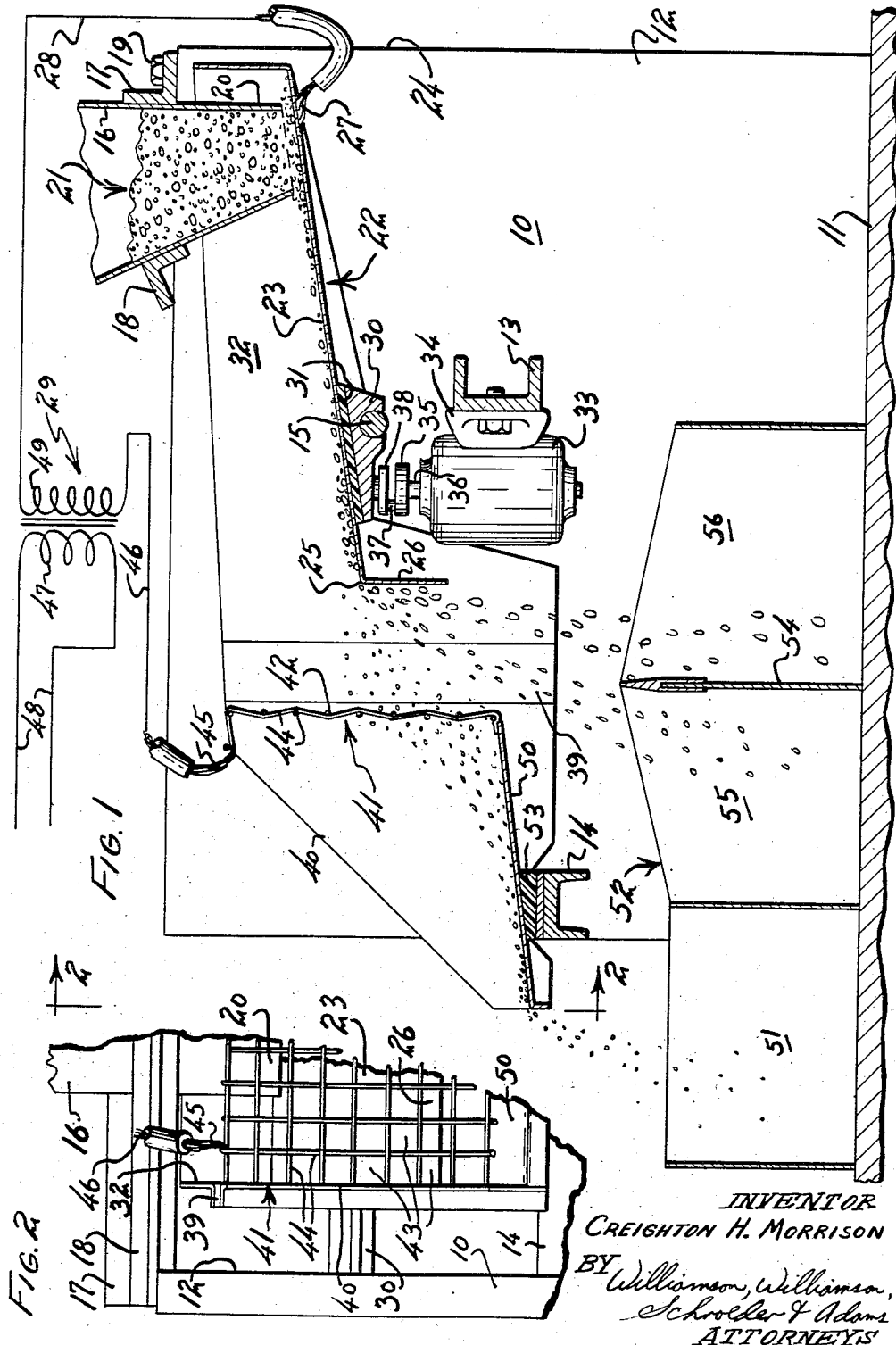


Aug. 20, 1957

C. H. MORRISON
MIDLINGS SEPARATOR

2,803,344

Filed Nov. 18, 1954



2,803,344

MIDDLINGS SEPARATOR

Creighton H. Morrison, Statesville, N. C.

