

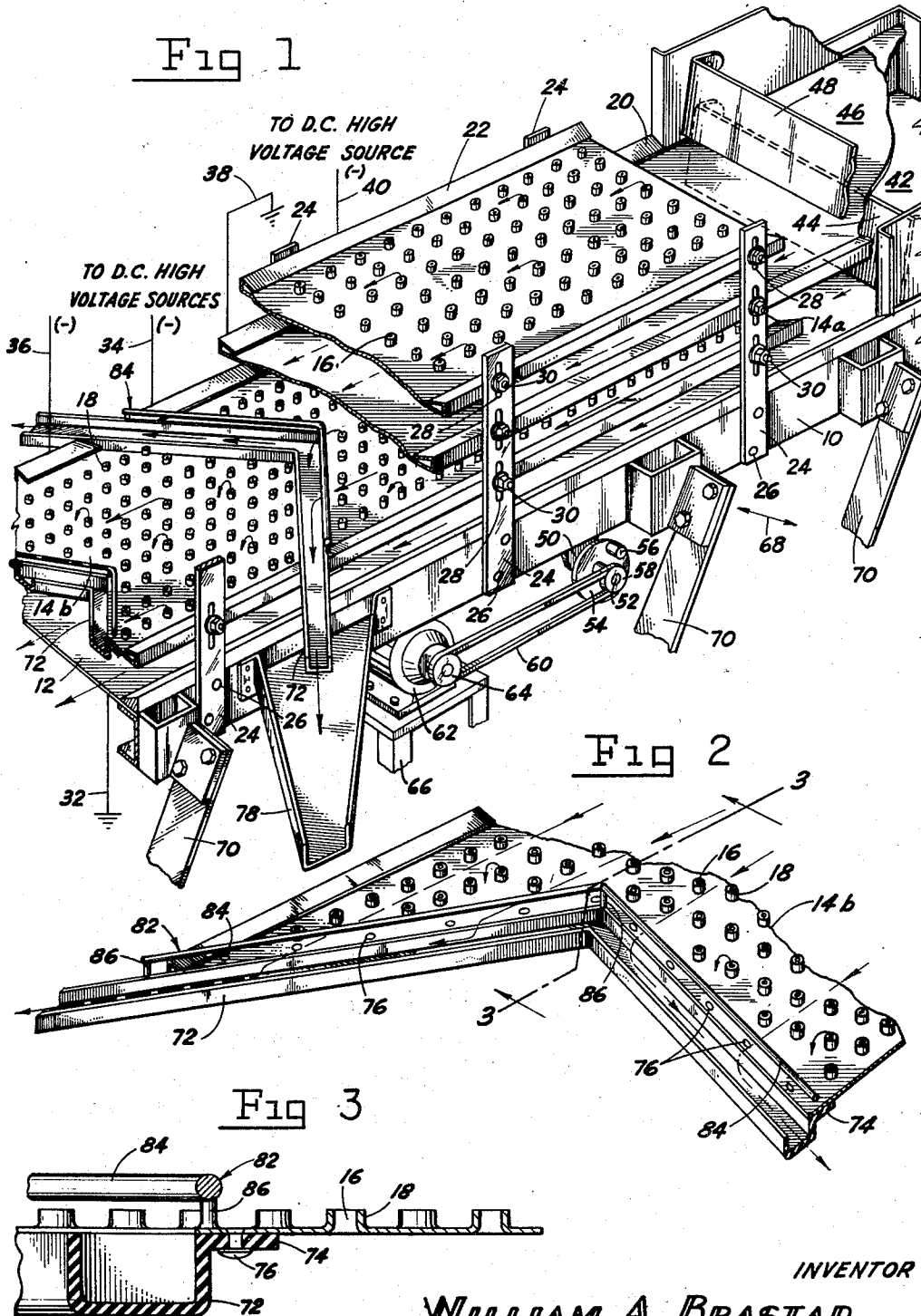
Aug. 12, 1958

W. A. BRASTAD
SUPPRESSOR ELECTRODE FOR A PERFORATED TYPE
OF ELECTROSTATIC SEPARATOR MACHINE

2,847,124

Filed Feb. 8, 1955

3 Sheets-Sheet 1



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Fig 4

