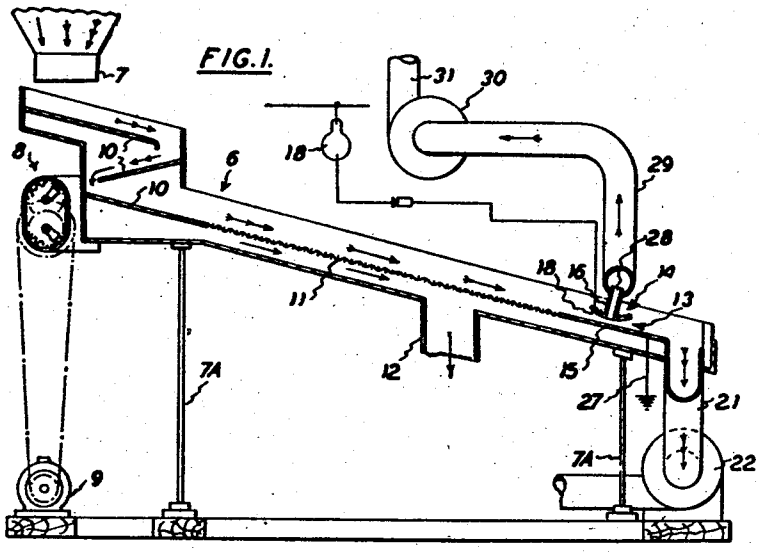
July 13, 1948. T. J. MASSE 2,445,229

METHOD AND APPARATUS FOR ELECTROSTATICALLY SEPARATING PARTICLES HAVING DIFFERENT ELECTRICAL PROPERTIES

Filed April 5, 1944

FIG. 1.



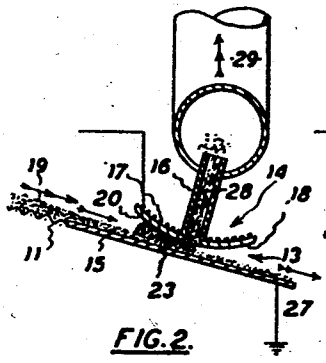


FIG. 2.

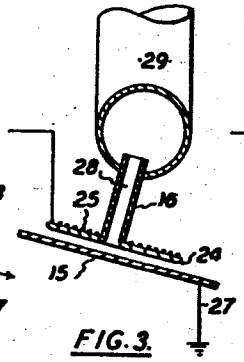


FIG. 3.

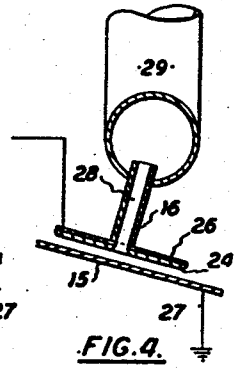


FIG. 4.

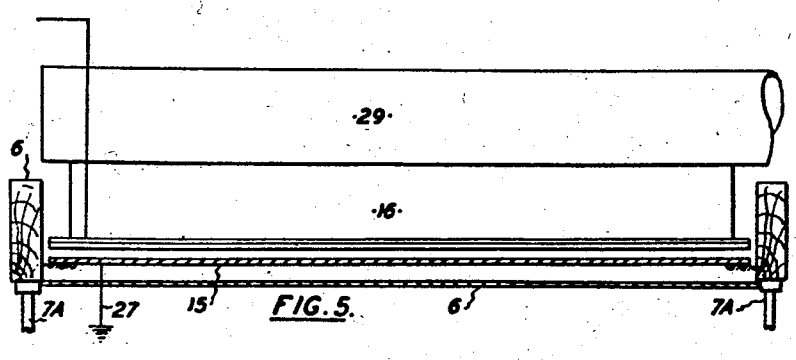


FIG. 5.

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Patented July 13, 1948 2,445,229

UNITED STATES PATENT OFFICE

2,445,229

METHOD AND APPARATUS FOR ELECTROSTATICALLY SEPARATING PARTICLES HAVING DIFFERENT ELECTRICAL PROPERTIES

Thomas Jerome Masse, Alexandria, near Sydney, New South Wales, Australia

Application April 5, 1944, Serial No. 529,584
In Australia April 14, 1943

15 Claims. (Cl. 209—127)

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This invention relates to improvements in method of and apparatus for separating for collection components of mixtures of materials which have different electrical properties. Such materials may be a mixture of two or more powdered, granular, shredded or such like solid materials. The invention is, for example, applicable to the removal from mixtures of materials of particles, say rubber, glass or ebonite or the like electrical insulation material from the particles of some other electrical insulation material, or the particles of a metal or other electrical conductive material.

The invention has relevance more particularly to a modification of the method of and means which are the subject-matter of my Patent No. 2,317,210 of the United States of America, dated April 20, 1943, for an invention entitled "Method and apparatus for separating textile material from rubber."

