

Aug. 22, 1944.

J. O. AMSTUZ

2,356,489

APPARATUS FOR COATING

Filed Aug. 19, 1939

5 Sheets-Sheet 1

Fig. 1a

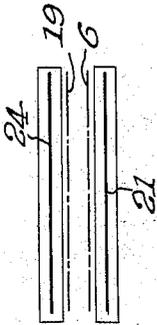
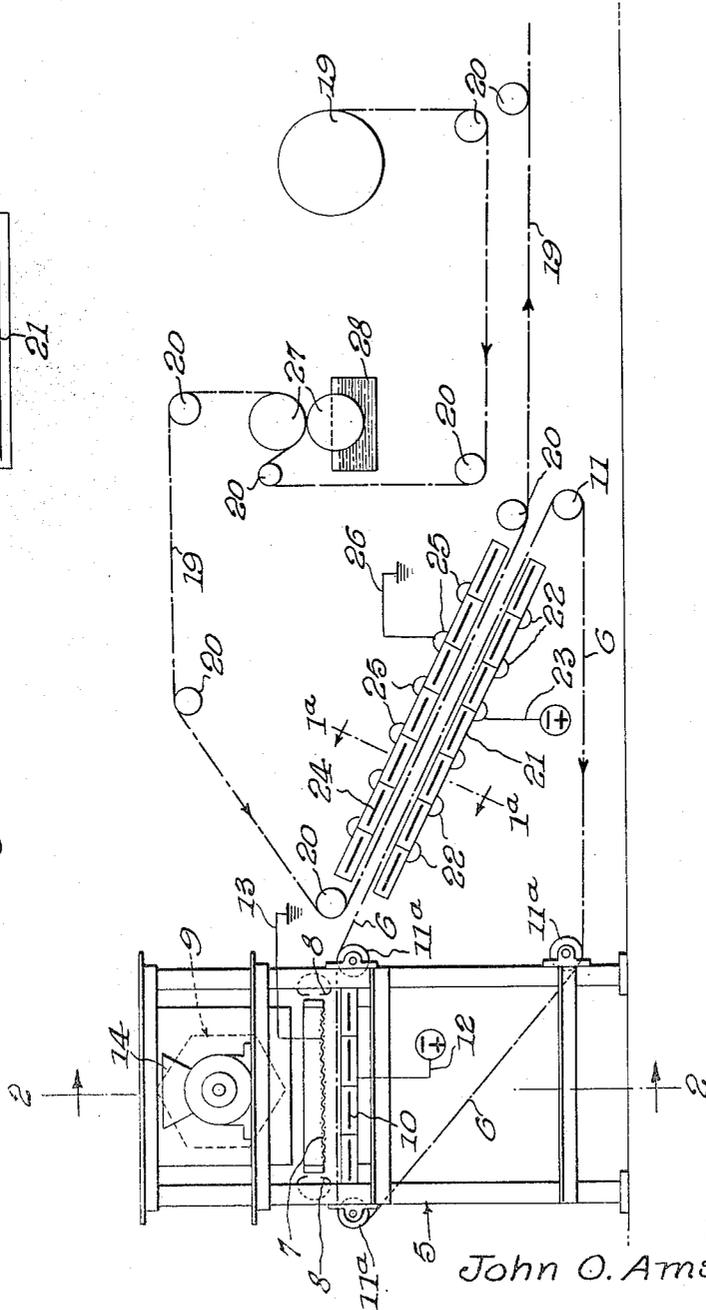


Fig. 1.



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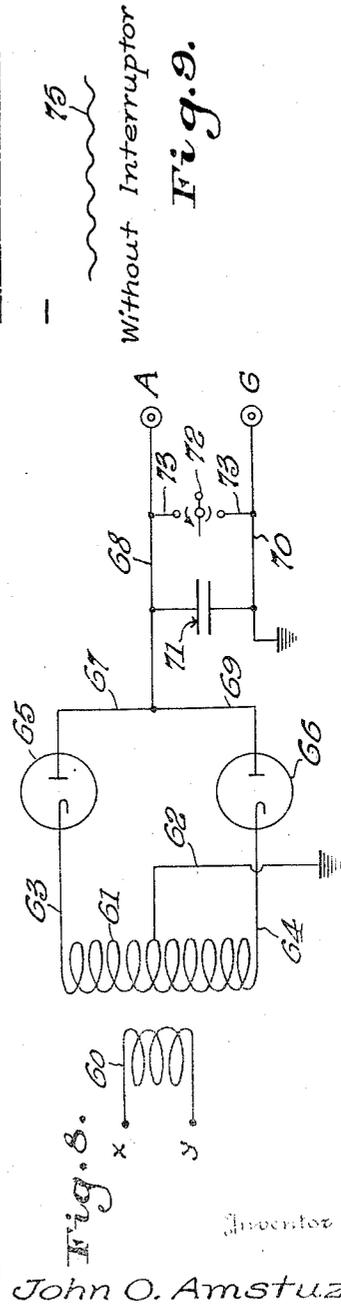
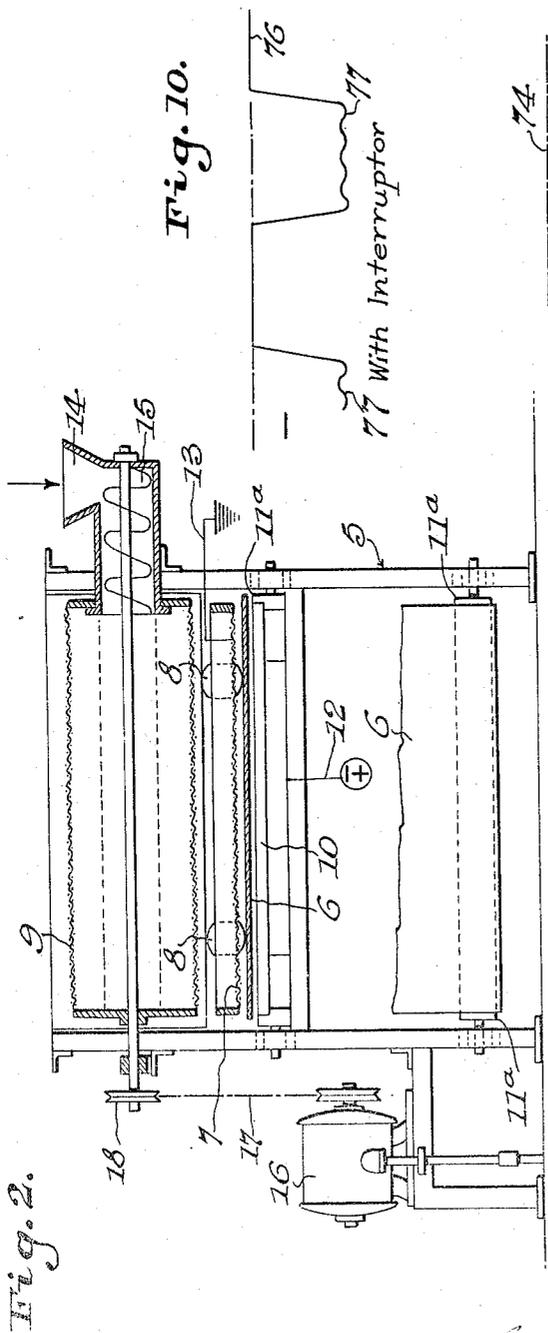
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APPARATUS FOR COATING

