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ELECTRICAL PRECIPITATION APPARATUS

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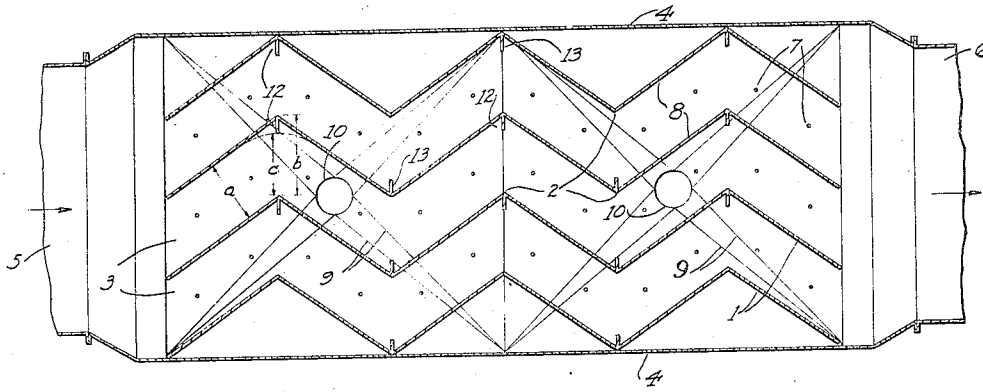


Fig. 1

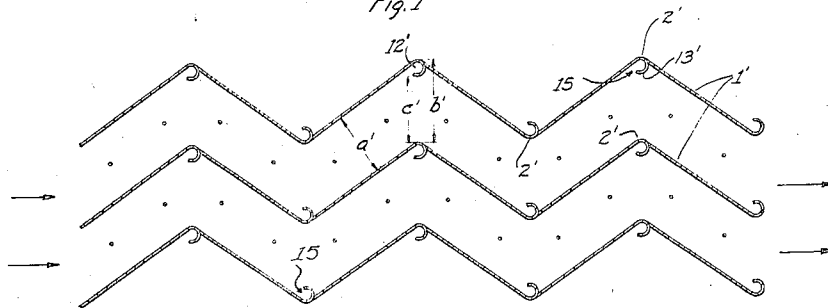


Fig. 2

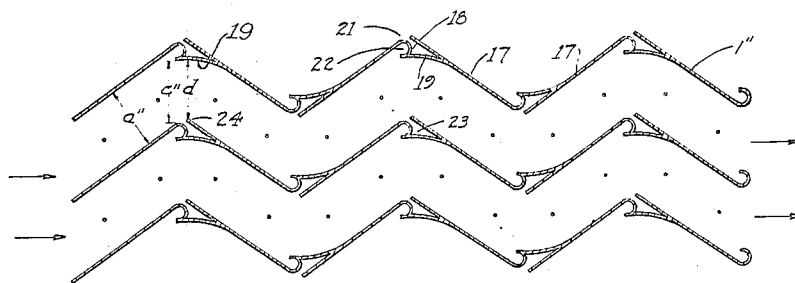


Fig. 3

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ELECTRICAL PRECIPITATION APPARATUS

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10 Claims. (Cl. 183—7)

This invention relates to apparatus for electrical precipitation of suspended particles from gases and particularly to a novel and advantageous form of collecting electrode arrangement for use in
5 such apparatus.

The principal object of the invention is to provide a collecting electrode of such construction as to facilitate the collection of precipitated material upon and adjacent the collecting surfaces
10 thereof and prevent or minimize dislodgment and carrying away of such material by the gases passing through the apparatus.

A further object of the invention is to provide a collecting electrode of simple, economical, and
15 rugged construction, and particularly, an electrode of such design that it may be of relatively light material without danger of undue deformation or warping of the surfaces thereof.

A further object of the invention is to provide
20 a collecting electrode arrangement in which the relation between adjacent collecting electrodes at the opposite sides of each duct or passage through which the gas is drawn is such as to provide comparatively dead collecting spaces or pockets at intervals along such surfaces.
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A further object of the invention is to provide a collecting electrode arrangement in which baffles or projections may be provided, extending outwardly from the surfaces of the collecting electrodes to assist in defining collecting pockets for
30 the precipitated material, without appreciably decreasing the cross-sectional area of the gas passages at the points where such baffles or projections are located, and hence without appreciably
35 affecting the pressure drop through the apparatus.