Application November 18, 1954, Serial No. 469,601

6 Claims. (Cl. 209—127)

This invention relates to the classification of particles and more particularly to an electrostatic separator for fractions of a middlings mixture such as produced in the milling of wheat.

In prior art practice a number of electrostatic machines have been developed for the separation of particles by electrostatic means. The more simple of these machines are directed to the separation of particles of low density from those of heavy density, or of metallic particles from non-metallic particles. The problem of electrostatically separating various portions of berries or kernels of grain presents more serious aspects because of the non-metallic character of the fragments and further because of close density between certain of the fractions. In United States Patent No. 2,615,570, issued October 28, 1952, my invention for a middlings purifier is set forth, and there is disclosed in this patent an apparatus in which cereal stock is fed downwardly between two parallel electrodes which are formed into step-like plates and provided with slots in the uppermost of the two electrodes. The general purpose of the apparatus therein set forth is to effect a continuous separation of the cereal stock in an electrostatic field during downward descent between the parallel electrodes. The branny fraction is caused to jump upwardly toward the uppermost electrode and to pass through an appropriate slot formed therein and thence into a space not subjected to an electrostatic field which the branny particles may be subsequently removed. The slots form but a small part of the total area of the upper stepped electrode and if any individual branny particle failed to pass through a given slot, it would drop back to the stream of cereal stock and be again attracted as the stream progressed over the edge of the next step. It is presumed that substantially all of the branny particles will be projected through the slots by the time the cereal stock has progressed to the end of the stepped electrode system. The remainder of the cereal stock in the meanwhile has been caused to stratify as the stock progresses over the steps under the gravitational influence of the downward disposition of the electrodes and further by the application of lateral shaking or vibration. These remaining particles will thus more or less stratify in accordance to their physical properties and the reason for this separation is not completely known. It is known, however, that there is no particular correlation of the electrostatic separation with density of the particles. The attraction probably is affected according to the ashy content since gray middlings and branny particles are more easily attracted in the electrostatic field. In my prior patent it was attempted to gain a simultaneous stratifying effect due to whatever difference in density existed while at the same time applying the electrostatic field thereto.

Other prior art devices have been shown for the separation of metal from non-metal particles and for dividing such fractions as finely ground ore into separate fractions for further processing. Some of these devices use traveling belts in connection with spaced electrodes and may