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5 Sheets-Sheet 2



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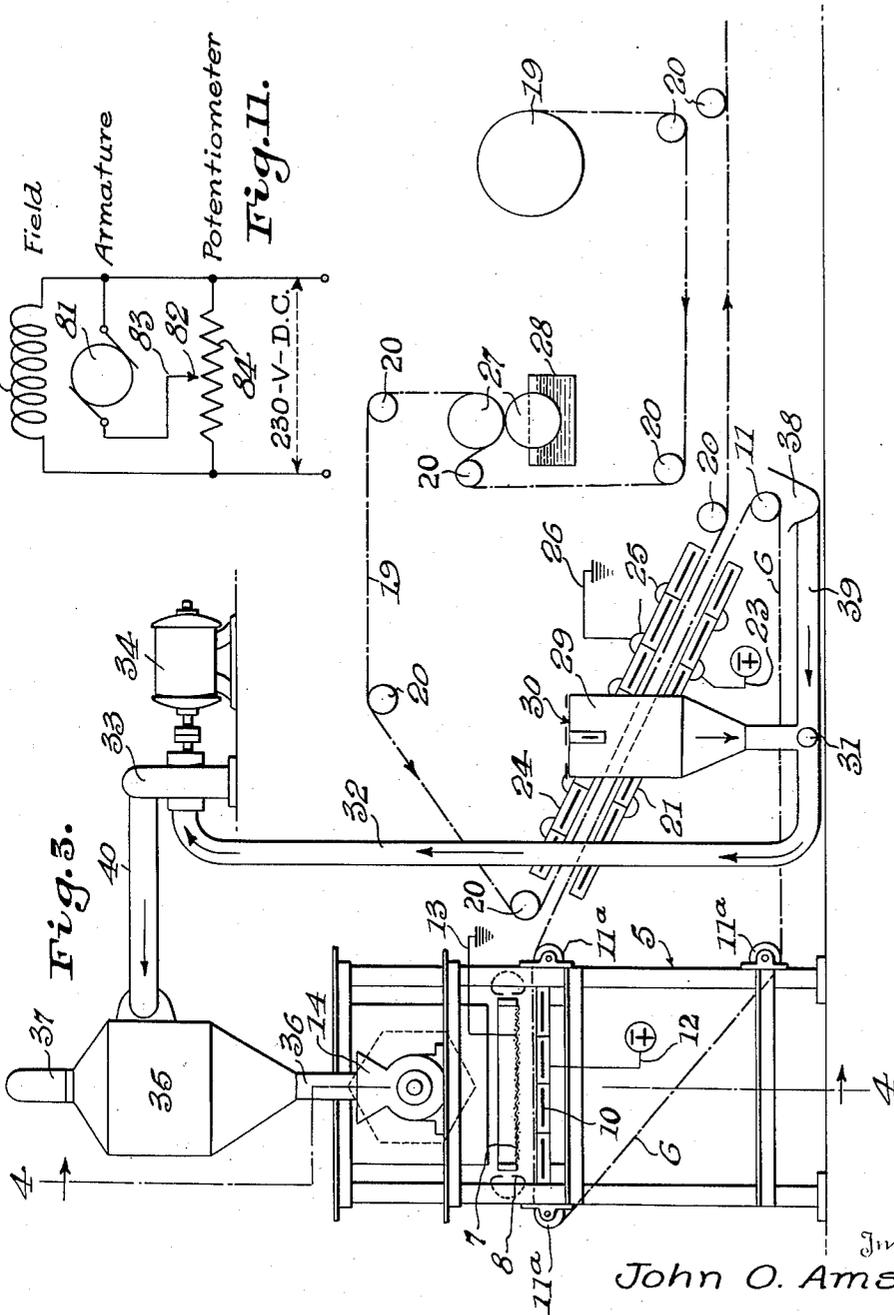
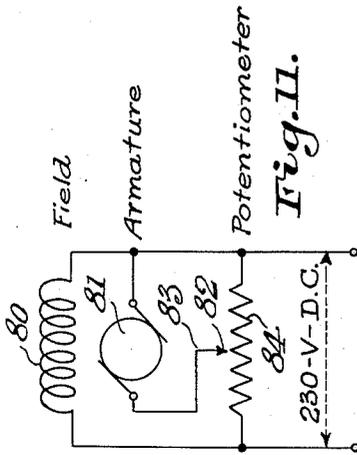
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APPARATUS FOR COATING