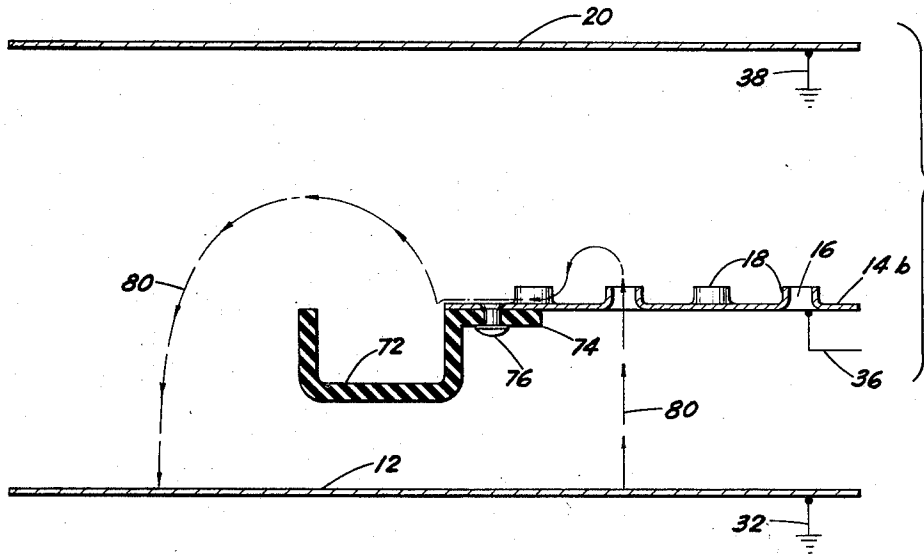
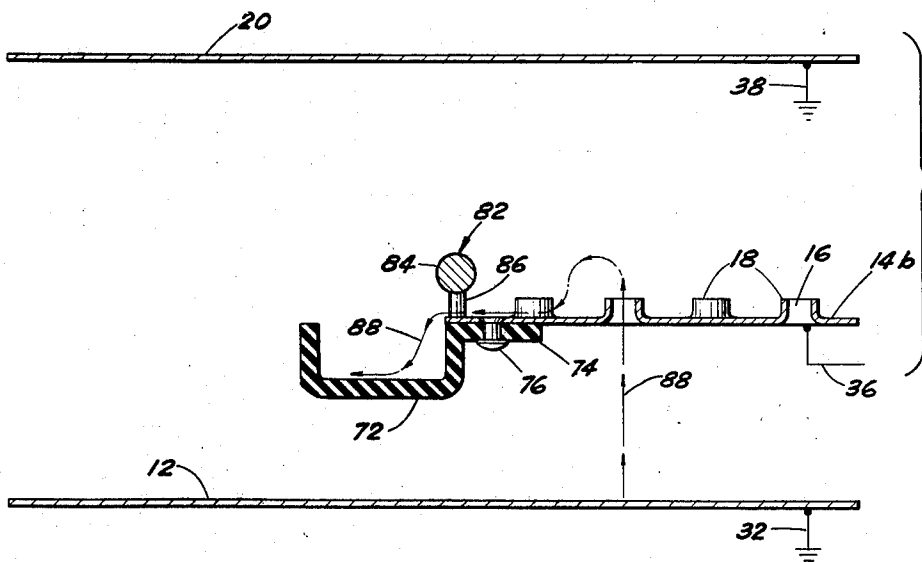


Fig 5



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Fig 6

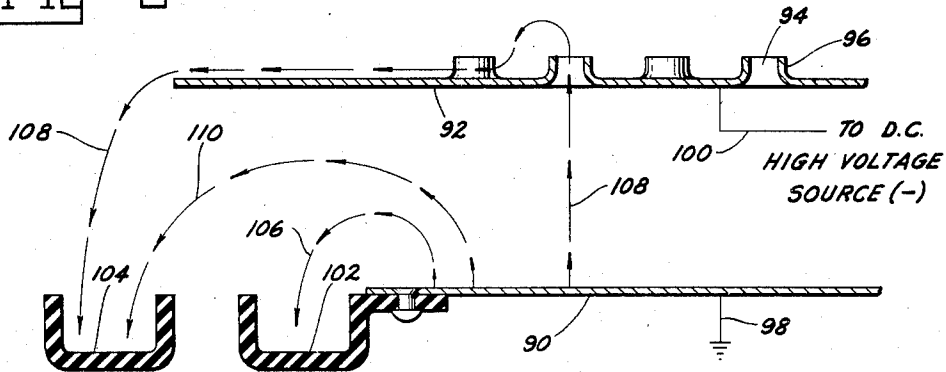
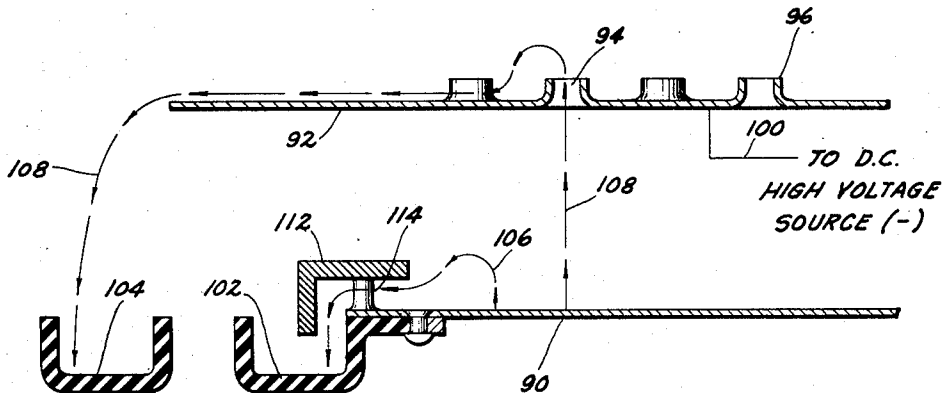