even employ additional physical means such as impinging or deflection plates for effecting a bounding of heavy particles into respective pathways which lead into product bins or collecting compartments. The electrostatic separators which are intended for use with dense particles such as heavy ores and metals are not at all suitable for the critical separation of non-metallic materials such as the middlings mixture produced in the milling of wheat. In addition, other prior art devices, including my apparatus disclosed in the above entitled patent, give trouble when it is attempted to separate the soft fraction of the wheat berry endosperm from soft grades of winter wheat used for cake, biscuits and the like as opposed to the hard wheat middlings employed for bread and the like. Furthermore, the prior art devices as a whole require careful control of the moisture content in the particle mixture to be separated electrostatically and, in some instances, require the material to be dried to as high a degree as possible. When soft wheat middlings of the class noted are separated in my prior apparatus, the soft fraction will behave erratically, often bounding into contact with the higher electrode plane, then returning to the stream of cereal stock progressing down the stepwise lower electrode. There seems to be an instantaneous change in the charge applied to each individual particle and, of course, the agitation imparted to the soft wheat middlings particles will disrupt the desired stratification of the cereal stock after branny particles have been separated therefrom, and where the moisture content is not controlled it becomes still more difficult to classify the soft wheat middlings. In the milling of flour, the humidity of the wheat berries is sought to be controlled for the influence it exerts on the breaking characteristics of the particles. Thus the miller regulates humidity in accordance with the most desirable reduction and classification of the particles. Unfortunately, the humidity control which is most desirable for reduction and screen classification may be entirely contrary to the humidity which will favor electrostatic separation by prior art means. Where material containing a larger percentage of moisture is sought to be classified in electrostatic separation equipment, it may become necessary to increase the voltage under otherwise similar conditions to get the same degree of attraction and proper separation of the particles. Where electrodes having comparatively large areas are positioned in spaced relation with a strata of cereal stock passing therebetween, increased voltage will render more critical the exact spacing of the electrode plates. If such plates have accidentally formed areas or positions which are closer than the surrounding areas, the electrostatic field will be concentrated at these closer positions, and the stock will tend to jump wildly at these points so as to disrupt the proper classification of the stream. By deliberately creating a number of controlled convergent and divergent areas between the electrodes, each such convergent and divergent area being uniform throughout the entire electrode width as in my previous invention, the benefits of a stronger field can be retained. The material, while tending slightly to lag at each step, will nevertheless maintain a uniform distribution horizontally across the electrodes. The lateral shaking or vibrating is, of course, common practice and will tend to assist in making uniform the lateral distribution of the stock while also aiding in stratification of the particle types. Although for some purposes my prior device was excellent, I still have difficulty with certain fractions such as the soft wheat endosperm mentioned above, in that these particles act wildly in such apparatus and sometimes bounce erratically upward and downward, gaining and losing charges and generally upsetting the orderly stratification of the remainder of the particles. Although branny particles may be fairly effectively removed through

the slots in the steps under such conditions, the other fractions will be poorly separated and the ultimate object of the apparatus thus be defeated.

If it is attempted to utilize in an electrostatic separator a single bar electrode spaced horizontally above a lower grounded electrode plate, the product capacity of the device is greatly reduced. Further, the electrostatic charge is concentrated at the closest plane between the bar and the grounded plate, and as before noted the stronger field may result in undesirable side effects from too great an electrostatic field so as to manifest themselves as, for example, in the above mentioned wild behavior of soft wheat endosperm.

My present invention contemplates the separation of particle fractions of critical properties such as those above mentioned in connection with soft wheat middlings. As far as I am aware I am the first, under the disclosure of the present invention, to be able to successfully separate the various fractions of soft wheat middlings such as obtained from soft winter wheat.

It is an important object of this invention to overcome the above noted disadvantages of prior art devices and practice, and to provide an electrostatic separator apparatus which will efficiently separate two or more fractions of cereal stock, even of such difficult and critical nature as soft wheat endosperm.

Another object of the invention is to provide an apparatus which will effectively separate dirt, dust, insect particles, etc., along with the branny particles of a wheat middlings mixture so that the branny fraction utilized for animal feed will contain any such impurities rather than the endosperm product which forms the base for food to be consumed by human beings.

A further object of the invention is to provide apparatus which will distinguish and selectively separate ash or imperfect middlings from the high quality middlings so that the latter may be sent directly to the rolls of a flour mill for the production of flour.

Another object is to provide electrostatic separation apparatus which will permit handling of a good capacity of middlings mixture at an elevated voltage, yet which will maintain clear-cut separation of particle fractions in a wide range of moisture content and at a voltage within a wide range.

A further object is to provide an electrostatic separation apparatus for a middlings mix in which an electrode thereof causes the light branny particles and impurities of the mix to pass through openings in the electrode while simultaneously influencing by deflection the remaining particle fractions during free fall to effect multiple separation without permitting or causing substantially any of the particles to bound, rub or change electrical potential during such free fall.

A still further object is to provide apparatus to effect electrostatic separation of wheat middlings fractions under improved control by employing a perforated electrode having substantially greater total area in the form of openings than in the form of solid structural material.

These and other objects and advantages of the invention will more fully appear from the following description made in connection with the accompanying drawings, wherein like reference characters refer to the same or similar parts throughout the views, and in which:

Fig. 1 is a more or less diagrammatic representation of my electrostatic separator taken in longitudinal section, it being understood that the width of the apparatus may be varied at will, the uniformity and relative positions of the feeding mechanism and electrodes remaining constant throughout the width of the apparatus; and

Fig. 2 is an enlarged segment of a portion of the transmitting and deflecting electrode showing a portion of the electrical conductor in its connection therewith.