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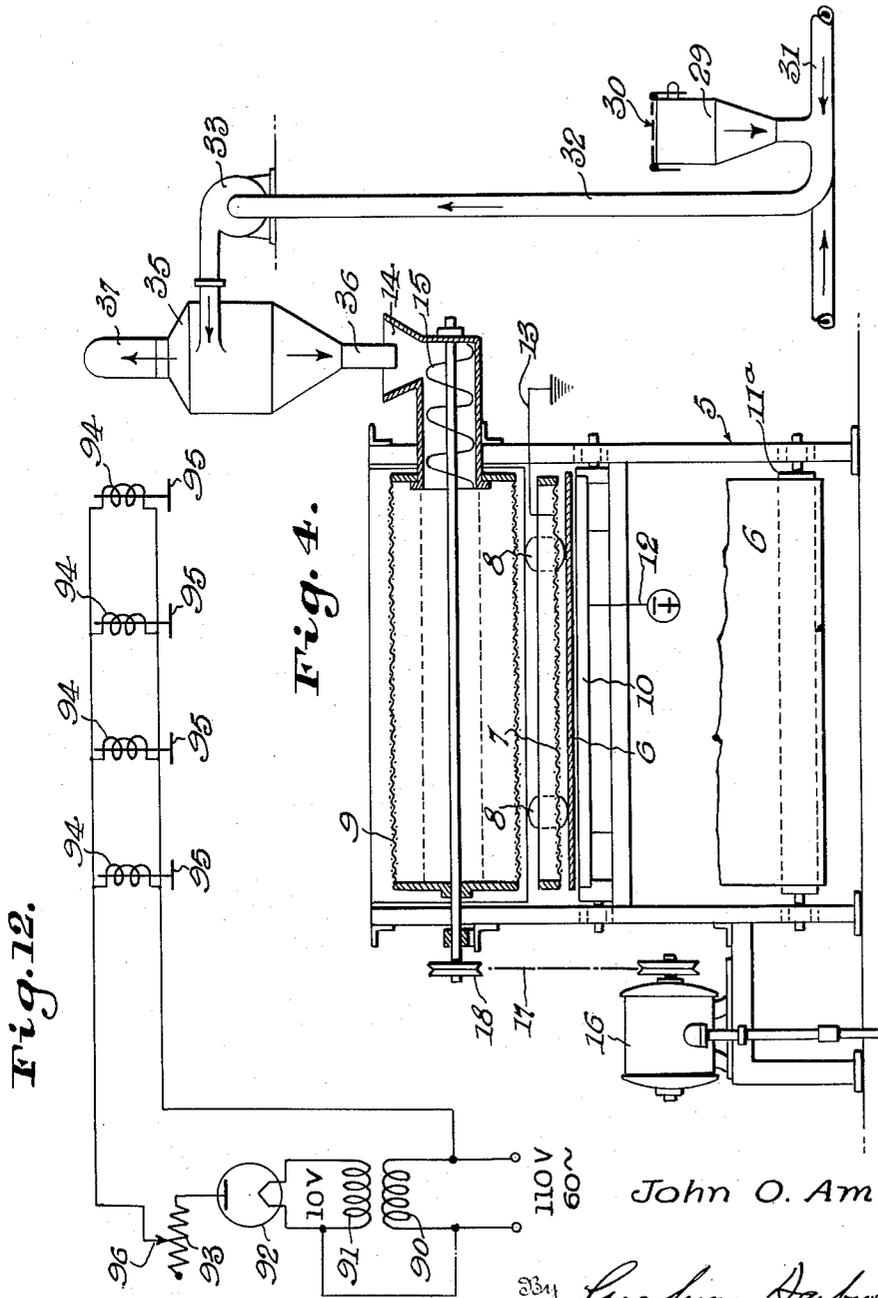
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Fig. 5.

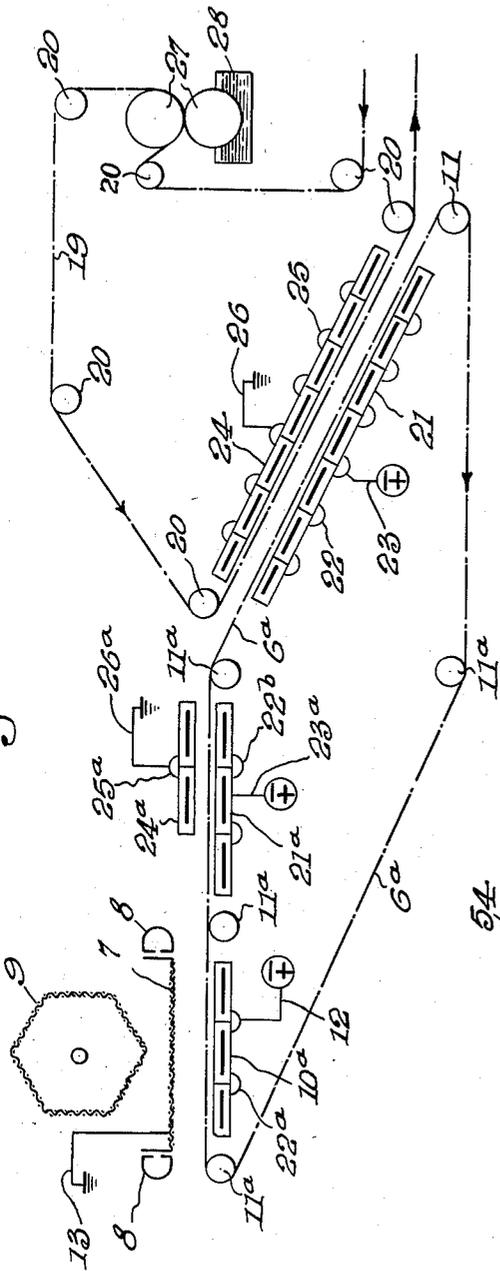


Fig. 7.

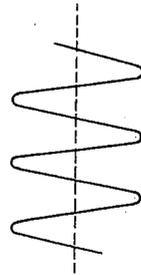
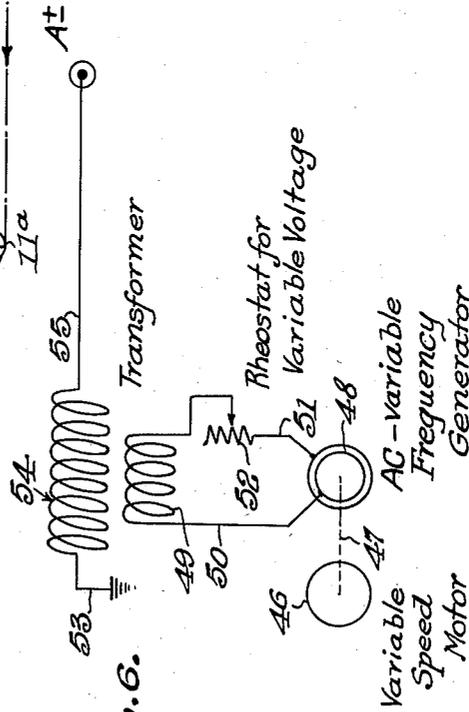


Fig. 6.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR COATING

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Application August 19, 1939, Serial No. 291,086

12 Claims. (Cl. 91—8)

The invention of the present application is an apparatus for coating, and more particularly for coating with fibrous material, such as flock, for the production of piled surfaces and pile-surfaced materials.

Heretofore, it has been proposed to produce pile-surfaced materials by depositing pile-forming particles, such as fibers or flock, upon an adhesively surfaced foundation material, and to orient or arrange the particles, preferably in parallelism and in endwise arrangement normal to the foundation material, by mechanical or electrical action. In some instances, both mechanical and electrical forces have been used. A process and apparatus involving electrical means alone is disclosed in my copending application Serial No. 108,706, filed November 2, 1936, and a process and apparatus employing both electrical and mechanical means is disclosed in the application of Harry A. Wintermute, Serial No. 699,456, filed November 23, 1933. For an example of a purely mechanical method and apparatus, reference may be had to the patent to Krueger, No. 1,955,552, dated April 17, 1934.

It has also been proposed, as disclosed in the above mentioned patent, to loosen and separate the fibers to some extent before they are subjected to mechanical or electrical action, or to both, in order to facilitate their deposition and orientation upon the adhesively coated foundation material.