Fig 7



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2,847,124

SUPPRESSOR ELECTRODE FOR A PERFORATED TYPE OF ELECTROSTATIC SEPARATOR MA- CHINE

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eral Mills, Inc., a corporation of Delaware

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14 Claims. (Cl. 209—127)

This invention relates in general to electrostatic separators and pertains more particularly to apparatus of this type which has been found especially suited for electrostatically separating cereal stocks.

One object of the invention is to provide an electrostatic separator capable of simultaneously performing multiple separations without danger of intermixing or remixing the segregated or classified material, even though spacings exist which would otherwise provide avenues of communication between the various fractions. More specifically, the invention recognizes the presence of intensified electrostatic fields in certain regions where collections are being made, the direction of such fields by reason of the proximal relationship of the several electrodes diverting portions of the separated material in such a manner that they are likely to be remixed, thereby reducing the ultimate purity or quality of classification. To obviate such a happening, it is contemplated that the electrostatic field undesirably present between one plate of one pair of electrodes and the plate adjacent thereto of opposite polarity belonging to a different pair of electrodes be displaced or reoriented so that the highly concentrated field condition will not exist in the more vulnerable locations.

Accordingly, one object of the invention is to employ what might be best termed a suppressor electrode which is instrumental in shifting or diverting the otherwise high intensity field between pairs of electrodes so it will no longer adversely affect the process of separation. In this regard, the invention will be particularly useful where the electrodes are stacked one above the other.

Also, by utilizing what has been referred to as a suppressor electrode, it is possible to arrange the various plate electrodes in close proximity to each other so that a compact and rugged separator is produced.

Another very important object of the instant invention is to use only a single vibratory mechanism for the various electrode plates, the electrodes all being vibrated in unison, although the apparatus is possibly being used simultaneously for the separation of different materials. In this way, the cost of the equipment measured in relation to the total output therefrom can be kept at a very low figure.

A further object is to provide separating apparatus of such flexible and universal character that various gradations of separation can be achieved as the material passes longitudinally through the machine. Stated otherwise, by longitudinally spacing certain of the electrodes with respect to each other, different values of potentials may be applied at different locations, thereby rendering one section of the machine selective for one material while another section is separating out from the original mass a component having a different characteristic.

Still further, it is conceivable that the suppressor electrode will find utility at the discharge end of the lower of a pair of parallel electrodes, mainly in this situation to prevent any possible attraction or jumping up of the particles from the lower electrode in this region of dis-

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charge so that these particles will not fall in with those being collected from the upper electrode.

Briefly, the present invention concerns the employment of substantially parallel plate electrodes by reason of which the material is separated into preferred classifications. However, in carrying out this idea the adjacency of certain plates relative to each other creates an undesirable electrostatic field problem and to combat this undesirable effect it is within the purview of the invention to employ a suppressor electrode in the form of a generally transversely extending bar, rod or angle member at the discharge end of certain plates. The suppressor electrode is slightly raised above the plate with which it is associated and in this way the material readily passes thereunder and will be discharged closely adjacent the end of the plate-like electrode to which the suppressor member is attached.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists of features of construction, combination of elements and arrangement which will be exemplified in the construction hereafter set forth and the scope of the application which will be indicated in the appended claims.

In the drawings:

Figure 1 is a perspective view showing the salient parts of the electrostatic machine forming the subject matter of the instant invention, portions thereof being broken away to disclose underlying parts;

Fig. 2 is a fragmentary perspective view, slightly enlarged, illustrating in more detail the arrangement of the suppressor electrode;

Fig. 3 is a sectional view taken in the direction of line 3—3 of Fig. 2;

Fig. 4 is an elevational view in section showing the machine with the suppressor electrode removed;

Fig. 5 is a view corresponding to Fig. 4 but showing the suppressor electrode installed thereon;

Fig. 6 is a view somewhat analogous to Fig. 4 illustrating a slightly different problem that the invention is capable of overcoming; and

Fig. 7 shows a solution to the problem typified in Fig. 6. Referring now in detail to Figure 1, the exemplified electrostatic apparatus there shown includes a frame bearing the reference numeral 10. Attached to the upper side of this frame is a first electrode plate 12 extending the full length of the frame. At an elevation above this electrode is a pair of longitudinally spaced electrode plates 14a and 14b. These electrode plates 14a and 14b are of generally similar construction, each having numerous apertures 16 and being readily formed by a punching operation which leaves an upstanding cylindrical wall or collar 18 circumscribing each aperture. As will presently be made clear, the various cylindrical walls 18 should be of a height sufficient to preclude the return of separated material downwardly through the apertures 16 once the material has been elevated onto the upper face of the electrode 14a or 14b.