Referring now more particularly to the drawing, my electrostatic separator has a supporting structure shown generally at 10 and preferably comprising a base 11 and

spaced side panels 12. Fig. 1 is somewhat diagrammatic in form and since all the members shown are disposed transversely of the sides of the separator 10, the entire device is shown in vertical section, it being understood that the portion which is cut away is of similar or duplicate structure and hence not shown in detail. Additional supporting members such as the cross braces 13, 14 and 15 may be secured between the side walls 12 of the device. Other covering structure and conventional conveying equipment, doors, and removable panels may be supplied as desired and are not considered to be a part of this invention.

It is preferred that a feed hopper 16 be positioned at the top of the supporting structure 10 and may be secured thereto by such means as the brackets 17 and 18 which in turn are mounted on the supporting structure by bolts 19 and by other fastening means such as welding. The feed hopper 16 is shown in part, the lower delivery end 20 thereof extending downwardly into the separator supporting structure 10 so as to deliver a quantity of pre-broken berries or grain particles, particularly a cereal mixture known as middlings mixture produced from wheat which may be either of the hard or soft variety as heretofore noted. The mass of middlings mixture is indicated generally at 21 and may be supplied to the spout 20 of the hopper 16 by batch operation or by continuous loading into the hopper.

The separator unit comprises a feeder mechanism shown generally at 22 which in turn comprises a slightly inclined plate or sheet 23 which is horizontal in a transverse line with respect to the side walls 12 of the supporting structure and having the previously mentioned downward pitch in a longitudinal direction extending from the rear wall 24 of the separator supporting structure 10 and terminating substantially at a horizontal edge 25 which extends for the operative width of the feeder mechanism. Immediately below and preferably formed integrally with the plate 23 at its forward edge 25 is an electrode plate 26, the plate having a forwardly facing surface preferably vertically disposed and lying horizontally across the separator structure as shown. It is contemplated that of the plate 23, electrode plate 26 and horizontal edge 25, at least the electrode plate 26 will be of conducting material. The apparatus may be slightly improved or given slightly different characteristics if the feed plate 23 is also unitarily formed with the electrode plate 26 and capable of functioning in its entirety as an electrode under a substantial charge of electricity. A terminal 27 is in electrical conductance with the electrode plate 26 and connects with a conductor 28 which is diagrammatically shown as leading to one pole of a source of high voltage electricity shown generally at 29. It is understood, of course, that this conductor 28 may be grounded if desired with respect to the opposite pole of the high voltage source which will be subsequently described. The feeder mechanism 22 also comprises a slide mount 30 which is mounted for lateral reciprocation upon the cross brace or shaft 15. A thickness of dielectric material 31 is interposed in supporting relation between the underside of feed plate 23 and the upper edge of the slide mount 30. Upstanding mounting plates 32 are formed at each side of the feed mechanism and are constructed of dielectric material so as to maintain the electrode plate 26 together with the conducting feed plate 23 in electrically insulated relation with other metallic parts of the separator. The dielectric walls 32 likewise form a support and confining structure which prevents the displacement of middlings mixture 21 from the side of the feed plate 23 as the material progresses downwardly toward the electrode plate 26. A motor 33 is mounted by such means as bolts 34 to a lateral brace 13, and is provided with an eccentric drive 35 mounted on the motor shaft 36, the eccentric drive 35 being provided with a crank pin 37 which drives an off-center rotary weight 38 which in turn is rotatably mounted in the slide mount 30 as shown.

The off-center or off-balance weight member 38 will provide a vibrating or lateral oscillation of the entire feeding mechanism and the mounting structure including the side walls 32 when the electric motor 33 is energized.