According to this invention, the collecting electrodes are of zigzag shape in the direction of gas flow therebetween, such electrodes being disposed with the longitudinal lines of the bends or angles
40 thereof extending transverse to the direction of gas flow. A plurality of such collecting electrodes are mounted parallel to one another, so that the salient angles of each electrode are disposed opposite the reentrant angles of an adjacent electrode, thus providing a plurality of zigzag gas passages or ducts therebetween, in which the discharge electrodes are mounted. With such an arrangement, the cross-sectional area of the gas passages is appreciably increased at the regions of
45 the bends or angles, as compared with the cross-sectional area at the regions between the flat surfaces of the plates, thus causing a decrease in the gas velocity at the first-named regions and providing relatively dead or quiescent spaces or
50 pockets in the reentrant angles, in which the pre-

cipitated particles may be collected and permitted to fall to the lower ends of the collecting electrodes and to suitable receiving means therebeneath, without danger of being dislodged and carried
55 away by the gas stream.

According to a preferred embodiment of the invention, suitably shaped baffles or projections are also provided adjacent these collecting spaces, which project somewhat from the surfaces of the collecting electrodes in such manner as to assist
60 in maintaining relatively quiescent conditions in said spaces and in preventing escape of precipitated material therefrom, without appreciably restricting the cross-sectional area of the passages at these points, as compared with the cross-sectional area between the flat surfaces of the
65 collecting electrodes.

The accompanying drawing illustrates several embodiments of this invention and referring thereto:
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Fig. 1 is a horizontal section of an electrical precipitator provided with a collecting electrode arrangement according to this invention.

Fig. 2 is a horizontal section of a modified collecting electrode construction.
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Fig. 3 is a similar view of another modification. Referring to Fig. 1, the collecting electrodes are shown as comprising a plurality of parallel zigzag plates 1 of metal or other suitable material disposed with the longitudinal lines of the angles or bends 2 extending vertically and with the salient angles of each plate opposite the reentrant angles of an adjacent plate, so as to define a plurality of zigzag gas passage ducts 3 through which the gas to be cleaned may be passed horizontally. The collecting electrodes are shown as inclosed within a precipitation housing whose side walls 4 substantially contact the two outermost plates at the salient angles thereof so as to substantially confine the gas flow to said passages 3. Said housing may be provided with an inlet flue connection 5 at one end and an outlet flue connection 6 at the other end, whereby gas may be passed therethrough.
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The discharge electrodes are shown as comprising a plurality of suitably spaced vertically extending discharge members 7 presenting small surface area and sharp surface curvature, so as to facilitate electrical discharge therefrom, in the usual manner of such apparatus. Such discharge members, for example, may consist of metal wires or rods of small diameter, and may be supported and insulated from the collecting electrodes in any suitable manner. Said discharge electrode members are disposed along zigzag lines
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extending substantially midway between each pair of adjacent collecting electrodes, and one or more of such discharge electrode members are preferably provided opposite the flat surface portions 8 of the collecting electrodes between the respective angles or bends thereof.

Suitable means may be provided below the collecting and discharge electrodes for receiving the precipitated material falling therefrom, such material receiving means being illustrated as comprising hoppers indicated at 9, whose walls taper downwardly and inwardly to discharge openings 10.

It is characteristic of the collecting electrodes of the present invention that the bends or angles 2 are relatively sharp instead of gradually curved, and that the portions 8, between adjacent angles or bends, are substantially flat or straight instead of curved so that each passage 3 consists of a succession of alternate straight portions and relatively sharp bends or angles.

It will be seen that the transverse width of each passage 3 is somewhat greater at the region of each angle or bend 2 therein than at regions intermediate such bends or angles. That is to say, the distance between each salient angle and opposing reentrant angle, indicated at b , is somewhat greater than the perpendicular distance between the flat portions 8 of two adjacent plates, as indicated at a , so that the velocity of the gas is decreased as it passes each bend or angle, thus providing relatively quiescent collecting pockets or spaces 12 at the reentrant side of each angle or bend.

