnetic particles 8 into the duct against the interior of the side wall means through one or more openings 14 at an upper point on each said side wall means near the beginning of the duct as shown in FIG. 2. For example, they may be iron ore dust particles. They are carried along the side wall means by the gas stream and gravity which thus distribute them. The moving magnets tend to move them down the side wall means to which they are adhering because of the magnetic field. The non-magnetic particles by mechanical contact are loosened and dragged down by the magnetic particles and by gravity as already mentioned. The added particles being disposed along the inner surface of the side wall means, do not add to the current ordinarily required with an increase in the dust in the gas stream.

In order to assist in removing the dust particles completely from the side wall means when they reach the bottom and yet not have reentrainment, the following additional means can be provided. An auxiliary electrode 15 is fitted along the bottom of the duct beginning vertically at a level in the neighborhood of the bottom

closure 7 of the duct. Its upper edge can be bevelled so as to enable the electrode to act more efficiently as a shave-off for the descending particles. As shown in the drawings, the electrode 15 thickens the side wall means thus diminishing somewhat the effect of the magnetic field on the particles. This saves using an extra roller to start moving the magnets away at this point. There is a second electrode 16 paralleling the shave-off electrode 15 spaced in the duct from the shave-off electrode, a distance at least of the order of the expected maximum wall dust layer thickness. This second electrode 16 may be attached to the closure 7 but insulated therefrom. The space between the two electrodes is open past the closure 7 so that dust particles between the electrodes can drop out of the duct into an area outside the duct without reentrainment. The area may be a dust bin (not shown). There are means 17 such as an electric circuit and power source adapted to charge the electrodes 15, 16 with high voltage alternating current (A.C. HV) (see FIG. 1). It will be seen that the magnets 10 drag the dust particles downwardly onto the shave-off auxiliary electrode 15, thus separating them from the side wall means. The magnets then move away from the exterior of the side wall means enough to remove all magnetic influence from the dust particles. The alternating current acting through auxiliary electrodes 15, 16 neutralizes or removes any residual electrostatic electricity from the particles at the same time. This frees the particles to be influenced by gravity and they float down and out of the duct as shown by the lower right arrow in FIG. 1.

In FIG. 3 we have shown the grounding means in the neighborhood of the wall means for the side electrostatic rectified current as consisting of a ground 18 attached to the shaft 12 moving the magnets. The belt means 11 can be metallic in this case. Thus the ground can be via the magnets and the side wall means 1 be non-conductive. If desired, grounds can be used on both the wall means and the side magnets.

What is claimed is:

1. An electrostatic precipitator for removing dust including a mixture of magnetic and non-magnetic particles from a fluid carrier, comprising a duct including stationary side wall means through which duct and along the inner surface of said side wall means the dust laden carrier is adapted to pass, said side wall means constituting the collecting electrode of the precipitator, and emitting electrode means in said duct spaced from the inner surface of said side wall means, in combination with a series of magnets on the opposite side of said side wall means from the emitting electrode means, and belt means moving the magnets relative to said side wall means whereby the magnetic field created by said magnets and acting at said side wall means assists movement of the dust particles relative to such stationary side wall means thereby clearing said side wall means of dust.

2. An electrostatic precipitator according to claim 1, wherein the belt means is so located with respect to said stationary side wall means that after assisting the movement of the particles relative to said side wall means said magnets are carried away from said side wall means thereby ending the influence of said magnets on the particles on said side wall means.

3. An electrostatic precipitator according to claim 1, wherein the strength of said magnets limits their magnetic field to the proximity of said side wall means, whereby only a relatively short movement of said magnets away from said stationary side wall means is required to free particles on said side wall means from the magnetic influence of said magnets.