The dielectric side walls or panels 32 forming the supporting mount for the separator mechanism extend forwardly and downwardly to terminate in a lower edge 39 and further extend forwardly in an edge 40 at each side of the separator, the side walls or panels 32 obviously being maintained in sufficient clearance with the walls 12 of supporting structure 10 to permit the entire mechanism to oscillate or vibrate laterally without striking the sides thereof.

Also disposed laterally across the upstanding dielectric walls 32 is a transmitting and deflecting electrode 41 which has a rearwardly facing surface 42 in spaced parallel relation with the electrode plate 26 and with the horizontal upper edge 25, as shown in Fig. 1. The transmitting and deflecting electrode is provided with a multiplicity of openings 43 as shown in the enlarged segment of Fig. 2. It is intended that the openings 43 constitute a substantial portion of the total area of the transmitting and deflecting electrode and preferably amounts to a greater total area than that of the remaining electrode structure which comprises the electrode conductor material 44. I have found that a metallic screen having conventional wire structure of $\frac{1}{16}$ of an inch or less and having openings in the neighborhood of a quarter inch, performs satisfactorily in my apparatus. It is to be understood, however, that I may employ numerous other forms of electrode material in which a multiplicity of openings are uniformly dispersed through the surface of the electrode. For example, I have found useful a series of parallel bars extending from one side to the other in spaced relation and presenting openings considerably larger than the width of the bars themselves. It is understood, of course, that the ends of the bars will be interconnected so that they all may be supplied with appropriate electrical charge to effect the electrostatic separation to be subsequently described herein. In the form shown in Fig. 2, the side panels 32 are dielectric as previously noted, and may have the electrode screen 41 secured thereacross so as to be coextensive with the width between the walls of the feeder mechanism and the width of the electrode plate 26 which lies forwardly and downwardly from the feeder plate 23. A terminal 45 is formed on the conducting material 44 of the transmitting and deflecting electrode 41, and interconnects with conductor 46 which in turn leads to the source 29 of high voltage electricity. The source of high voltage current 29 may be a transformer having a primary coil 47 connecting with leads 48 from a suitable source of electrical power, and the secondary coil 49 interconnecting with the conductors 28 and 46 as previously noted. The operating voltage which I prefer lies in a range of from 1,000 up to 10,000 volts and preferably in the vicinity of 5,000 or 6,000 volts.

It will be noted that the transmitting and deflecting electrode screen 41 is arranged so that a substantial portion of the electrode extends upwardly beyond the horizontal plane which includes the edge 25 overlying the electrode plate 26, and a substantial portion thereof also lies below a horizontal plane of the nature described. The large area encourages passage of light particles as will be subsequently described and at the same time, because of the relatively large total area of space in comparison to the area of conducting material, will not unduly influence or cause middlings particles to bounce wildly from electrode to electrode, but rather will selectively exert a deflecting influence on those particles which are more easily attracted by electrostatic electricity than the remaining particles and accomplish the foregoing in an orderly and clearly defined manner.

Disposed forwardly of the transmitting and deflecting electrode 41 is a downwardly and forwardly extending

plate 50 which extends across and is connected to the forward ends of the mounting side walls 32 to define a chute terminating over chamber 51 of collecting means 52 shown generally in Fig. 1. The plate 50 is supported on a dielectric cushion 53 which in turn may be shiftably supported on the cross brace 14, and during sideways oscillation or vibration of the feeder mechanism and electrostatic electrodes will cause the particles passing screen electrode 41 to work downwardly along the plate and be discharged into the forwardmost collecting chamber 51.

The collecting means 52 further has a dividing element 54 which provides a common wall between chambers 55 and 56 as shown. The chamber 55 lies below the electrodes 26 and 41 and forwardly of the divider plate 54, while the collecting chamber 56 lies below the electrodes and to the rear of the divider plate 54. Divider plate 54 is at least as wide as the distance between dielectric walls 32 so that material falling downwardly from the electrostatic separating mechanism will not be accidentally cast to the side of chambers 55 and 56.