While the specific number of electrode plates will depend chiefly upon the type and quantity of separation or classification to be undertaken, the invention will find appreciable advantage when the various plates are vertically arrayed so as to produce a stacked arrangement. Therefore, at an elevation above the electrode 14a is another electrode plate 20, resembling in function the electrode plate 12, and above the electrode plate 20 is shown still another electrode plate 22, corresponding to the electrode 14a.

All of the aforementioned electrode plates are retained at preferred elevations by reason of a number of upstanding studs 24 of insulating material so that the various plates or electrodes may be maintained at dif-

ferent operating potentials. Anchoring the studs 24 to the frame 10 are a series of rivets 26. However, since the various electrodes are to be held at preferred elevations with respect to each other, which elevations depend largely upon the material undergoing separation and the applied electrical potentials, each stud is provided with a plurality of slots 28. Issuing outwardly through these slots is an equal number of nuts and bolts collectively indicated by the numeral 30. In this way, the electrode plates may be adjusted for optimum spacings with respect to each other.

As shown in Figure 1, the lowest electrode 12 is maintained at ground potential by means of a conductor element 32. The more negative electrodes 14a and 14b, on the other hand, are maintained at high D. C. potentials by means of separate conductors 34 and 36. In this regard, it may be pointed out at this time, although more will be said later about this, that by having the electrodes 14a and 14b electrically isolated from each other, the two electrodes need not be subjected to the same voltage conditions. While the potential or potentials to be applied to the electrodes 12, 14a and 14b will vary in accordance with the particular material to be segregated, nonetheless it might be mentioned that where the purification of comminuted wheat stock is desired, then a potential difference of from approximately 1,500 to 5,000 volts per inch of electrode spacing has been found satisfactory. Actually, an optimum physical spacing of the electrodes has been found to produce very satisfactory results when such spacing is from one-half to one inch.

For the purpose of increasing production of purified stock, the invention contemplates the stacking of electrodes, as already brought out. Therefore, the electrodes 20 and 22 have been mentioned. Since the electrode 20 corresponds in function to the electrode 12, it is grounded by means of a conductor 38 and the other electrode 22, which is apertured and resembles the electrode 14a, is connected by a conductor 40 to a D. C. high voltage source, which may or may not be a voltage of the same value as that impressed upon either of the electrodes 14a or 14b, any difference depending upon the particular separation to be made.

At one end of the electrode 12 is a bin or hopper 42, the electrode forming the floor thereof, provided with a hinged gate 44 for releasing in a controlled manner a stream of material to be separated. A similar hopper 46 is superimposed upon the first hopper, the electrode 20 serving as the floor in this instance, and is likewise equipped with a hinged gate, which is designated by the numeral 48. Because of limited drawing space, these hoppers have been only fragmentarily depicted, but it is thought that sufficient structure has been presented to illustrate clearly that material stored in the lower hopper 42 is available for feeding along the upper face of the electrode 12, whereas material contained in the upper hopper 46 will pass along the upper surface of the electrode 20.

To cause material to advance or progress along the electrodes 12 and 20 it is contemplated that some form of vibrating mechanism be employed. A number of such mechanisms are available, and while the mechanism might equally well be a conventional electromagnet one, the one selected for illustration is of the unbalanced rotary type. Accordingly, a pair (one of which is visible) of spaced bearing brackets 50 journal a transverse shaft 52. Rotatable with the shaft 52 is a disk 54 at each end thereof, each disk carrying a single offset or unbalanced weight 56. Also fixed to the shaft is a sheave 58 over which is trained a belt 60. Means for driving the belt 60 includes an electric motor 62 having a sheave 64 about which the belt is engaged, the motor being mounted on a stand 66 which may, if desired, be separate from the frame 10. Thus when the motor 62 is energized the frame is rapidly vibrated and hence the

various electrodes supported thereon. Vibration of the frame 10 and its electrode superstructure is guided in the direction of the arrow 68, involving both vertical and horizontal components, by a plurality of resilient spring members 70, the upper ends of these spring members being connected to the frame and the lower ends being fixedly mounted to a base or platform (not shown).