4. An electrostatic precipitator for removing dust particles from a moving stream of dirty gas including a mixture of magnetic and non-magnetic dust particles, comprising a duct including vertically stationary side wall means through which duct and along the inner surface of said side wall means the dirty gas stream is adapted to pass, emitting electrode means in said duct spaced from the inner surface of said side wall means, said side wall means being adapted to act as a dust collecting electrode, in combination with a series of magnets on the opposite side of said side wall means from the interior of said duct and sufficiently close to said side wall means to have the magnetic field of said magnets limited to the proximity of said side wall means and to hold any magnetic dust particles on said side wall means, and belt means moving said magnets downwardly relative to said vertically stationary side wall means in the direction of gravity thereby concentrating the magnetic particles at the bottom of said side wall means, and means associated with said side wall means to ground the dust collecting electrode constituted by said side wall means, whereby the magnets help move magnetic particles from the dirty gas stream by magnetic attraction and also move any non-magnetic particles in contact with said magnetic particles.

5. An electrostatic precipitator according to claim 4 wherein means are provided near an upper point on said vertically stationary side wall means to introduce additional magnetic particles against the inner surface of said side wall means, whereby additional magnetic particles are supplied to the dirty gas stream to loosen nearly all of the non-magnetic dust particles from the inner surface of said vertically stationary side wall means thereby freeing the dust to the action of gravity and the movement of the magnetic particles.

6. An electrostatic precipitator according to claim 4 wherein there are two auxiliary electrodes near the lower edge of said duct, one of said auxiliary electrodes being positioned near the lower edge of said side wall means and the other being spaced from said one of said auxiliary electrodes a distance at least more than any expected dust layer thickness to define a pasage between said auxiliary electrodes leading to an area outside said duct, in combination with means adapted to charge each of said two auxiliary electrodes with high voltage alternating current, whereby the moving magnets and auxiliary electrodes cooperate to move the dust particles off said side wall means and to free said dust particles to be acted on by gravity thus cleaning said side wall means.

7. An electrostatic precipitator for removing dust particles from a moving stream of dirty gas including a mixture of magnetic and non-magnetic dust particles comprising a duct through which said dirty gas is adapted to pass, said duct including vertically stationary side wall means and a bottom closure, emitting electrode means inside said duct and spaced from the inner surface of said side wall means, said side wall means constituting the collecting electrode of the precipitator, in combination with a series of moving magnets on the outside of said side wall means, the magnetic field created by said magnets being effective to hold on the inner surface of said side wall means any magnetic dust particles thereon, belt means for moving the magnets downwardly of said side wall means in the direction of gravity, means for grounding said collecting electrode constituted by said side wall means, two auxiliary electrodes near the lower edge of said duct and in proximity to the bottom closure of said duct, one of said auxiliary electrodes being positioned along the lower edge of said side wall means and the other being spaced from said one of said auxiliary electrodes at a distance at least more than any expected dust layer thickness to define a passage between said auxiliary electrodes leading to an area below the bottom closure of said duct and outside said duct, and means to charge said two auxiliary electrodes with high voltage alternating current, belt means moving said magnets downwardly relative to said side wall means to move magnetic particles downwardly and onto said one auxiliary electrode positioned along the lower edge of said side wall means thereby shaving said magnetic particles off said side wall means, whereby said magnetic particles are freed from said side wall means and from magnetic and electrostatic influences

to drop out of said duct without the possibility of re-entrainment.

8. An electrostatic precipitator for removing dust including a mixture of magnetic and non-magnetic particles from a fluid carrier, comprising a duct including vertically stationary side wall means through which duct and along the inner surface of said side wall means the dust laden carrier is adapted to pass, said side wall means constituting the collecting electrode of the precipitator, and emitting electrode means, said duct spaced from the inner surface of said side wall means, in combination with a series of magnets on the opposite side of said side wall means from said emitting electrode means, and belt means moving said magnets with a downward component of movement adjacent said side wall means and along the said opposite side of said side wall means, whereby magnetic particles from said fluid carrier are concentrated together at the bottom of said duct, the belt means being so located with respect to said side wall means that after assisting the downward movement of said magnetic dust particles along the inner surface of said side wall means to the bottom of said duct the magnets are moved away from said side wall means thereby ending their influence on the dust particles on said side wall means.

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