In the use and operation of my electrostatic separator, the cereal product such as middlings mixture 21 is supplied to the hopper 16 and permitted to flow downwardly toward the feed plate 23. Motor 33 is energized so as to vibrate the entire feeder mechanism and electrode structure and to cause a uniform layer of the middlings mixture to progress over the upper surface of feed plate 23 forwardly and downwardly to the horizontal edge 25 of the electrode plate 26. High voltage electrical current is supplied from source 29 to the electrode 26, or as previously noted, the electrode 26 may be grounded to achieve comparable results. The transmitting and deflecting electrode 41 is connected to the other pole of the high voltage source 29 so as to form the "hot" electrode of the electrostatic field. The screen electrode 41 is positioned in parallel relation with its surface disposed in the manner described and preferably several inches from the electrode plate 26. The middlings mixture as it reaches the upper edge 25 will begin to be influenced by the electrostatic field which exists between the electrodes. This is especially true because of the concentration of charge which will occur along the pronounced angular edge 25. Light particles will thus begin to move upwardly and forwardly from the middlings mixture, sometimes even before the material has progressed to the very edge 25. Thus, insect wings, dust and the like will first begin to separate and then the branny particles will fly forwardly in the electrostatic field as though impelled by a wind. Since the open area of my screen electrode 41 is so much greater than that of the stepped electrode disclosed in my previous patent, the light branny particles and imperfect matter mentioned will have no difficulty in seeking and passing through the openings of the screen. Furthermore, the area presented by face 42 is so great that the particles need not be re-collected for failure to find an opening. As soon as the light particles have passed through the openings 43 in screen electrode 41, they will be immediately outside the influence of an electrostatic field and will drop downwardly to the plate 50 from which they are advanced forwardly to fall into bin 51 under the lateral oscillation or vibration imparted to the entire mechanism. Furthermore, because of the depth of the screen electrode 41, the lighter particles will jump upwardly and forwardly to pass through the screen at a higher position, while the heavier branny particles will pass through the screen at a lower position and under a somewhat greater electrostatic force. The impure middlings such as ashy gray endosperm containing a higher mineral content and having portions of bran still attached thereto, will be influenced under the electrostatic field so as to be deflected toward the screen electrode 41. A relatively high voltage such as 5,000 to 6,000 volts may be applied to screen electrode 41, and if this electrode were to have any substantial areas of conducting material presented thereby, the electrostatic field would

be so concentrated as to cause these impure middlings to likewise strike or pass through the electrode 41. However, since the high voltage is applied to a conductor in a dispersed manner through the wires which form only a relatively small part of the total area, the particles will merely be deflected and not actually caused to strike the transmitting and deflecting electrode 41. The consequence is a forward movement of this impure class of middlings so that a distinct stream of particles in free flow will form above and forwardly of the divider plate 54 and will be collected in the collecting chamber 55 as indicated.

The good or pure middlings having a lower ash content and unattached to bran particles will be least affected in the electrostatic field and will drop substantially vertically of horizontal edge 25, through the electrostatic field without substantial forward movement and will, in free falling movement, collect rearwardly of the divider plate 54 in the collecting chamber 56. It will be noted that I do not rely upon stratification but rather have discovered how to effect a multiple separation of the particles in free suspension in the air, utilizing a particular type of electrode for actually collecting a light fraction of the material, and secondly by virtue of the location of the electrode to cause a selective deflection without contact on the remainder of the dropping material so that the said remainder will be further divided into separate and collectable streams.

It is within the contemplation of this invention to utilize a multiple-stage operation in which the branny particles passing through the transmitting and deflecting electrode 41 will be passed directly to feed, whereas the impure middlings collected in the chamber 55 may be further processed as by further grinding to free the particles from bran and then passing through one or more following stages to effect further separation in the manner noted. The good middlings collected in chamber 56 may be passed through a multi-stage operation wherein the entire feed and electrode arrangement is repeated, the multi-stage operation at each pass effecting further classification of the particles to produce an extremely pure product. I have found that still better results can be obtained by a multi-stage separation as noted above in which the electrode potential is maintained at about 5,000 to 5,500 volts through five stages of separation and then the good or pure middlings fraction is subjected to another five stages of similar nature except that the voltage is stepped up to around 6,000 to 7,000 volts. The final product is of such purity and quality as can be passed directly to the rolls for production of high grade flour.

