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2,887,175

PURGING CONTINUOUSLY ENERGIZED ELECTROSTATIC PRECIPITATOR

Filed Nov. 9, 1956

3 Sheets-Sheet 1

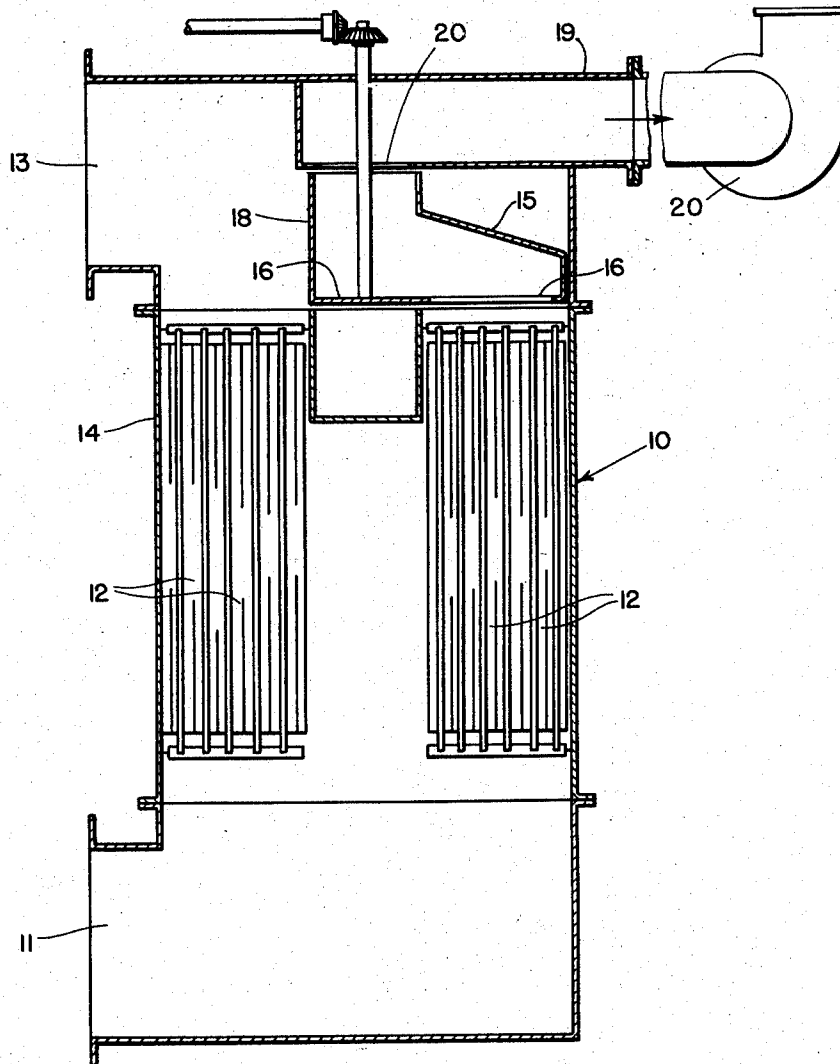


FIG. 1

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FIG. 2

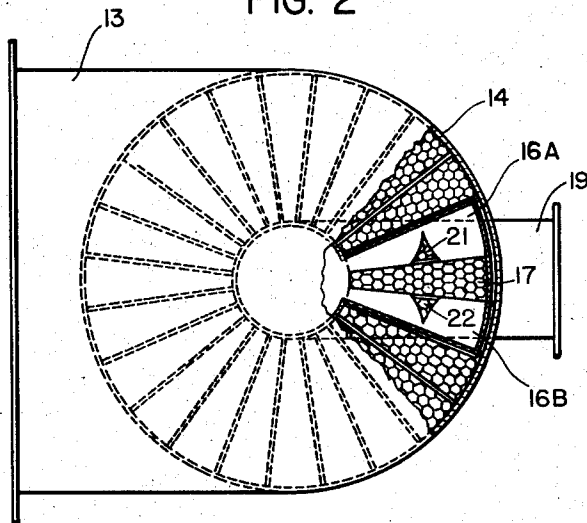
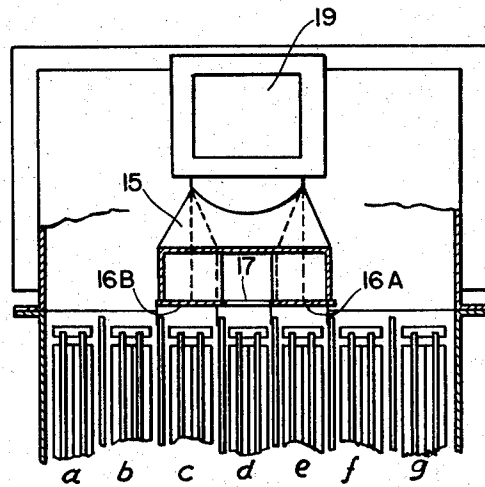


FIG. 3

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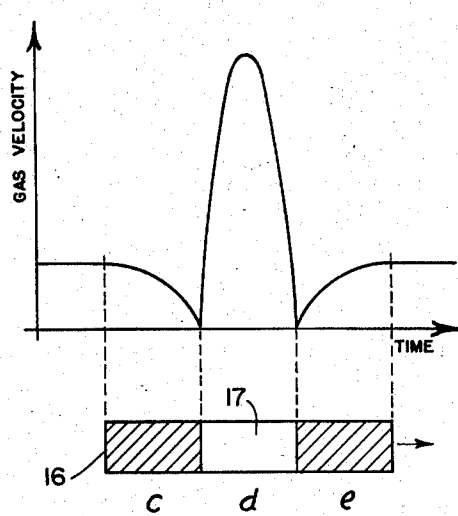
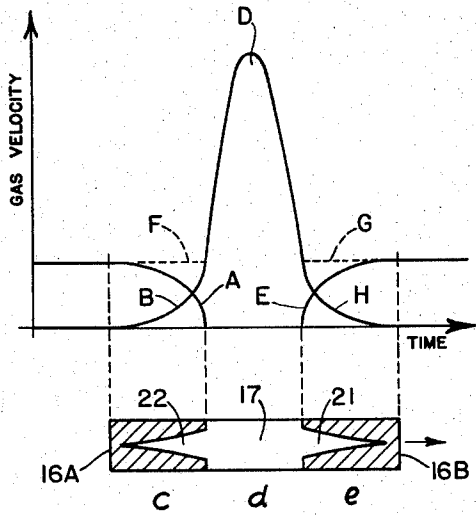
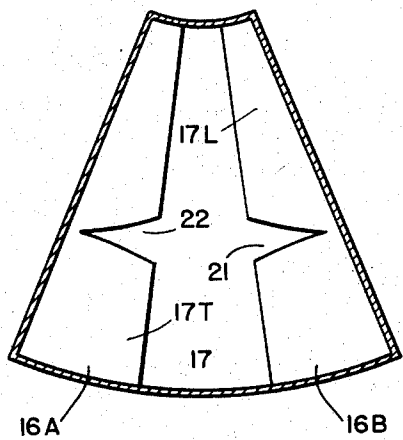
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3 Sheets-Sheet 3



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PURGING CONTINUOUSLY ENERGIZED ELECTROSTATIC PRECIPITATOR

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Application November 9, 1956, Serial No. 621,413

3 Claims. (Cl. 183-7)

This invention relates to electrostatic dust precipitators of the kind wherein gases carrying fine particles to be removed are passed through an electric field causing the particles to become electrically charged and repelled from discharge electrodes to be attracted to and collect on the surfaces of channels surrounding the discharge electrodes.

In particular the invention relates to apparatus for purging or cleaning the deposited particles from the collecting surfaces while maintaining the electrodes continuously energized, preferably at a constant voltage.