Due to the vibration of the frame in the direction indicated by the numeral 68, it will be appreciated that material from both hoppers 42 and 46 is moved along the electrodes 12 and 20 and at the same time is jostled about so that the particles thereof continually jump up and down. This procedure results in certain of the particles accumulating electrostatic charges that result in their being attracted upwardly toward the respective electrodes 14a and 22, some of which particles pass through those apertures 16 nearest the hoppers and others of which remain for some time in the neighborhood of the electrodes 12 and 20 before being propelled through any of the apertures 16. However, since there is a large number of apertures 16, an appreciable amount of separation will take place as the material is advanced along the electrodes.

Each of the electrodes 14a and 14b is shown in Figure 1 to be provided with a trough 72 and the electrode 22 in practice would be similarly equipped. By having the troughs 72 constructed of dielectric material, even though these troughs depend downwardly toward the electrode 12, the electrostatic field existing between the vertically spaced electrodes is not adversely intensified. Also, between the electrodes 14a and 14b, as hereinbefore mentioned, the use of an insulating trough electrically isolates these two electrodes, permitting different potentials to be applied. In this way, the electrode 14a might be utilized in separating out one particular fraction of the original material, whereas the electrode 14b would be available for separating out another fraction, merely by having, say, the electrode 14b at a higher D. C. potential with respect to the electrode 12 than is the electrode 14a.

From Figures 2 and 3, it can be discerned that each trough 72 is equipped with a lateral flange 74, this lateral flange being shown fixedly anchored to the electrode 14b by means of a plurality of rivets 76. As already indicated, by having the troughs of insulating or dielectric material, such as plastic, the troughs will not distort the electrostatic field due to the downward projection thereof in the way that a metallic one would.

In the embodiment illustrated, the trough 72 associated with the electrode 14a discharges into a chute 78 which is attached to one side of the frame 10. Since the trough is of angular configuration when viewed from above, another such chute would be provided on the opposite side of the frame, and the other trough might be similarly equipped, though such additional chutes are not pictured. It might be stated at this time, too, that the top electrode 22 in actual practice would have a similar trough associated therewith. At any rate, it can be seen that the material that has been projected onto the upper side of the electrodes 14a and 14b will be maintained in a segregated condition by virtue of the inclusion in the apparatus of the troughs 72. Likewise, material passing up onto the electrode 22 will be kept separated from that remaining on the electrode 20.

While the stacking of a plurality of electrodes, one above the other, is to be desired, both from the viewpoint of saving space and also to utilize a single vibratory mechanism, nonetheless this arranging of electrodes carries with it a distinct disadvantage in the form of an unwanted electrostatic field. The field referred to stems primarily from the fact that in the illustrated embodiment the electrodes 14a and 14b, which have been indicated as being of negative polarity, are closely adjacent the electrode 20, which is of opposite polarity. As far as electrostatically separating material is concerned, it

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is desirable that the electrodes 14a and 14b be of opposite polarity from the electrode 12 in order to have certain of the material particles pass upwardly through the electrodes 14a and 14b. However, the particles, once they have passed through either electrode 14a or 14b onto the upper surface thereof, should thereafter not be subjected to electrostatic fields, at least a field of such intensity that might cause the particles on these longitudinally spaced electrodes to be attracted upwardly as they reach the end of either of them.

In the case of the electrode 14a, assuming that the electrode 14b is being utilized to separate out a different fraction of material, any elevating or jumping up of the particles that have been projected up onto this electrode 14a is to be avoided in the region of the trough 72 associated therewith, for some of such particles would have sufficient impetus to hop over the trough onto the electrode 14b where a fraction possessing different characteristics is being accumulated, thereby contaminating this other fraction. More importantly yet would be the situation applying to the electrode 14b and its trough 72, because any jumping up of the particles on the last mentioned electrode in the region of the trough of this electrode would result in some of them leaping over the trough, falling back onto the electrode 12. Quite obviously, such a remixing of material could not be tolerated.

To illustrate more specifically what is meant, reference should now be had to Figure 4, where it will be observed that a trajectory of arrows 80 indicates a probable path that the material from the electrode 14b is likely to follow. Not every particle, of course, would traverse such a path, but a sufficient number of particles are apt to be elevated and urged forwardly so that instead of dropping into the trough 72, these particles leap over the trough and fall back onto the lower electrode 12, since the electrode 14b is last. Quite obviously, this course of action is most undesirable and it is with the correction or elimination thereof that the present invention is primarily concerned.