It is to be understood, of course, that a great number of variations may be employed in apparatus for effecting multi-stage separation, and I do not wish to be bound by any particular structural arrangement for the accomplishment of such multi-stage separation. By way of example, the complete electrostatic separation may be accomplished as illustrated in the drawing and the products passed to similar devices positioned consecutively below the prior ones so as to utilize gravity flow. Another arrangement in the multi-stage operation contemplates circular stages one mounted above the other wherein the feeder mechanism rotates so as to distribute the feed and fractions outwardly to spouts or passageways which in turn supply the preliminarily separated product to subsequent similar stages. Also, the means for oscillating or vibrating may be of the eccentric drive type shown or may comprise such other means as an electrical vibrator. Where circular discs are employed, it may not be necessary to utilize any vibration whatsoever but merely relying upon the centrifugal action of the particles to uniformly distribute themselves outwardly toward the upper horizontal edge of the electrode plate and rearwardly of the screen electrode, the latter always being of the open character described and having its area disposed with respect to the electrode plate as previously noted.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of my invention.

What is claimed is:

1. A separator for a middlings mixture substantially composed of branny particles, imperfect middlings and pure middlings, said separator comprising an elongated electrode member having a surface capable of carrying and conducting a charge of electricity, said electrode having at least a portion disposed horizontally in the separator and uniformly constructed across its operative width, feeder mechanism having a broad horizontal delivery terminus overlying the horizontally disposed electrode portion and adapted to deliver a uniformly distributed stream of middlings mixture fed from a rearward position edgewise over and forwardly of said horizontally disposed electrode portion, said electrode and said delivery terminus being substantially stationary with respect to each other, a transmitting and deflecting electrode dielectrically mounted and presenting a generally upright surface horizontally spaced from the first-mentioned electrode at a distance facilitating the creation of a particle-influencing electrostatic field therebetween, said transmitting and deflecting electrode having a multiplicity of openings therethrough surrounded by interconnecting electrode material and adapted to be subjected to an electrical potential to establish an electrostatic field between the first-mentioned electrode and the transmitting and deflecting electrode, and a source of electric potential connected with said electrodes and changing the same at different potentials, whereby to cause branny particles and light impurities to be projected through said transmitting and deflecting electrode while exerting forwardly deflecting influence upon the imperfect middlings particles and lesser influence upon the pure middlings fraction for separation of the middlings particles in free fall.

2. A separator for a middlings mixture substantially composed of branny particles, imperfect middlings and pure middlings, said separator comprising, a dielectric mounting structure having upstanding side supports, an electrode plate having a substantially vertical surface mounted across said dielectric side supports and having a horizontal upper edge, feeder mechanism having a broad delivery terminus at said horizontal upper edge and overlying said vertical electrode plate, for delivering a uniformly distributed stream of middlings mixture fed from a rearward position over said horizontal edge and forwardly thereof, and a transmitting and deflecting electrode presenting a rearwardly facing surface and dielectrically mounted in spaced parallel relation forwardly of said electrode plate, said transmitting and deflecting electrode having a multiplicity of openings therethrough and surrounded by interconnecting electrode material, and further having said rearwardly facing surface positioned with a portion above a horizontal plane including said horizontal edge and another portion lying therebelow, said transmitting and deflecting electrode being adapted to receive a charge of electricity to establish an electrostatic field between the electrode plate and the transmitting and deflecting electrode, whereby to cause branny particles and light impurities to be projected through said transmitting and deflecting electrode while exerting forwardly deflecting influence upon the imperfect middlings particles and a lesser influence upon the pure middlings fraction for separation of the middlings fractions in free fall.