During use the collecting surfaces rapidly become covered with a fine dust deposit which must be removed in order to maintain the efficiency of collection. It has therefore been proposed, as for example disclosed in United States Patent No. 2,582,133 issued January 8, 1952, to isolate one or more sections or electrode banks of the collector in succession from the gas stream passing through the collector and to subject such isolated section to a cleaning operation by means of a stream of gaseous fluid to remove the dust fines adhering to the collecting surfaces. This cleaning of the isolated bank or banks of electrodes take place while the remaining electrode banks are active to produce the desired dust collection.

Heretofore it has been proposed, as disclosed in United States Patent No. 2,672,947 issued March 23, 1954, to reduce the charging voltage to an electrode bank immediately prior to the cleaning period at which time the current is cut off. Subsequently, the voltage is restored at a reduced level before being again increased to the full operating voltage. Hence there are transition periods at the beginning and ending of the cleaning period and during these periods the collecting function is diminished so that the overall efficiency of the precipitator is decreased.

The present invention contemplates maintaining the full normal charging voltage on the precipitator electrodes both during the transition periods and the actual cleaning period. However, with the voltage still applied to electrode banks at either side of the one being cleaned and which are isolated from the main stream of gas there is a possibility that flashovers will occur or their frequency will increase because the effect of the flowing gas stream is not available to "tear off" and extinguish flashovers.

The object of this invention is to provide means for improving the efficiency of the precipitator by maintaining the electrodes fully charged and effective for collecting purposes while at the same time reducing the possibility of flashovers occurring.

According to the present invention an electrostatic dust precipitator of the kind mentioned above is provided having a plurality of electrode banks in sector shaped dust collecting compartments and a relatively movable cleaning hood having a sealing end plate formed with an aperture adapted to guide and distribute the cleaning fluid including slots in the sealing plate located

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adjacent the leading and trailing edges of this aperture so as to place electrode banks adjacent the one being cleaned in fluid communication with the cleaning hood to maintain a reduced volume of gas flowing at a desired velocity through each electrode bank before and on completion of the cleaning operation through said slots as they pass across said electrode banks.

The invention will be hereinafter more fully described with reference to the embodiment thereof shown by way of example in the accompanying diagrammatic drawings, in which:

Figure 1 shows an axial section of the dust precipitating part of the apparatus.

Figure 2 shows a plan view with certain of the elements broken away.

Figure 2A is an enlarged view of the end plate of the cleaning hood appearing in Figure 2.

Figure 3 is a side elevation and partial section of the upper part of the collector viewed from the right hand side of Figure 2.

Figure 4 is a graph illustrating gas velocity in an electrode bank which is completely cut off from the gas flow in the transition periods and wherein the charging voltage is reduced in the transition periods immediately prior and following the cleaning operation.

Figure 5 is a similar graph illustrating the gas velocity in an electrode bank in the transition and cleaning periods when utilizing cleaning apparatus in accordance with the present invention and maintaining the electrodes continuously charged.

Referring to the drawings, the precipitator denoted generally by 10 is interposed in the flow of gas to be cleaned, for example, boiler flue gas which is drawn by the induced draft fan of the boiler from an inlet 11 through the collecting cells 12 to the outlet duct 13. In the cells 12 the fine dust particles are electrically separated from the gas and deposited on the side walls of the collecting cells in known manner. The electrodes to which the charging voltage is applied are indicated as being rods extending co-axially of the cells 12.

In the illustrated embodiment the collecting cells are in the form of compartments of sector shape disposed within a cylindrical housing 14, the sectors having an angle of 15° so that twenty four sectors each constituting a separate electrode bank are arranged within the housing. For cleaning purposes each electrode bank is isolated in turn from the main gas stream passing from the inlet 11 to the outlet 13 for the purpose of cleaning off precipitated particles from the walls of the collecting cells, the said particles being withdrawn outside the precipitator 10 by the cleaning fluid in a conduit separate from the main gas flow as will be hereinafter described.