According to the method of operation for treatment of materials the subject of the aforesaid Letters Patent, fabric fragments are separated from rubber fragments by steps which include passing a mixture of said fragments into an electrostatic field between a repelling electrode and a collector electrode, the said electrodes being electrically charged to an extent whereby the fabric fragments move from the mixture and adhere to said collector electrode and by which they are removed and transferred for collection.

The apparatus according to the subject of the aforesaid Letters Patent consists of an inclined screen to which the mixture to be operated on is fed, a flat repelling electrode aligned with said screen, means for vibrating said screen and said repelling electrode, at least one rotatable collector electrode having a metal core, a wrapping of dielectric material for said core, and an encasement for said wrapped core of a material having a minutely tentacled surface, means for establishing a high tension electrostatic field between said electrodes, and suction means for removing fragments adhering to the collector electrode. In some cases a counter-charging electrode may be provided together with means for establishing a high tension electrostatic field of one polarity between said collector electrode and said repelling electrode and for establishing a high tension electrostatic field of opposite polarity between said counter-charging electrode and said repelling electrode. Further, said apparatus might also include a heating element and a reflector for providing a localised air conditioning unit to

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enable the collector encasement to be kept in dry condition.

According to the method of the present invention the mixture of materials to be treated for the recovery of different particles thereof is moved through an electrostatic field established between a repelling electrode and an attracting electrode, said electrodes are held in such spaced relationship to each other and are so electrically charged that the field strength between them will influence certain particles of the said moving mixture to a rising position with respect to said repelling electrode, as a mass which may contact the attracting electrode without losing contact with said moving mixture; and the said mass is translated by its continuing contact with said moving mixture to a zone of separation where the said particles are subjected to a suction element for collection away from said moving mixture. Preferably, the mixture is passed by gravity over an inclined table constituting the repelling electrode, while being vibrated to facilitate the movement and separation; and before this it is disintegrated or shredded so as to produce at least one of its components in particles of elongated or shredded form.

Apparatus usable for carrying out the above method is of simple character. The construction and arrangement of the repelling electrode with the attracting electrode and the construction of the latter are hereinafter referred to. The said apparatus is mainly differentiated in its working and construction and arrangement from the apparatus usable in connection with the method of my invention the subject-matter of my prior patent aforesaid, by the facts that apparatus according to the present invention is operable without the separated particles of the mixture having to adhere to the attracting electrode to be carried out of the electrostatic field; that the attracting electrode is stationary and does not rotate as is the case with the collector electrode referred to in connection with my patent before-mentioned; and that the mixture of materials when moving through the electrostatic field, carries the separated particles to a suction element from whence they are transferred for collection. The improvements herein disclosed not only have the advantage of relative simplicity, but they also serve more efficiently for separating the components of certain mixtures, such as, for example, the fabric from the rubber of de-treaded pneumatic tires.

For a better understanding of the invention, reference is now made to the accompanying

drawings in which are diagrammatically shown preferred forms of apparatus suitable for use in practicing the invention.

In these drawings:

Fig. 1 is a sectional view of one form of the apparatus, the attracting electrode being shown in curved formation.

Fig. 2 is an enlarged view of part of Fig. 1 showing the two electrodes.

Fig. 3 is a sectional view of a modified form of the attracting electrode.

Fig. 4 is another sectional view of a further modified form of the attracting electrode, and

Fig. 5 is a broken side elevational view partly in section of the two said electrodes and part of the framing associated with one of the said electrodes.

In the drawings (Fig. 1) the mixture of materials to be treated for the recovery of different particles therefrom, is fed on to a vibratory table 6 from a hopper 7. The hopper may be associated with a disintegrator mill (not shown). The table is supported on flexible legs 7A and a vibratory unit 8, rotated by a motor 9, imparts to the table a vibratory effect. The mixture of materials passes along spreader boards 10 and on to an inclined screen 11 through which very fine granules of the material will pass. These fine granules which are indicated by plain arrows, will then pass through chute 12 for collection.

Shreds of the mixture of materials (indicated by single barbed arrows) and large granules (indicated by double barbed arrows) of the mixture of materials are caused to travel over the screen 11 towards the lower end thereof and pass into the electrostatic field 13 formed by an electrically charged stationary attracting electrode 14 and a repelling electrode 15. The attracting electrode is associated with a suction element 16, directly in contact with the electrostatic field. The attracting electrode 14 is shown in Fig. 1 and Fig. 2 with a curved plate of dielectric material, say wood, Bakelite or the like, which carries thereon, an electric conductive wire 17 which may be arranged in sinuous form. This electrode may be charged through a rectifier valve 18a. The outer surface 18 of the attracting electrode is smooth.