3. The subject matter of claim 2, and means oscillably interconnected with said mounting structure for laterally vibrating both the electrode plate and the transmitting and deflecting electrode.

4. A separator for a middlings mixture substantially composed of branny particles, imperfect middlings and pure middlings, said separator comprising an electrode plate member having an electrically conductive forward

vertical portion with an upper edge, said forward portion being disposed horizontally across the separator and uniformly constructed for its operative width, feeder mechanism having a broad horizontal delivery terminus substantially coinciding with said upper edge of the electrode vertical portion for delivering a uniformly distributed stream of middlings mixture fed from a rearward position edgewise over and forwardly of the vertical plate portion, a transmitting and deflecting screen electrode presenting a rearwardly facing surface and dielectrically mounted in spaced parallel relation forwardly of the horizontal edge of the first-mentioned electrode, said transmitting and deflecting screen electrode having screen openings, the total area of which is greater than the remainder of the screen electrode, said screen electrode being adapted to be subjected to an electrical potential to establish an electrostatic field between the first-mentioned forward electrode portion and the transmitting and deflecting screen electrode, whereby to cause branny particles and light impurities moved over said upper electrode edge to be impelled through said screen electrode while exerting a uniform forward deflecting influence upon the imperfect middlings particles and a lesser influence upon the pure middlings particles for separation of the middlings fractions in free fall.

5. A separator for a middlings mixture substantially composed of branny particles, imperfect middlings and pure middlings, said separator comprising an electrode member having a substantially vertical forward plate portion disposed across the separator and provided with a horizontal upper edge, said electrode being capable of conducting a charge of electricity, feeder mechanism having a broad horizontal delivery terminus substantially coinciding with said horizontal edge of the electrode plate and adapted to deliver a uniformly distributed stream of middlings mixture fed from a rearward position over the horizontal edge and forwardly of the vertical plate portion, a transmitting and deflecting stream electrode presenting a rearwardly facing surface and dielectrically mounted in spaced parallel relation forwardly of the first-mentioned electrode plate, said transmitting and deflecting screen electrode having a multiplicity of screen openings of greater total area than the surrounding electrode material, a portion of said screen electrode being disposed above said horizontal electrode edge and a portion therebelow, said screen electrode being adapted to be subjected to a high voltage potential to establish an electrostatic field between the electrode plate and the electrode screen, a collecting chamber forwardly and below the electrode screen for receiving branny particles and light impurities

electrostatically attracted through the screen openings, a divider plate below and intermediate the screen and the plate electrodes, and a collecting chamber forwardly of said divider plate for receiving a stream of imperfect middlings forwardly deflected by said screen electrode, and a collecting chamber disposed rearwardly of the divider plate for receiving pure middlings particles, affected least by the electrostatic field.

6. A separator for a middlings mixture substantially composed of branny particles, imperfect middlings and pure middlings, said separator comprising feeder mechanism having a broad delivery terminus and being constructed and arranged to deliver such a middlings mixture in a stratum over said terminus to fall freely therefrom, an electrode disposed below said delivery terminus and having a generally upright surface and a generally horizontal electrostatic charge-concentrating edge positioned adjacent the delivery terminus of said feed conveyor and electrostatically influencing the particles and middlings falling thereover, an upright gridwork electrode dielectrically mounted in spaced opposition with said first mentioned electrode and extending downwardly therefrom, said gridwork electrode having a multiplicity of openings formed therethrough of such size and numbers that the total area of openings exceeds the total area of the electrode conductive material, a source of potential difference connected with said electrodes and being constructed and arranged for creating potential differences therebetween and thereby creating an electrostatic field between the electrodes, and compartmented collecting means disposed below said electrodes for collecting the separated middlings and particles, whereby the pure middlings fall freely from the delivery terminus and are virtually unaffected by the electrostatic field, the branny particles are rapidly impelled by the electrostatic field as they pass over said edge toward and through said gridwork electrode, and the imperfect middlings fall downwardly and are impelled by the field away from the pure middlings to be separated therefrom.

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