To obviate the foregoing condition, it is within the purview of the invention to provide a suppressor electrode 82 situated in this vulnerable region. The suppressor electrode 82 comprises a rod or bar 84 supported in a slightly elevated relationship with the electrode 14b by means of several upstanding metallic posts 86. Due to the presence of the suppressor electrode 82, the electrode 20 can be in fairly close proximity to the electrode 14b, the intense field that would otherwise exist by reason of the sharp edge at the discharge end of the electrode 14b extending from this suppressor electrode 82 to the electrode 20 next above rather than from the electrode 14b to said electrode 20. Accordingly, the material passing along the upper side of the electrode 14b will not enter the above-mentioned intense field extending from the suppressor electrode upwardly to the electrode 20, but will pass under the strong field inasmuch as the rod 84 is raised somewhat above the electrode 14b. In order to contrast the action occurring in Figure 4, this figure, as already stated, showing the apparatus without the suppressor electrode 82, a sequence of arrows 88 has been used in Figure 5 where the suppressor electrode has been depicted. Therefore, from Figure 5 it can be seen that the material on the electrode 14b merely advances along this electrode and under the suppressor electrode 82, the material dropping immediately by gravity into the trough 72 upon reaching the discharge edge of the electrode 14b. There is no likelihood whatsoever that any material will leap over the trough as is the case where the suppressor electrode is omitted. Accordingly, no material will fall down onto the electrode 12 and no remixing or intermixing of the material ensues.

As a result of the foregoing description of the action taking place with and without the suppressor electrode 82 as applied to electrode 14b (Figs. 4 and 5), it is

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thought that the reason for another suppressor electrode 82 adjacent the trough 72 of the electrode 14a will be readily understood. Since the suppressor electrodes on both the electrode plates 14a and 14b are identical and bear the same reference numerals, further description of the one associated with the electrode 14a is felt to be unnecessary, since its function is to prevent particles from leaping over the trough onto the electrode 14b rather than onto the electrode 12 as with the more fully described suppressor electrode associated with electrode 14b.

From the foregoing description it is believed that the functioning of my apparatus will be readily understood. However, to help in understanding the manner in which the apparatus functions, a typical separating operation will be described. Assuming that comminuted wheat stock is to be separated and that the elevated electrodes 14a and 14b are positioned at the proper vertical distance above the lower electrode 12 by means of the adjusting nuts and bolts 30 and that the proper voltage is applied to the electrode plates, then the vibratory mechanism 52, 54, 62 may be started. The functioning of the vibratory mechanism is instrumental in vibrating the entire apparatus in the direction of the arrow labeled 68. The vibration causes the material placed in the bin 42 to exit therefrom via the underside of the gate 44 and to advance along the electrode 12. Continued advancement and jostling of the material particles soon cause them to accumulate induced electric charges of appropriate magnitude and in the specific case of comminuted wheat stock, which stock contains pure bran particles, pure endosperm and particles in which both bran and endosperm are attached in varying proportions, the invention contemplates that the brannier fraction will be attracted to the upper electrode 14a, thereby becoming separated from the predominantly endosperm material, inasmuch as these more branny particles gather charges of different magnitude than do the endosperm particles. Consequently, the more branny particles will be attracted upwardly toward the electrode 14a with the ultimate result that a great majority of these brannier particles will pass through the apertures 16 onto the upper face of the electrode 14a. Their continued movement in a direction away from the bin 14 will cause them to drop into the first trough 72 and thus they are discharged in a manner by which they can be collected separately.

The removal in the exemplified operation leaves endosperm and other particles in which both bran and endosperm are attached together on the lowest electrode 12. It might be that an intermediate fraction is desired, such a fraction suggestively containing particles of both bran and endosperm. Therefore, if desired, the electrode 14b may be at a still higher potential in order to effect the separation of these intermediate particles from endosperm ones. Ultimately, the particles leaving the electrode 12 at the end thereof remote from the bin or hopper 42 will have substantially the quality or characteristic desired, other fractions being removed via electrodes corresponding to the electrodes 14a and 14b. The other hopper or bin 46 houses material to be introduced onto the electrode 20. The electrode 20, it will be remembered, is fixedly mounted by means of the insulated studs 24 to the frame 10 so that it will be vibrated in unison with the bottom electrode 12. By reason of the same electrostatic action, coupled with the vibratory movement, the material passing along the electrode 20 will be separated via the apertures 16 in the top electrode 22. However, as hereinbefore indicated, the presence of the electrode 20 will not react adversely with the electrodes 14a and 14b as far as producing unwanted field concentrations in the region of the troughs 72 because of the suppressor electrodes 82 and the material intended to fall into these troughs will do so.

It is envisaged that in some instances, depending to a

certain extent upon the manner in which the discharge from the electrodes is brought about, that the utilization of a suppressor electrode 82 will find favor on the lower electrode of a single pair of electrodes or upon the lower of each of a plurality of pairs of vertically arrayed electrodes. In such instances any suppressor electrodes would be instrumental in reducing the field intensity at the discharge edges of the electrodes to which they would be attached, thereby preventing undesired upward movement between electrodes which are designed to coact with each other.