Shreds of material and large granules of material indicated at 19 (Fig. 2) are passed into the electrostatic field, and the material to be collected, which in this case consists of the shreds of material indicated at 20, are attracted to the attracting electrode, whilst moving through the electrostatic field, in the following manner. Some of the shreds are attracted to the attracting electrode with a hair-on-end effect, other shreds are attracted to the already attracted shreds, in contact with the attracting electrode, while a further series of shreds are attracted to the second mentioned attracted shreds and so on. The attracted shreds stand in a more or less upright pyramidical direction in mass formation and the mass or masses of the attracted shreds, at the bottom end thereof, being associated with the downwardly moving unattracted mixture are caused to be carried towards the suction element 16, from whence the attracted shreds are transferred for collection. Uncollected particles of the mixture pass through the electrostatic field into a chute 21 where they may be passed back to the disintegrator by the action of fan 22 for further treatment.

Fig. 2 shows the mixture of materials 19 passing downwardly over the screen 11 and over the repelling electrode 15. The attracted shreds are shown in mass formation at 23.

Although I have described by way of example a manner in which the shreds are attracted under the influence of the electrostatic field, it is to be understood that any number of a series of shreds may be attracted to each other. In any case the mass of attracted shreds at their bottom end is always contacting the downwardly moving mixture of materials so that the shreds in their upraised position are carried to the suction element.

The outer surface 18a of the attracting electrode 14 being smooth, the attracted shreds, although some of them are in electrical contact with the smooth surface, do not adhere to the attracting electrode as is the case in my patent aforesaid. In my patent aforesaid, the attracting electrode is coated with felt or other material having a minutely tentacled surface and is rotated, so that the attracted shreds adhere thereto and are carried thereby out of the electrostatic field for collection.

Although the drawing (Fig. 1) shows only one pair of electrodes, it is to be understood that more than one pair of electrodes may be used on a single vibratory table.

Instead of the attracting electrode being constructed as shown in Fig. 1 and Fig. 2 of the drawings, it may consist of a flat dielectric plate 24 as shown in Fig. 3 and Fig. 4. In the construction shown in Fig. 3, the flat dielectric plate 24 is shown with conductive wire 25 thereon, which may be arranged in sinuous formation. In the construction shown in Fig. 4 the flat dielectric plate 24 is shown with a conductive flat metal plate 26 thereon. The curved dielectric plate shown in Fig. 1 and Fig. 2 may also incorporate a curved conductive plate instead of the conductive wire as shown.

In every case the attracting electrode is stationary and the plate of the attracting electrode is of dielectric material such as wood, ebonite or the like. The outer surface of the plate is smooth so that the particles of the mixture undergoing treatment which contact the plate, will slip along the plate surface.

The repelling elecrode 15 may consist of a metal plate and is earthed at 27. As an alternative the repelling electrode may consist of an extended portion of the screen 11.

The suction unit is associated with the attracting electrode. This unit comprises one or more slotted members 28, which are open at one end to receive particles which have been treated; the other ends open into a conduit or conduits 29 in communication with a fan 30 and conduits 31 whereby treated particles are transferred directly from the electrostatic field between the electrodes.

The attracting electrode may be insulated from the conduits in any suitable manner.

The distance between the adjacent surfaces of the electrodes 14 and 15 may be adjustable by providing for adjustment of the electrode 14 in relation to the electrode 15, so that the dielectric capacity will not be interfered with, and so that the attracted particles which are in mass formation, can move relatively to the downwardly moving unattracted mixture of materials, through the electrostatic field and into contact with the suction element.

Instead of the electrodes 14 and 15 being associated with a vibratory screen as shown in Fig. 1 of the drawings, the repelling electrode 15 may comprise an electrically earthed endless driving

belt arrangement with or without any vibratory effect.

The electrical current may be supplied to the electrodes in similar manner to that disclosed in my beforementioned Letters Patent:

It will be understood that various modifications of and departures from the details of the foregoing description and drawings may be made without departing from the improvements of my invention, which are intended to be defined in the claims.

What is claimed is:

1. The method of separating components of a mixture of disintegrated materials having different electrical properties, which comprises passing a stream of such mixture over a support into a high tension electrostatic field between a repelling electrode constituting part of said support and an attracting electrode spaced thereabove having a face of dielectric material, holding said electrodes so spaced from each other and so charged that selective particles are lifted from said mixture by said field as the stream enters said field to form a mass of such particles contacting said dielectric material and yet maintaining contact with said stream, continuing the movement of said stream through said field so that said stream drags said mass of lifted particles along said face into a zone of separation across its path, and suctionally drawing and conducting such lifted articles away from said stream in said zone.

2. A method as described in claim 1 wherein the mixture is disintegrated so as to form shreds of at least one of its components before it is passed into said field.