The apparatus is further shown as provided with baffles or projecting strips 13 projecting laterally from the reentrant side of each bend of each collecting electrode plate, said baffles or strips preferably extending throughout substantially the entire height of said plates. Said baffles or strips preferably project outwardly only to an extent equal to the difference between the distance b and the distance a , so that the distance c between the outer edge of each of said baffles or strips and the opposing salient angle of the adjacent plate is substantially equal to the distance a . Said baffles or strips thus interpose substantially no added resistance to gas flow, but tend to equalize the cross-section of the gas passages throughout the length thereof, and at the same time serve to prevent or minimize the flow of gas into the quiescent pockets or spaces 12.

In the operation of the above-described apparatus, a gas is passed horizontally through the passages 3, for example in the direction indicated by the arrows, and the velocity thereof is maintained substantially uniform throughout. It will be understood that the discharge and collecting electrode means are connected to any suitable source of electric current at suitable potential to effect electric discharge of the silent or corona type from the collecting electrodes. The suspended particles which become electrically charged by the action of such discharge are caused by the electrical field to move toward and precipitate upon the surfaces of the collecting electrode plates 1. There may be some tendency for some of the material thus precipitated to be carried along the surfaces of the collecting electrodes by the friction of the passing gas stream, but such material is caught within the collecting pockets or spaces 12, where it is much less subject to the action of the gas stream, and these collecting pockets or spaces therefore serve to permit the material to accumulate and eventually

fall by gravity into the collecting hoppers 9, instead of being picked up and carried away by the gas stream. A high efficiency of gas cleaning is thus obtained, while the ability of the collecting electrodes to prevent dislodgment and carrying away of precipitated particles permits the gas to be passed through the apparatus at higher velocity than would otherwise be permissible, and consequently increases the capacity of a given size precipitator.

A further advantage of the zigzag construction of the collecting electrodes is that the bends or angles tend to stiffen the same and provide more resistance against lateral deformation or warping than is the case with ordinary flat plates. For this reason the collecting electrode plates may be made of relatively light metal, and the cost and weight of the entire apparatus may be reduced to a minimum.

The construction shown in Fig. 2 is quite similar to that above described, with the exception that the angles or bends of the zigzag collecting electrode plates 1' are shown as somewhat rounded, as indicated at 2' and the projecting baffles or strips 13' are shown as curved channels disposed with their open side toward the gas stream, as indicated at 15. As before, the distance b' between two opposing angles is somewhat greater than the distance a' between opposing flat portions of the plates and the distance c' , between the outer edge of each channel 13' and the opposing angle 2' is substantially equal to the distance a' . The increased cross-section at b' , together with the channels 13' serve as before to provide relatively quiescent collecting pockets or spaces 12' for collection of precipitated material and for permitting such material to fall to the bottom of the collecting electrodes without being swept away by the gas stream. The discharge electrodes may be similar to those above described, and the operation of this form of the invention is substantially the same as that shown in Fig. 1.

In the form of construction shown in Fig. 3, each collecting electrode 1'' is shown as made up of a plurality of vertical plates or strips 17 disposed in zigzag relation with respect to one another, and each of said strips or plates is shown as provided with a curved flange or channel portion 18 at the further edge thereof disposed within the reentrant angle between that plate or strip and the next succeeding plate or strip. Said curved flanges or channel portions are concave when viewed in the direction of gas flow, and the outer edges thereof are preferably connected to the surfaces of the succeeding strips or plates by means of slightly curved connecting strips 19. Furthermore, the further edge of each plate or strip 17 and the curved flange 18 thereof are preferably spaced somewhat from the nearer edge of the next succeeding plate or strip, as indicated at 21. By means of this construction, relatively quiescent collecting pockets 22 are provided as before at the reentrant angles of the collecting electrodes, and additional collecting pockets or spaces 23 are provided adjacent the salient angles thereof. Thus, means are provided at both sides of the gas passages, at the region of each angle or bend therein, for facilitating the collection of precipitated material and preventing such material from being carried away by the gas stream, without causing any appreciable constriction of the gas passages at these regions.