To this end there is arranged at the outlet end of the cells, that is to say, the upper end in Figure 1, a rotatable cleaning hood 15 provided with a flat sector shaped distributing plate 16 which in the embodiment illustrated is of such width that it covers approximately three of the 15° sectors. The distributing plate 16 is formed with an aperture 17 which is substantially radially disposed and approximates in size and shape one of the sectors. The aperture 17 is at the base of and covered by the cleaning hood 15 which communicates with a central annular duct 18 opening into a fixed outlet cleaning duct 19 through openings 20.

During operation of the precipitator the hood 15 and sector plate 16 are rotated continuously, thus isolating and sealing off in turn each individual electrode bank.

The actual sealing is effected by means of suitable radially and circumferentially disposed sealing elements (not shown) secured to the radial and circumferential walls of each sector at the upper ends thereof and adapted to

bear on machined surfaces of the rotatable distributing plate 16.

The distributing plate 16 shown in Figures 2 and 3 is so dimensioned in the illustrated embodiment to cover three sectors containing the collector cells 12. As shown in Figure 3, the plate covers electrode banks *c*, *d*, and *e* with the slot 17 of the plate being over the bank *d* so that at the particular instant shown the cleaning fluid is passing through the electrode bank *d*. Since the lower ends of the various electrode banks each communicate with the main gas flow inlet 11 a part of the volume of gas entering the precipitator serves as the fluid for cleaning the bank *d* sealed off by the distributing plate 16 from the main gas flow. The purge gas is drawn from the inlet 11 through the bank *d* and, after passing through the aperture 17 and the hood 15, is delivered through the outlet duct 19. Since the sector *d* is cut off from the outlet 13 and the main gas stream flowing thereto the purge gas is drawn over the isolated electrode bank by a separate fan indicated diagrammatically at 20 in Figure 1. Such a purge system for an electrostatic precipitator is disclosed in the Hodson application, Serial No. 526,260, filed August 3, 1955, now Patent No. 2,835,337, dated May 20, 1958.

In the operation of the cleaning system illustrated as in Figure 3 the electrode bank *c* is in transition from normal collection of particles from the main gas stream to the cleaning operation by a portion of the gas moving at higher velocity as a purging stream, that is from normal to cleaning gas flow, bank *d* is undergoing cleaning, bank *e* is in transition from cleaning back to normal gas flow, while banks *a*, *b* and *f*, *g*, are carrying out the normal collecting operation.

When the imperforate portion 16A of the distributing plate 16 moves across the electrode bank *d* which is to be subjected to the cleaning action, the velocity of the dust laden gas flowing over the electrodes of this bank decreases in the period immediately before cleaning of this bank *d* by gas drawn through aperture 17. The velocity increases in the bank *d* after it has been cleaned as the imperforate portion 16B moves over and clears the bank *d* as is indicated in Fig. 4. Consequently, when the gas velocity approaches or reaches zero there is a possibility of flashovers occurring or increasing in frequency if the charging current is not cut off during the transition periods.

In accordance with the present invention it is considered desirable for improving the efficiency of the precipitator to maintain the electrodes charged during the periods an electrode bank is in transition from full laden gas flow to full purging gas flow. To permit this to be done a sufficient velocity of gas flow is maintained in the electrode banks at either side of the one actually being cleaned so that any incipient flashovers will be immediately removed due to the gas velocity. This gas velocity is maintained by placing the electrode banks at either side of the one being cleaned in communication with the stream of purging gas being drawn over the latter bank and through the hood 15 at a time when the adjacent banks are substantially isolated from the main stream of dust laden gas and fully cut off from the main gas outlet 13. One way of accomplishing this is to form re-entrant slots 21 and 22 extending from the leading and trailing edges 17L and 17T of the purge slot 17 in the distributing plate 16 into the imperforate portions 16A and 16B of the distributing plate. Thus, when the electrode banks *c* and *d* are temporarily isolated from the full flow conditions of the dust laden gas stream during the transition periods before and after cleaning a sufficient volume of gas is drawn over these electrode banks and at a higher velocity than normal by the action of the suction of the stream of purge gas in the hood 15 acting through the slots 21 and 22 which are in open communication with the aperture 17 for the purging stream. Under these conditions as the velocity of the dust laden