The present invention is based upon the discovery that superior results may be obtained if the fibers are electrically oriented and deposited upon a supporting surface before being subjected to the mechanical or electrical forces which serve finally to deposit them upon the adhesive surface. It is also based upon the discovery that this preliminary electrical orientation upon a supporting surface, such as a carrier sheet, facilitates the subsequent deposit and orientation upon the adhesive foundation by transfer thereto from the carrier sheet. I have discovered that if the preliminary orientation on a carrier sheet is accompanied by an electrical charging of the particles, they are rendered more responsive to the electrical field which deposits them when they are moved into the latter field by the carrier sheet.

An object of the invention is to provide an apparatus by means of which the flocks, for example, may be continuously subjected to an electrical charge and electrically oriented upon a supporting surface, preferably immediately prior to their entry into a field by means of which they

are deposited and finally oriented on and secured to the adhesive surface.

While the invention is particularly useful in the art of coating, it is also applicable to the feeding of comminuted material generally, and in connection with either mechanical or electrical coating devices or a combination of the two. It is also useful in connection with the feeding and coating with abrasive grains and other comminuted material, such as, for example, comminuted cork in a conveying or coating system.

It is an object of this invention to provide a uniform feed of comminuted material. It is a further object of the invention to break up or separate comminuted materials, such as flocks, so that the same may be more readily coated. It is another object of this invention to eliminate knots or clusters of comminuted material so that the comminuted material may be coated as individual particles. It is a further object of this invention to continuously form a uniform layer of flock upon a feed belt used to convey flocks and other comminuted material through a coating device. It is another object of this invention to orient elongated particles, such as, for example, flocks, before they enter an electro-coating device, which propels them to an adhesively coated backing whereby the comminuted material is more readily oriented and coated by the coating device. It is still a further object of this invention to pre-charge comminuted materials, such as flocks and other poor conductors, and to deposit and orient the materials on a carrier sheet before they enter an electrostatic coating device. Further objects of the invention are to provide practical apparatus by which one or more of the objects mentioned may be readily accomplished. Other objects will be in part obvious or in part pointed out hereafter.

In carrying out the invention, there is provided in connection with apparatus such as is disclosed, for example, in my copending application above referred to, means for preliminarily subjecting the flocks to an electrical field which will charge and/or orient them preliminary to their entrance into the field which serves to deposit the flocks upon an adhesively coated foundation. In association with the field, there may be provided means for mechanically separating the flocks, such as, for example, a rotary screen or screen conveyor. In addition to mechanical means for separating the flocks, it often is advantageous to use the electrical means for separating the flocks that are provided, as for example, the vibrating screen, which constitutes one electrode of an elec-

trostatic field, which is used to separate, disperse and uniformly deposit the fibres. Preferably, after a certain amount of mechanical distribution and separation, and in many cases, also after electrical separation and dispersion followed by deposition upon a supporting member, the flocks are caused to pass through an electrical field by means of which they are charged and also preferably oriented in relation to one another. For this purpose, a conveying belt or other carrier sheet may be used and the electrodes arranged in relation thereto in such a way that the particles are oriented on the belt substantially perpendicular to its surface. Immediately following this orientation and, preferably, before they lose their charge, the flocks, carried by the belt or sheet, are then subjected to the electrical field or other means, by which the particles are oriented, arranged, and deposited upon the adhesive coated foundation material. By this preliminary treatment, the flocks are handled more readily by the electrical field or other means which orients and deposits them upon the adhesive foundation, and a more uniform coating in the final article is more readily produced. The pre-charging of the flocks and the positive conveying of the same into a final electrical field, employed to produce the coating, enables that field to produce a more uniform product, since the fibers are pre-oriented and are also more responsive to the field which propels them with greater ease toward the backing material and attaches them to the adhesive foundation more evenly and with greater tenacity.

For breaking up and separating the flocks and other comminuted material and for dispersing the comminuted material and forming a uniform deposition of the same upon a feed belt or a similar conveying device, I may use either direct current or alternating current, but I prefer to use pulsating direct current or alternating current. I provide a means of varying and controlling the number of cycles and the voltage amplitude of both direct current and alternating current. Where alternating current is used, a preferred range of frequency is 2 to 200 cycles per second and for pulsating or interrupted direct current, a preferred range is 2 to 200 impulses per second. While not limited thereto, I prefer a voltage range of from 5000 to 75,000 volts with electrode spacings of one-half inch to three inches. I have obtained good results with many flocks with an electrode spacing of one and three-quarters inches using 60,000 volts and 60 cycle alternating current.

The apparatus by which my invention is carried out will be explained by reference to the accompanying drawings in which:

Figure 1 is a side elevation of one form of apparatus which may be used for carrying out my invention.

Figure 1a is a section on the line 1a—1a of Figure 1.

Figure 2 is a section through line 2—2 of Figure 1.

Figure 3 is a side elevation of another form of apparatus for carrying out my invention.

Figure 4 is a section through 4—4 of Figure 3.

Figure 5 is a side elevation of another form of apparatus for carrying out my invention and shows a special arrangement for pre-charging the flock before it enters the electrostatic coating device.

Figure 6 shows a wiring diagram for the alternating current used in carrying out my invention.

Figure 7 is a typical sine curve illustrating the

variation of the potential on an electrode when the alternating current provided as illustrated in Figure 6 is superimposed upon the electrode.

Figure 8 shows a wiring diagram for the interrupted direct current and interrupted direct current used in carrying out my invention.

Figure 9 illustrates an uninterrupted direct negative potential.

Figure 10 illustrates an interrupted direct negative potential.

Figure 11 shows the electrical connections of the variable voltage motor driving the commutator or interrupter of the high tension set as shown in Figure 8.

Figure 12 illustrates the electrical connections of the vibrators.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Referring to Figures 1 and 2, 5 is a frame for supporting the equipment and 6 is a conveyor belt which may be made of rubberized fabric or rubber. The flock is deposited upon this conveyor belt 6 and carried through the coating device. I provide a flat vibrating screen 7 of suitable mesh according to the type of comminuted material being passed through the screen and I provide electric vibrators 8 to vibrate the screen 7. A rotary sifting screen 9 delivers the flock or other comminuted material to the vibrating screen 7. I provide suitable electrodes 10 which are joined together by conductors, not shown. Roll 11 is driven by a motor, not shown, and continuously drives the conveyor belt around idler rolls 11a in the direction shown by the arrow in Figure 1. I provide a terminal and conducting connection 12 by means of which the electrodes 10 are connected to a source of high potential of suitable characteristics. A conductor 13 connects the vibrating screen 7 to ground. I provide a feed hopper 14 from which the flock or other comminuted material is supplied to a screw feeder 15 which in turn delivers the comminuted material to the rotary sifting screen 9. The rotary screen 9 and the screw conveyor 15 may be driven by a motor 16 driving a belt 17 which drives a pulley 18 attached to the shaft of the rotary screen 9 and screw feeder 15. I provide a suitably mounted roll of fabric 19 or other material which is to be coated with flocks or other comminuted materials. The fabric 19 is drawn over a plurality of idler rolls 20 in a course which may be as shown, by means of any suitable take-up device as a suction drum, not shown. I provide a set of electrodes 21 which may or may not be insulated and which are connected together by suitable conductors 22. A terminal and connection 23 are provided to connect electrodes 21 to a suitable source of high potential having the desired characteristics as set forth herein. I further provide another set of coating electrodes 24 and these electrodes 24 may be joined together by suitable conductors 25. The electrodes 24 may be grounded as indicated at 26. The fabric 19 is coated with adhesive as by means of a suitable set of coating rolls 27 and an adhesive trough 28 and is conducted between the electrodes which at least equal in width (Figure 1a) the fabric to be coated.