By referring to Fig. 3 it may be seen that the distance c'' between the rounded end of each

strip 17 and the outer edge of the channel 18 of the opposing strip is substantially equal to the distance a'' between the flat portions of said strips, and that the distance d between the forward edge of each strip and the opposing connecting strip 19 may also be substantially equal to or only slightly less than the distance a'' , according to the relation which it is desired to maintain between this forward edge and the plane of the next preceding strip. It is seen that it is not necessary that this edge, such as indicated at 24, project outwardly beyond said plane in order to catch the precipitated material, due to the relatively sharp curvature of the gas stream inwardly toward said plane as it passes this point.

I claim:

1. In an electrical precipitator, a plurality of collecting electrodes of zigzag shape characterized by sharp angles and flat portions between adjacent angles, said collecting electrodes being disposed parallel to one another with the longitudinal lines of the angles thereof extending transverse to the direction of gas flow and with the salient angles of each electrode opposite the reentrant angles of an adjacent electrode, each of said electrodes being provided with projections extending laterally therefrom at the reentrant sides of said angles and serving to define pockets for collection of precipitated material.

2. The invention as set forth in claim 1, the outer edge of each of said laterally extending projections being spaced from the opposing salient angle of an adjacent electrode by a distance substantially equal to the distance between the opposing portions of the collecting electrodes between the angles thereof.

3. An electrical precipitator comprising a plurality of collecting electrodes of zigzag shape whose angles extend substantially vertically, with the reentrant angles of each electrode disposed opposite the salient angles of an adjacent electrode, baffle means projecting inwardly from the reentrant angles of each electrode, said baffle means extending throughout substantially the entire height of said electrodes and having their outer edges spaced from the salient angles of the adjacent electrodes by a distance substantially equal to the distance between the flat portions of the adjacent electrodes, discharge electrode means disposed between the adjacent collecting electrodes, and means for passing gas substantially horizontally between said collecting electrodes.

4. In an electrical precipitator, a plurality of collecting electrodes of zigzag shape disposed parallel to one another with their angles extending substantially transverse to the direction of gas flow said angles being relatively sharp and the portions of said electrodes between adjacent an-

gles being substantially flat, the angles of the respective collecting electrodes being disposed opposite one another and the distance between the opposing angles of adjacent electrodes being materially greater than the perpendicular distance between the opposing substantially flat portions of adjacent electrodes, and each of said electrodes being provided with baffle means projecting therefrom at each reentrant angle toward the opposing salient angle of an adjacent electrode and extending throughout substantially the entire height thereof so as to define a collecting pocket within said reentrant angle.

5. The invention as set forth in claim 4, each of said baffle means having its outer edge spaced from said opposing salient angle of an adjacent electrode by a distance substantially equal to the perpendicular distance between the opposing substantially flat portions of adjacent electrodes.

6. The invention as set forth in claim 4, each of said baffle means comprising a narrow flat strip projecting substantially in the direction toward said opposing salient angle of an adjacent electrode.

7. The invention as set forth in claim 4, each of said baffle means comprising a channel shaped member having its open side disposed toward the direction from which the gas is passed through the apparatus.

8. The invention as set forth in claim 4, each of said collecting electrodes being further provided with means defining additional collecting pockets adjacent the salient angles thereof.

9. In an electrical precipitator, a plurality of collecting electrodes of zigzag shape characterized by sharp angles and flat portions between adjacent angles said collecting electrodes being disposed parallel to one another with their angles extending substantially vertically and opposite those of adjacent electrodes, discharge electrode means disposed between the respective collecting electrodes, means for passing gas substantially horizontally between said collecting electrodes, and baffle means projecting outwardly from the reentrant angles of said collecting electrodes and defining collecting pockets lying within said reentrant angles.

10. In an electrical precipitator, a plurality of collecting electrodes of zigzag shape having their angles extending substantially vertically and the salient angles of each electrode disposed opposite the reentrant angles of each adjacent electrode, means defining collecting pockets within the reentrant angles of the respective electrodes, and means providing additional collecting pockets adjacent the salient angles of the respective collecting electrodes.

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