gas stream tends to fall to zero as indicated at A in Figure 5, the flow induced through the slots 21 increases as indicated at B. During cleaning of the electrode bank this velocity of the stream rises to a peak and then declines as aperture 17 moves past the bank as indicated at D in Figure 5. As the imperforate part of the distributing plate moves over the bank the main gas flow velocity rises as at E while the purge gas velocity induced through slot 22 declines as indicated at H. The resultant velocity during transition is as indicated at F, G in Figure 5 which shows that in the electrode banks at either side of the bank which is being actually cleaned a resultant gas flow velocity F, G is maintained which acts to suppress incipient flashovers and permits maintenance of the charge on the electrodes of electrode banks during the transition periods.

The slots 21, 22 are so shaped that the progressive flow increasing action of the purging suction through the aperture 17 is just large enough to increase the disappearing or reappearing main gas flow in the electrode banks during transition periods to such a volume that full power in these banks maintains a high efficiency of precipitation without increase in the flashover rate. If, for instance, operation is at normally 36 feet/sec. gas velocity, the slots 21, 22 have to be designed so as to keep the flow velocity during transitions between 25 and 45 feet/sec.; this means the arrangement is not critical.

In addition to electrical savings other improvements result; there is increased precipitator efficiency, as has been observed when power was kept at high level during the transitions; reduction in purge dust loading occurs because the hood 15 sucks a portion of cleaned gas through the slot 22 and there is reduced loss from purge gas entrained in the electrode banks. On the negative side, there may be a small loss in purge gas volume, but this is considered negligible. With this arrangement it is also possible to cut down the width of the cover plates because every portion of the gas that passes a transition sector is subjected to high efficiency precipitation.

What is claimed is:

1. An electrostatic dust precipitator having a housing containing a plurality of contiguous banks of collecting electrodes, inlet and outlet means for causing simultaneous traversal of said electrode banks by a main stream of dust laden gas to effect the removal of dust particles therefrom; a cleaning hood movable relatively to said banks for aligning it with each electrode bank in succession to isolate the electrode banks from the main gas outlet for cleaning successively; gas distributing means associated with said hood alignable with an electrode bank in advance of and following, in the direction of cleaning hood movement, the electrode bank isolated for cleaning by said cleaning hood for simultaneously isolating said adjacent banks from the main gas outlets; means associated with said distributing means for placing said adjacent electrode banks in fluid communication with said cleaning hood; and fan means associated with said cleaning hood for causing the flow of a stream of cleaning gas over the electrode banks in operative relation with said cleaning hood.

2. An electrostatic dust precipitator having a housing containing a plurality of contiguous banks of collecting electrodes, inlet and outlet means for causing simultaneous traversal of said electrode banks by a main stream of dust laden gas to effect the removal of dust particles therefrom; a cleaning hood movable relatively to said banks for aligning it with each electrode bank in succession to isolate the electrode banks from the main gas outlet for cleaning successively; gas distributing means associated with said hood alignable with an electrode bank in advance of and following, in the direction of cleaning hood movement, the electrode bank isolated for cleaning by said cleaning hood for simultaneously isolating said adjacent banks from the main gas outlet; means associated with said distributing means for placing said adjacent elec-

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trode banks in fluid communication with said cleaning hood; and fan means associated with said cleaning hood for causing the flow of a stream of cleaning gas over the electrode banks in operative relation with said cleaning hood at a higher velocity than the flow of the main gas stream. 5

3. Precipitator cleaning apparatus as recited in claim 1 wherein said cleaning hood is provided with an aperture alignable with an electrode bank to be cleaned and the gas distributing means comprise plate portions extending 10 from the leading and trailing edges of the nozzle aperture to overlie the adjacent electrode banks with re-entrant slots formed in said sealing plates at the leading and trailing

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edges of said aperture and extending therefrom to overlie parts of said adjacent electrode banks for placing said adjacent banks in fluid communication with said cleaning hood.

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