3. A method as described in claim 1 wherein the mixture is passed over said support into and through said field by vibrating said support while holding it inclined downward toward said repelling electrode and continuously feeding said mixture onto an upper part of said support.

4. The method of separating fabric fragments from a mixture of disintegrated rubber and fabric which comprises moving the mixture on a supporting member into a high tension electrostatic field maintained between a repelling electrode constituting part of said member and a superposed attracting electrode having a face of dielectric material, so maintaining the depth and strength of said field that fabric fragments are lifted from said mixture to form a mass of coherent fabric particles in contact with said face and with the residue of said mixture at the upper and lower extremities, respetcively, of said mass, continuing the movement of said residue on said member through said field and thereby dragging said mass of fabric fragments along said face to a zone of separation across the path of said mass, and suctionally removing fabric fragments from said mass in said zone.

5. A method as described in claim 4 wherein the said member is inclined and vibrated so that the mixture is moved continuously by gravity into and through said field.

6. A method as described in claim 4 wherein said mixture is first disintegrated into particles largely of shred-like form, then is screened to separate fine granules therefrom, and thereafter is treated as aforesaid.

7. In an apparatus for separating electrostatically components of a mixture of materials having different electrical properties, a stationary attracting electrode of extended surface area having a face of dielectric material, a repelling electrode therebelow, means for charging said attracting electrode to establish an electrostatic field between said electrodes, means to move such mixture on said repelling electrode into and through said field, said electrodes being so spaced apart and so charged that selective particles of the mixture entering said field are lifted to form a suspended mass of such particles contacting said face and yet maintaining contact with the residue of said mixture, whereby said mass is dragged along said face as said mixture continues to be moved into and through said field, and suction means opening at said face across the path of movement of said mass to create a zone of suction for drawing and conducting such lifted particles away from said mixture.

8. An attracting electrode for apparatus of the character described, comprising a plate of dielectric material having a smooth face, an electrically conductive element disposed over and on the back of said plate, and a tubular element constituting a part of suction means arranged to open at the face of said plate and to extend backwardly therefrom.

9. An attracting electrode for apparatus of the character described, comprising a curved plate of dielectric material having a smooth face, an electrically conductive wire extending over and on the back of said plate, and a tubular element constituting a part of suction means arranged to open at the face of said plate and to extend backwardly therefrom.

10. An attracting electrode for apparatus of the character described, comprising a flat plate of dielectric material having a smooth face, an electrically conductive plate extending over and on the back of said flat plate, and a tubular element constituting a part of suction means arranged to open at said face and to extend backwardly from said plates.

11. An attracting electrode for apparatus of the character described, comprising a plate of dielectric material having a smooth face, an electrically conductive element extending over and on the back of said plate, and a tubular element constituting a part of suction means extending backwardly from said plate and opening at said face near the central portion thereof.

12. In an apparatus for separating electrostatically components of a mixture of disintegrated materials having different electrical properties, a table having an inclined surface formed at least in part by a grounded electrically conductive member constituting a repelling electrode, means to feed the mixture onto an upper part of said table, means for vibrating said table to agitate and move said mixture continuously down said surface, an attracting electrode mounted above said member, said attracting electrode comprising a stationary plate of dielectric material having a smooth face and an electrically conductive backing element, means for charging said attracting electrode to establish an electrostatic field of high tension between said electrodes, whereby selective particles of said mixture moving over said member may be lifted to form a coherent mass of such particles, of which some contact said face and some maintain contact with the moving mixture such that the mass is dragged downwardly along said face by the continuing movement of said mixture, and suction means to draw and conduct such particles away from said mass including a tubular element opening across the path of said mass in a zone beyond a substantial area of said face.

13. Apparatus as described in claim 12, and a collector for the residue of said mixture at the lower end of said table.

14. Apparatus as described in claim 12 wherein said member forms a lower part of said table and an upper part thereof comprises a screen to sift fine granules out of said mixture before the mixture moves into said field.

15. In an apparatus for separating electrostatically components of a mixture of mateirals having different electrical properties, a stationary attracting electrode of extended surface area having a face of dielectric material, a repelling electrode therebelow, means for charging said attracting electrode to establish an electrostatic field between said electrodes, means to move such mixture on said repelling electrode into and through said field, said electrodes being so spaced apart and so charged that selective particles of the mixture entering said field are lifted to form a suspended mass of such particles contacting said face and yet maintaining contact with the residue of said mixture, whereby said mass is dragged along said face as said mixture continues to be moved into and through said field, and suction means opening at said face across the path of movement of said mass to create a zone of

suction for drawing and conducting such lifted particles away from said mixture, said attracting electrode comprising a plate of dielectric material having a smooth face, an electrically conductive element disposed over and on the back of said plate, and a tubular element constituting a part of said suction means arranged to open at the face of said plate and to extend backwardly therefrom.

THOMAS JEROME MASSE.

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