To illustrate pictorially a situation where a suppressor electrode will find utility when associatedly coupled with the lower of a pair of electrode plates, attention should now be shifted to Figs. 6 and 7. In this instance we will assume that we are dealing with the extreme end or final discharge station of a pair of electrodes 90 and 92, the lower electrode 90 corresponding to the earlier-described electrode 12 and the upper electrode corresponding in function to either the electrode 14a or 14b. To let the elevated material pass onto the upper side of the electrode 92, this electrode is provided with apertures 94 formed by upstanding collars 96. As with the aforementioned electrodes 12 and 14 these present electrodes are connected to a source of electrical potential by conductors 98 and 100, the conductor 98 leading to ground and the other to a high D. C. negative voltage.

Attached to the lower electrode 90 is a transverse trough 102 and spaced under the upper electrode 92 is another trough 104. These troughs or receptacles can be of any preferred configuration, dependent primarily upon the shape of the discharge edges of the electrodes 90 and 92. For the sake of discussion, it will be assumed that the discharge edges are straight or linear and that the troughs are rectangular when viewed from above.

From Fig. 6 it can be discerned that some of the particles that should drop into the trough 102 do not necessarily do so, instead leaping completely over this trough and either falling into the trough 104 or possibly missing it, but in either event being lost as far as their proper collection is concerned. Accordingly those particles following desired paths have been designated by arrows bearing numerals 106 and 108, whereas those particles traversing a path to be avoided have been given the numeral 110.

Correction of the above, i. e., elimination of the trajectory 110, is achieved by attaching a suppressor electrode 112, depicted in the form of a bar or strip having an angular cross-section. As with the already described electrodes, the instant one may be supported by a plurality of metallic posts 114 extending upwardly from the electrode 90. The presence of the suppressor member 112 influences or modifies the electrostatic field in this region so that the particles following the path 110 in Fig. 6 instead combine with those that comprise the path 106, the combined flow passing readily under the electrode 112 without the jumping up action that transpired in Fig. 6. In this way those particles intended to be collected in the trough 102 and those intended to be collected in the trough 104 will be so collected without objectionable intermingling and without loss due to missing the trough 104.

In conclusion, it will be understood that while only a relatively limited number of electrodes have been pictured, nevertheless additional electrodes might be used depending upon the circumstances and the multiple separating procedures desired. Therefore, it will be recognized, though presented in specific form, that my apparatus is susceptible to a wide number of uses as far as the classification of granular material is concerned. Therefore, as many changes could be made in the above construction and many apparently widely different embodiments of the invention could be made without departing from the scope thereof, it is intended that all

matter contained in the above description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

I claim as my invention:

1. An electrostatic separator comprising spaced upper and lower electrodes, the upper electrode having a plurality of openings therein through which material attracted from the lower electrode may pass onto the upper surface of the upper electrode, means for feeding a stream of material along the lower electrode, means for maintaining a difference of potential between the electrodes, suppressor means including an elongated member disposed above one of said electrodes and adjacent the discharge edge thereof, and means for maintaining said elongated member at substantially the same potential as the electrode with which it is associated to reduce thereby the field intensity in the region of said elongated member and thus prevent undesired upward movement of particles in said region.

2. An electrostatic separator comprising spaced upper and lower electrodes, the upper electrode having a plurality of openings therein through which material attracted from the lower electrode may pass onto the upper surface of the upper electrode, means for feeding a stream of material along the lower electrode, means for maintaining a difference of potential between the electrodes, a trough associated with one edge of the upper electrode for collecting the material that has passed onto said upper electrode, suppressor means including an elongated member disposed above one of said electrodes adjacent the discharge edge thereof, and means for maintaining said elongated member at substantially the same potential as said one electrode.

3. An electrostatic separator comprising spaced upper and lower electrodes, the upper electrode having a plurality of openings therein through which material attracted from the lower electrode may pass onto the upper surface of the upper electrode, means for feeding a stream of material along the lower electrode, means for maintaining a difference of potential between the electrodes, a trough associated with one edge of the upper electrode for collecting the material that has passed onto said upper electrode, suppressor means including an elongated member disposed above said upper electrode adjacent said one edge, and means for maintaining said elongated member at substantially the same potential as said upper electrode.

4. An electrostatic separator comprising substantially parallel upper and lower electrodes, the upper electrode having a plurality of openings therein through which material attracted from the lower electrode may pass onto the upper surface of the upper electrode, means for feeding a stream of material along the lower electrode, means for maintaining a difference of potential between the electrodes, a trough affixed to one edge of the upper electrode for collecting the material that has passed onto said upper electrode, and suppressor means including an elongated metallic bar disposed adjacent one edge of the upper electrode and upstanding metallic posts for supporting said bar at an elevation along the upper electrode and for maintaining said bar at the same potential as said upper electrode.