The flock or other comminuted material is introduced into the hopper 14 of Figures 1 and 2 and delivered by the screw conveyor 15 to the rotary sifting screen 9 which in turn delivers the comminuted material to the flat vibrating screen 7. The flock passes through the vibrating screen

7 and is jerked apart and uniformly distributed over the conveyor belt 6 by the electrostatic field set up between electrodes 10 and 7, the vibrating screen 7 being a grounded electrode. The conveyor belt 6 continuously carries the flock between the coating electrodes 21 and 24. The fabric 19 passes over the idler rolls 20 between the coating rolls 27 where a suitable adhesive such as, for example, rubber cement is applied to the fabric from the coating trough 28. Fabric 19 continues over the idler rolls 20 between the coating electrodes 21 and 24 where the flocks or other comminuted materials are propelled into the adhesive coating on the fabric 19. The coated fabric continues over idler rolls 20 being pulled by a suction drum, as mentioned, and is delivered to festooning racks or other suitable drying equipment.

Referring to Figures 3 and 4, numbers 5-28 inc. denote parts identical with the parts denoted by the same numerals in Figures 1 and 2. Figures 3 and 4 illustrate how the advantages of feeding flock by an air current or other gaseous medium may be combined with the other advantages disclosed in Figures 1 and 2. In Figures 3 and 4, 29 denotes a feed hopper into which the flock that is used in the coating process may be introduced. The numeral 30 represents a hinged cover for the feed hopper 29. In these figures 31 is an air intake and 32 is an air duct that connects feed hopper 29 to a blower 33 which is used to propel the air current with the flocks entrained therein. Pipe 40 is an air duct extending from blower 33 to a centrifugal collector 35. The numeral 34 represents a motor which drives the blower 33 through suitable connecting means. Pipe 36 is a discharge extending from the centrifugal collector 35 to the feed hopper 29 whereby the flocks are conveyed from the collector to the hopper. Pipe 37 is an exhaust from the centrifugal collector 35 and the size of the exhaust pipe may be varied as desired, depending upon the material being used and the rate at which air is blown into the collector. I may provide a surplus hopper 38 in which the case the flocks not coated onto the adhesive on the fabric 19 are dumped into the belt 6 into the surplus hopper 38. From the surplus hopper 38 the surplus flock collected may pass through duct 39 into the air stream of duct 32 for recirculation along with additional flock added through hopper 29 or the surplus flock may be retained in hopper 38 and removed from time to time whereby only the new flock added through hopper 29 is coated.

Referring to Figure 5, 6a denotes the belt trained about idler rolls 11a and driven by the motor-driven roll 11 in the direction indicated by the arrow. Part 7 is the flat vibrating screen to which are attached the vibrators 8. The flat vibrating screen 7 serves as an electrode and is grounded as indicated by 13. The rotary sifting screen 9 is fed, for example, by a screw conveyor as illustrated in Figures 1 and 2 and the flock passes from the rotary screen 9 to the flat vibrating screen 7. Numerals 10a represent electrodes which may be insulated and joined together by suitable conductors 22a. Electrodes 10a are provided with a terminal and connection 12 to a high tension set. The flocks pass through flat vibrating screen 7 into the electrostatic field set up between the electrodes 10a and the flat vibrating screen 7 which is also an electrode. In this field the flocks are broken up and loosened and prepared for the subsequent operation. I provide a set of electrodes 21a which may or may not be

insulated and which are connected by suitable conductors 22b. A terminal and connection 23a connects electrodes 21a with a source of high potential of suitable characteristics. Numeral 24a represents another set of electrodes located above the belt 6a. These electrodes may or may not be insulated and are joined together by suitable conductors 25a. Electrodes 24a are grounded as indicated at 26a. The flock passes from the electrostatic field set up between electrodes 10a and flat vibrating screen 7 into the electrostatic field set up between the electrodes 21a and 24a. In this latter field the flocks are oriented on the belt substantially perpendicular to the surface of the belt and are thereby rendered more suitable for the subsequent coating operation. A fabric 19 is passed between coating rolls 27 where adhesive is picked up from coating box 28. The adhesively coated fabric 19 then passes over idler rolls 20 and through the electrostatic field set up between electrodes 21 and 24, the flock being delivered into this field in an oriented condition, as previously explained, by endless belt 6a. In the electrostatic field between electrodes 21 and 24 the flock is propelled into and retained by the adhesive coating on fabric 19 and the flock coated fabric passes continuously to some suitable drying arrangement, not shown, being pulled by a suitable suction drum as specified. Terminal, ground connection and connecting conductors are provided as previously specified in the case of the embodiment of Figures 1 and 2.

Referring to Figure 6 which illustrates diagrammatically a set-up for obtaining any desired frequency of pulsation of alternating current and any desired potential from an electrode used in my coating process, 46 is a variable speed motor connected through suitable connecting means 47 to an alternating current variable frequency generator 48. Suitable motors, connections and generators are well known in the art. The alternating current generated in generator 48 is fed through conductors 50 and 51 to the primary winding 49 of a transformer. In conductor 51 between the motor generator and the primary winding 49 of the transformer is located a rheostat 52 for varying the voltage. The transformer may be of any desired type, but for purposes of illustration, I use a core type transformer. At 53 is shown a ground for the secondary winding 54 of the transformer, the secondary winding 54 of the transformer being connected to a suitable conductor 55 which leads to a suitable terminal A± which may be one of the electrodes indicated as connected to a high tension set in Figures 1, 2, 3, 4, and 5 or it may be a terminal which is in turn connected to one of the aforesaid electrodes. By such adjustments as are known in the art, the variable speed motor 46, the generator 48, the transformer windings 49 and 54 and the rheostat 52 may be controlled to obtain any desired frequency and potential at the terminal A±.

Figure 7 shows diagrammatically a typical sine curve characteristic of the potential impressed upon the terminal A± of Figure 6.