5. An electrostatic separator comprising a plurality of first and second electrodes alternately spaced one above the other, said second electrodes having a plurality of openings therein through which material attracted from each first electrode next below may pass onto the respective upper surfaces of said second electrodes, means for feeding a stream of material along each first elec-

trode, means for maintaining a difference of potential between the first and second electrodes, a trough supported at one edge of each of the second electrodes for collecting the material that has passed onto said second electrodes, elongated electrically chargeable means mounted between selected first and second electrodes near said one edge, and means for maintaining said elongated means at substantially the same potential as said second electrodes.

6. An electrostatic separator comprising a pair of first and a pair of second electrodes alternately spaced one above the other, said second electrodes having a plurality of openings therein through which material attracted from each first electrode may pass onto the second electrode next above, means for feeding a stream of material along each first electrode, means for maintaining a difference of potential between the first and second electrodes, a trough supported at one edge of each of the second electrodes for collecting the material that has passed onto said second electrodes, an elongated metallic bar disposed above the lower of the two upper electrodes near said one edge, and a plurality of upstanding spaced metallic posts for retaining said bar at an elevation above the lower of the two upper electrodes and for maintaining said bar at the same electrical potential as the electrode on which it is supported.

7. An electrostatic separator comprising a pair of vertically spaced electrodes at one potential, a pair of longitudinally spaced electrodes intermediate said vertically spaced ones provided with a plurality of openings therein through which material attracted from the bottom one of said vertically spaced electrodes may pass onto the intermediate electrodes, means for feeding a stream of material along said bottom electrode including a bin for containing the material, a trough at the far edge of each of the intermediate electrodes for collecting the material that has passed onto said intermediate electrodes, an elongated metallic bar disposed above each intermediate electrode adjacent the edge thereof nearest its associated trough, and means for maintaining said bars at substantially the same electrical potential as that intermediate electrode with which the bar is associated.

8. An electrostatic separator in accordance with claim 7 in which said troughs are of dielectric material and said last-mentioned means include a plurality of metallic posts retaining said bars at a preferred elevation above the intermediate electrodes with which they are associated.

9. An electrostatic separator in accordance with claim 8 in which said troughs are of angular configuration with their apices pointing in the direction of said bin and said bars are of similar angular configuration.

10. An electrostatic separator comprising spaced upper and lower electrodes, the upper electrode having a plurality of openings therein through which material attracted from the lower electrode may pass onto the upper surface of the upper electrode, means for feeding a stream of material along the lower electrode, means for maintaining a difference of potential between the electrodes, suppressor means including an elongated member spaced

with respect to one of said electrodes and located adjacent the discharge edge thereof, and means for maintaining said elongated member at a preferred potential, which potential will reduce the field intensity in the region of said elongated member and thus prevent undesired displacement of particles in said region in a direction having a component normal to said electrodes.

11. An electrostatic separator comprising spaced upper and lower electrodes, the upper electrode having a plurality of openings therein through which material attracted from the lower electrode may pass onto the upper surface of the upper electrode, means for feeding a stream of material along the lower electrode, means for maintaining a difference of potential between the electrodes, suppressor means including an elongated member associated with one of said electrodes and located adjacent the discharge edge thereof, and means for maintaining said elongated member at substantially the same potential as the electrode with which it is associated to reduce thereby the field intensity in the region of said elongated member and thus prevent undesired upward movement of particles in said region.

12. An electrostatic separator comprising spaced upper and lower electrodes, the upper electrode having a plurality of openings therein through which material attracted from the lower electrode may pass onto the upper surface of the upper electrode, means for feeding a stream of material along the lower electrode, means for maintaining a difference of potential between the electrodes, a receptacle disposed beneath one edge of the upper electrode for collecting the material that has passed onto said upper electrode, a second receptacle associated with one edge of the lower electrode for collecting the material that has passed along this electrode, suppressor means including an elongated member disposed above the lower electrode adjacent one edge thereof, and means for maintaining said elongated member at substantially the same potential as said lower electrode.

13. An electrostatic separator in accordance with claim 12 in which said suppressor electrode is of angular cross-section.

14. An electrostatic separator comprising spaced upper and lower electrodes, the upper electrode having a plurality of openings therein through which material attracted from the lower electrode may pass onto the upper surface of the upper electrode, means for feeding a stream of material along the lower electrode, means for maintaining a difference of potential between the electrodes, suppressor means including an elongated member disposed above the lower of said electrodes, and means for maintaining said elongated member at substantially the same potential as said lower electrode to reduce thereby the field intensity in the region of said elongated member and thus prevent undesired upward movement of particles in said region.

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