In Figure 8 is illustrated a set-up suitable for producing a continuous direct current of a desired high potential or an interrupted direct current of the desired potential. In Figure 8, 60 represents the primary winding of a transformer fed by a suitable source of alternating current at the terminals x and y and 61 represents the secondary winding of the transformer. Any suitable transformer may be used, but I generally employ a transformer of the core type. The

transformer is grounded, as indicated in Figure 8, by a suitable conductor 62. Conductors 63 and 64 run from the secondary winding of the transformer to Kenotron tubes 65 and 66. Conductor 67 runs from Kenotron tube 65 to conductor 68 and conductor 69 runs from Kenotron tube 66 to conductor 68. Conductor 70 is grounded and extends to a terminal (G) which may be the electrodes indicated as grounded in Figures 1, 2, 3, 4 and 5 or an intermediate terminal which is in turn connected to the said electrodes. Conductor 68 leads to a terminal A— which may be the electrodes indicated as connected to a high tension set in Figures 1, 2, 3, 4, and 5, or an intermediate terminal which is, in turn, connected to these electrodes. I provide a condenser 71 connected by suitable conductors to the conductors 68 and 70. The purpose of condenser 71 is to largely eliminate the ripple effect that would otherwise be obtained in the potential delivered to the terminal A—. I provide a commutator 72 located between the two branches of a conductor 73 which runs from conductor 68 to the conductor 70. Commutator 72 is driven by a variable speed motor, not shown. A suitable wiring diagram for a variable speed motor which may be used to drive the commutator or interrupter 72 is shown in Figure 11. Commutator 72 is used only in those cases where a pulsating direct current is desired. When it is desired to have one of the electrodes in Figures 1, 2, 3, 4, and 5 grounded and the opposing electrode of an uninterrupted negative potential, the interrupter 72 is not used. By not using the interrupter 72 and by properly adjusting the transformer and the characteristics of the current delivered to the primary winding 60 by methods well known in the art, I am able to obtain any desired negative potential at the terminal A—. If, instead of a negative potential on one electrode and the other electrode grounded, I desire a positive potential on one electrode and the other electrode grounded, I reverse the Kenotron tubes 65 and 66, that is, the plates of the Kenotron tubes 65 and 66 will be joined to conductors 63 and 64, thus reversing the direction of flow of electrons. Thus, I am able to deliver to the terminal A— either a positive or negative potential of any desired voltage. If, instead of a steady direct potential I desire an interrupted potential, either the positive or negative potential may be interrupted with any desired frequency by operating commutator 72. By varying the time of contact and the time that the contact is broken, I may obtain any desired frequency of interruption and any desired duration of time of the interruptions, and any desired duration of time of the electrical impulses.

In Figure 9, I have illustrated diagrammatically an uninterrupted direct potential. In this figure, 74 represents the base line or zero potential and 75 the applied negative potential which has only a relatively small ripple effect. This ripple effect is not very great because of the action of the condenser 71 of Figure 8.

In Figure 10, I have illustrated the same negative direct potential interrupted. In this figure, 76 represents the base line or zero potential and 77 represents the interrupted negative potential. The potential as illustrated in Figures 9 and 10 are taken from the negative terminal A— of Figure 8. Positive potentials, uninterrupted and interrupted, similar to the negative potentials illustrated in Figures 9 and 10 may be obtained where the Kenotron tubes of Figure 8 are reversed

so as to apply a positive potential at the terminal A—.

Referring to Figure 11, 80 is the field winding, 81 is the armature and 82 is a potentiometer used for controlling the armature current, which in turn controls the speed, the greater the current, the greater the speed of the motor and vice versa. Potentiometer 82 consists of parts 83 and 84 and 83 is a connection between armature 81 and the resistance 84, 83 making a sliding or other adjustable contact with resistance 84 whereby the current may be increased or decreased at will.

Referring to Figure 12, 90 is the primary of the transformer and 91 is the secondary, the transformer reducing the potential from 110 volts to 10 volts. The secondary of the transformer may be connected to the filament of a Tungar rectifier 92 or other suitable rectifier. The plate of the rectifier 92 is connected to a variable resistance 93 provided with a sliding or other adjustable contact 96 and this variable resistance is used to control the amplitude of the vibrators by controlling the current energizing the vibrators. Windings 94 are the windings for the solenoids of the electric vibrators and 95 are the cores of the vibrators which transmit the mechanical vibration to the flat vibrating screen 7 of Figures 1, 2, 3, 4, and 5. The windings 94 of the vibrators are energized, for example, by 110 volt, 60 cycle, single phase A. C. current plus a superimposed pulsating D. C. current supplied by the rectifier 92. The applied D. C. potential serves to unbalance the alternating current wave and causes the cores 95 of the vibrators to move back and forth within the windings 94 of the solenoids. The amplitude of the vibration is regulated by controlling the D. C. voltage and current supplied by rectifier 92 by adjusting sliding contact 96. If the voltage and current are increased, the system becomes more unbalanced and the amplitude of the vibrations is increased. A decrease in the applied D. C. voltage and current, on the contrary, decreases the amplitude. With the arrangement shown the desired amplitude of vibration may be attained. If other frequencies of vibration are desired, different frequencies of alternating current may be supplied to the primary winding of the transformer and to the windings 94 of the solenoids.

The apparatus of the present invention and the different embodiments as above set forth have the following advantageous features:

a. The flock is effectively broken up prior to being coated upon the fabric 19. Under certain conditions of manufacture and humidity, flock as received by the coater is badly matted and it has been difficult effectively to separate the individual fibres. By providing apparatus which separates the fibres effectively before the flock arrives at the final electrostatic field which does the coating, I am enabled to handle material which it has been difficult to use heretofore. The various embodiments of the present invention use one or more apparatus to shake up and separate the flock fibres and the selection of a particular apparatus among those illustrated and described herein may depend upon the type of material being produced, the grade of flock being used and its condition, whether matted or not, and, if so, how much.

The method illustrated in Figures 1 and 2 contemplates using a vibrating screen which constitutes one electrode of an electrostatic field and an auxiliary electrode or electrodes to break up lumps of fibres and separate them into individual

fibres and deposit them evenly on a conveying means for subsequent coating, in oriented relation, on an adhesively coated foundation material.

b. Another feature of the invention is the production of a more uniform coating in the final article. This is dependent to a large extent upon the effectiveness of the dispersion prior to the time the flock enters the final electrostatic field which does the coating. Even though all of the fibres are separated from each other a poor distribution thereof will have a tendency to produce an uneven coating and in order that the textile goods may present a uniform appearance, a uniform coating is desired. As in the case of separation of the fibres, the particular apparatus of those herein disclosed which will be used for a particular coating job depends upon the type of flock which is being used and the condition thereof.

c. A third feature of the invention is the production of a piled fabric in which the individual fibres are maintained to a greater extent in parallelism and more nearly normal to the backing material 19. It is the final electrostatic field which finally orients and coats the fibres prepared for coating by the previous orientation, but a previous electrostatic field gives the final electrostatic field less work to do in this respect and the ultimate result has been found to be superior.

d. Still another feature of the invention involves pre-charging the individual flock fibres so that the final electrostatic field which does the coating finds them more responsive and propels them with greater ease towards the backing material 19. Certain flock materials are hard to lift electrostatically and such materials can be more readily handled by apparatus as herein disclosed than previously. Furthermore, the durability of the fabric produced involves the tenacity with which the pile is attached thereto. This may be a function of the adhesive employed, but with a given adhesive it may also be a function of the force or speed with which the particles are propelled to the backing material 19. By providing apparatus to pre-charge the flocks prior to their entering between the coating electrodes 21 and 24, I am enabled to handle materials which could either not be handled previously or only with difficulty and at a slow rate of production. This advantageous feature may thus also involve an increase in the production of the machine.

In order to attain the advantageous features (a) and (b), that is, to break up and disperse the flock, either direct current or alternating current may be used. I prefer to use either alternating current or a pulsating direct current. In order that a given machine may effectively handle different types and kinds of flock material and under varying conditions of temperature and humidity, both the frequency and the effective E. M. F. should be variable and controllable. I have found that the frequency should have a range of from 2 to 200 cycles per second for alternating current and 2 to 200 impulses per second for pulsating direct current. The effective voltage should range from 5000 to 75,000 volts. However, I do not wish to be limited to any particular range in either respect and the foregoing is given merely to assist one in putting the present invention into practice.

It should be understood that in order to properly break up and disperse the flocks, it is often

advantageous to bring about a bouncing back and forth between the electrodes which is readily accomplished under the influence of an alternating current or an interrupted direct current superimposed upon the electrodes, as for example, electrodes 10, Figure 1, connected to the source of high potential.

For the accomplishment of feature (c), that is, in order to orient the flock, direct current is preferred and this may or may not be a pulsating or interrupted direct current. The same holds true for the accomplishment of feature (d), that is, for pre-charging the flock particles before they enter the final electrostatic coating field.

In pre-charging or in orienting the particles, the object is not to bounce the particles up and down and separate them as in the case of feature (a), but to charge and orient the particles on the supporting member, as for instance, belt 6a. It will be clear that orientation and alignment will be best accomplished where the fibres are charged and made to stand erect parallel to the lines of force of the field on the supporting member, without being propelled backwards and forwards between the electrodes. The voltages and electrode spacings required to charge and orient the fibres without propelling them depends upon the conductivity of the comminuted materials, as for instance, flocks, and the conductivity of the supporting belt, both of which may vary with the humidity of the atmosphere. While I cannot give any specific spacings and voltages for a particular instance, the voltages and spacings may be readily adjusted to the point that the comminuted materials or fibres simply stand erect and orient without being propelled toward the opposite electrode. In many cases, good results have been obtained with an electrode spacing of one inch and 20,000 volts. In some instances, an electrode spacing which is not much greater than the length of the fibres will be found effective.

For the accomplishment of feature (d), that is, to cause the flock particles to be impelled with greater force to the fabric 19, the pre-charging electrode should be charged with electricity of the same sign as the electrode of the electrocoating apparatus which is on the same side of the belt 6a where direct current, either uninterrupted or interrupted, is used in coating. On the other hand, this might be varied to the extent of having the pre-charging electrode of opposite sign to the electrode of the coating apparatus which is on the opposite side of the belt 6a. In case the coating is carried out with alternating current, that is, an alternating polarity, pre-charging with either a positive or negative charge is advantageous if the flocks or other comminuted material is a good insulator or very poor conductor, that is, if the flow of electrons through the material or over its surface is relatively slow as compared with the speed of reversal of the polarity of the coating electrodes. The bottom electrodes in the various embodiments of this invention have been shown as connected to the high tension terminal of a source of high potential, and the upper electrodes have been shown as connected to ground. This is a preferred arrangement, but very satisfactory results may also be attained when the connections are reversed, that is, when the upper electrodes are connected to a source of high potential and the lower electrodes are grounded. It is particularly important that the upper electrodes in contact

with a fabric coated with a conductive adhesive be grounded.

The rotating screen 9 is effective to break up clumps of the flock which are further broken up by the vibrating screen 7. With the use of the apparatus shown in Figure 3, the flocks come to the rotating screen 9 fairly well broken up. This blower apparatus may, therefore, be used in cases where the flock is badly matted. The centrifugal blower 33 acts to break up the flock material both by reason of the air stream and also by the impact of the blades of the blower upon the material.

The electrostatic field between the electrodes 10a and the screen 7 in Figure 5 has the function of separating the flock fibres still further and distributing them uniformly on the belt 6a. The electrodes 21a and 24a cause a charging and/or orienting of the fibres on the belt 6a as well as providing an initial charge upon the fibres so that the final set of electrodes 21 and 24 which do the coating will transfer the particles more effectively in oriented relation into the adhesive and produce a superior coating.

By means of the apparatus and methods illustrated in Figure 5, I am therefore enabled to form on a supporting member, a layer of fibres in oriented relation and in contact with the supporting member and thereafter transfer the oriented layer of fibres in oriented relationship to an adhesively coated backing.

Certain types of materials are so conductive as to be handled with difficulty and other types of materials are so near being perfect insulators as to present great difficulty also. I may condition the atmosphere passing through the blower 33 or in the coating room to increase or lower the conductivity of the flocks, as, for example, by using an atmosphere of controlled humidity, that is to say, I may use greater or less humidity than that prevailing outside at the particular time, as desired.

It will thus be seen that there has been provided by this invention, apparatus in which the various objects hereinabove set forth, together with many thorough practical advantages, are successfully achieved. As various possible embodiments might be made of the mechanical features of the above invention, and as the art herein described might be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. Apparatus for coating a foundation material with comminuted material, such as flocks, comprising a vibratory screen, means for establishing an electrostatic field in which the screen constitutes one electrode, means for delivering comminuted material to the screen, whereby material sifted through the screen is charged with a potential different from that of the screen, a conveyor for conducting from the field the comminuted material sifted through the screen, the charges imparted to the material by the field serving to separate and disperse the material on the conveyor, a pair of electrodes for establishing an electrostatic field, means for passing said conveyor with the comminuted material in dispersed condition thereon between said electrodes, means for supplying adhesively coated foundation material in spaced relation to the conveyor between the electrodes and means for imparting to the electrode behind the conveyor and remote from the foundation material a charge of the

same polarity as the comminuted material, whereby the separated and dispersed material on the conveyor is propelled onto the adhesively coated foundation material.

2. Apparatus for feeding comminuted material, such as flocks, comprising a vibratory screen, means for establishing an electrostatic field in which the screen constitutes one electrode, means for delivering comminuted material to the screen, conveyor means for conducting from the field comminuted material sifted through the screen, the field serving to disperse the material, means for establishing an electrostatic field through which the dispersed material is conveyed and whereby the material is oriented on said conveyor, means for supplying adhesively coated foundation material with the adhesively coated surface facing the material on the conveyor in proximity thereto, and a pair of electrodes for creating an electrostatic field for projecting the material from the conveyor onto said adhesively coated surface.

3. Apparatus for feeding comminuted material, such as flocks, comprising a vibratory screen, means for establishing an electrostatic field in which the screen constitutes one electrode, means for delivering comminuted material to the screen, and conveyor means for conducting from the field comminuted material sifted through the screen, the field serving to impart to the material electrostatic charges of like polarity to disperse the particles on the conveyor, means for establishing an electrostatic field through which the dispersed material is conveyed by said conveyor and whereby the material is oriented and additionally charged on said conveyor means, means for positioning adhesively coated foundation material in proximity to the oriented and charged comminuted material on said conveyor means, and means for establishing another electrostatic field for projecting the oriented and charged particles from the conveyor means onto the adhesively coated foundation material and including a projecting electrode having the same polarity as the charged particles.

4. Apparatus for handling comminuted material, such as flocks, comprising means for creating an air stream, means for delivering the comminuted material into the stream, a collector, means for directing the air stream with the entrained material into the collector, sifting means for receiving the flocks from the collector, means for receiving the flocks from the sifting means, means for electrically charging the flocks for dispersing the same on said receiving means, said receiving means serving to conduct the material along a predetermined path, means for positioning an adhesively coated foundation material in closely spaced proximity to said path and means for creating an electrostatic field for projecting the material from the receiving means to the adhesively coated foundation material in proximity thereto.

5. In an apparatus for depositing comminuted, pile-surface-forming material upon an adhesively coated backing sheet, a conveyor for conveying a layer of such material into proximity to the adhesively coated backing sheet, means for sifting said material onto the conveyor, means for delivering the material to the sifting means, means for breaking up bunches or clusters of the material and for dispersing the same evenly on the conveyor, and means for transferring the dispersed comminuted material from the conveyor onto the backing sheet, said breaking-up

and dispersing means comprising an electrode below and adjacent the conveyor and means for establishing an electrostatic field between the sifting means and said electrode, whereby electrostatic charges of like polarity are imparted to the particles of material and the bunches or clusters are broken up and the particles dispersed by the mutually repellent forces resulting from said charges.

6. In an apparatus for depositing comminuted, pile-surface-forming material upon an adhesively coated backing sheet, a conveyor for conveying a layer of such material into proximity to the adhesively coated backing sheet, means for sifting said material onto the conveyor, means for breaking up bunches or clusters of the material and for dispersing the same evenly on the conveyor, and means for transferring the dispersed comminuted material from the conveyor onto the backing sheet, said breaking-up and dispersing means comprising an electrode below the conveyor and means for establishing an electrostatic field of alternating polarity between the sifting means and said electrode, whereby electrostatic charges of like polarity are momentarily imparted to the particles and the bunches or clusters are broken up and the particles dispersed by the mutually repellent forces resulting from said charges.

7. An apparatus for depositing a coating of pile-forming fibres in oriented relation upon an adhesively coated backing sheet, comprising means for moving such a backing sheet along a predetermined path with the adhesive coating facing downwardly, a conveyor trained for movement below the backing sheet in proximity thereto, means for sifting a layer of comminuted pile-forming fibres on the conveyor, an electrode below the sifting means, means for establishing an electrostatic field of alternating polarity between the sifting means and said electrode to impart electrostatic charges of like polarity to the particles momentarily and thereby break up bunches or clusters of particles and disperse the same by the mutually repellent forces resulting from said charges, a pair of electrodes spaced from the first-mentioned electrode and between which the backing sheet and the conveyor are moved, and means for establishing a second electrostatic field of alternating polarity between the last-mentioned electrodes, whereby the dispersed particles on the conveyor are projected onto the adhesively coated surface of the backing sheet in oriented relation.

8. An apparatus for depositing a coating of pile-forming fibres in oriented relation upon an adhesively coated backing sheet, comprising means for moving such a backing sheet along a predetermined path with the adhesive coating facing downwardly, a conveyor trained for move-

ment below the backing sheet in proximity thereto, means for depositing a layer of comminuted pile-forming fibres on the conveyor, means for establishing a preliminary electrostatic field of alternating polarity to impart electrostatic charges of like polarity to the particles momentarily and thereby break up bunches or clusters of particles and disperse the same on the conveyor by the mutually repellent forces resulting from said charges, a pair of electrodes spaced from the first-mentioned electrostatic field and between which the backing sheet and the conveyor are moved, and means for establishing a second electrostatic field of alternating polarity between said electrodes, whereby the dispersed particles on the conveyor are projected onto the adhesively coated surface of the backing sheet in oriented relation.

9. An apparatus as specified in claim 5 in which the sifting means includes a vibratory screen and in which means are provided to create an electrical field between a pair of electrodes, one of which is constituted by the screen.

10. Apparatus as specified in claim 5 in which the means for delivering the comminuted material to the sifting means comprises an air conduit including means for forming an air stream, and means for introducing comminuted material into the conduit.

11. Apparatus as specified in claim 5 in which the means for delivering the comminuted material to the sifting means comprises an air conduit including means for forming an air stream, and means for introducing comminuted material into the conduit, and in which the sifting means includes a vibratory screen to which the material is delivered, and means for creating an electrical field between a pair of electrodes, one of which is constituted by the screen.

12. In an apparatus for depositing comminuted, pile-surface forming material upon an adhesively coated backing sheet, a conveyor for conveying a layer of such material into proximity to the adhesively coated backing sheet, and means for breaking-up bunches or clusters of such material and for depositing the same in evenly dispersed condition on the conveyor, the last-mentioned means comprising a vibrating screen above the conveyor, an electrode below the conveyor, means for delivering comminuted material to the screen, and means for establishing between the screen and the lower electrode, an electrostatic field of alternating polarity, whereby electrostatic charges of like polarity are momentarily imparted to the particles and the bunches or clusters are broken up and the particles dispersed by the mutually repellent forces resulting from said charges.

JOHN O. AMSTUZ.

CERTIFICATE OF CORRECTION.

Patent No. 2,356,489.

August 22, 1944.

JOHN O. AMSTUZ.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 45, before the word "case" strike out "the"; line 46, after "dumped" strike out "into" and insert instead --from--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of November, A. D. 1944.

Leslie Frazer
Acting Commissioner of Patents.

(Seal)