Sept. 12, 1939. A. F. MESTON 2,173,078

PRODUCTION OF PILE SURFACES

Filed Oct. 4, 1933 2 Sheets-Sheet 1

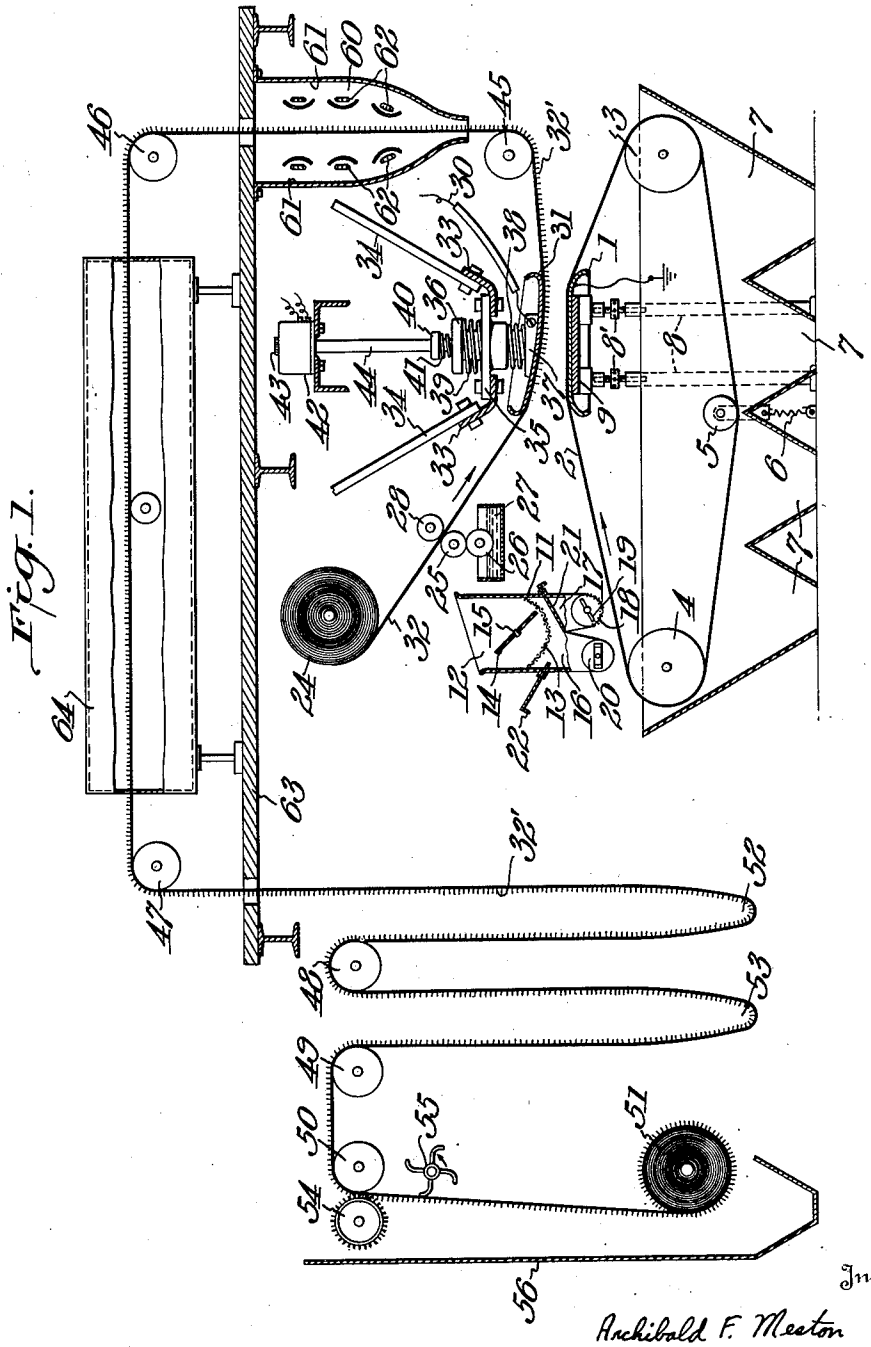

Fig. 1.

Inventor:
Archibald F. Meston
By Potter, Pierce & Scheffler
Attorneys.

Sept. 12, 1939. A. F. MESTON 2,173,078

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Filed Oct. 4, 1933 2 Sheets-Sheet 2

Fig. 2.

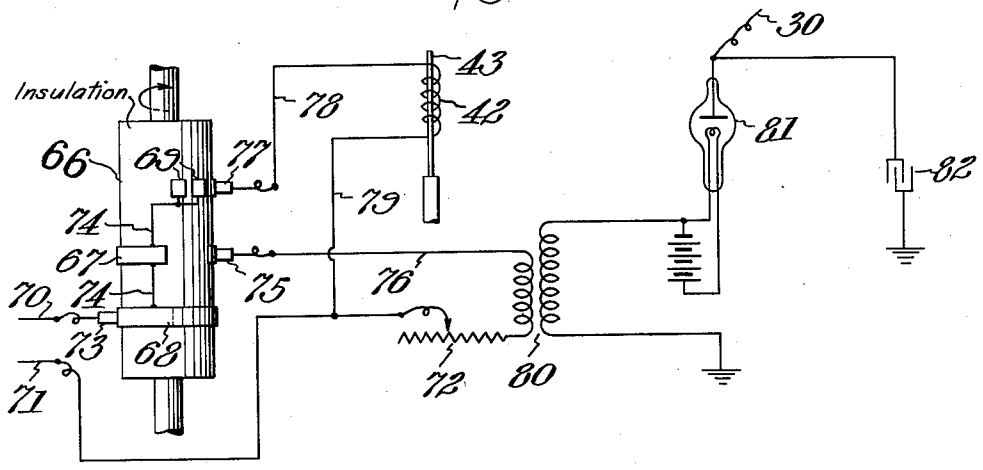
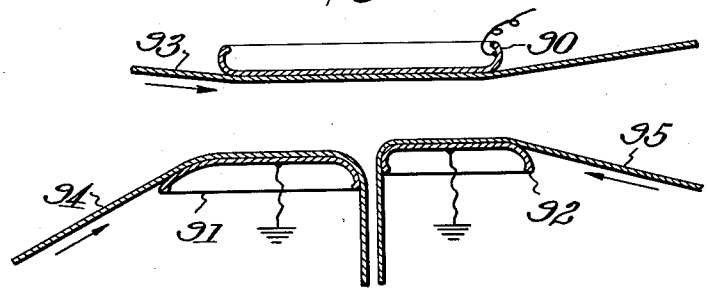


Fig. 3.



Inventor:

Archibald F. Meston

By Potter, Pierce & Scheffler

Attorneys.

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PRODUCTION OF PILE SURFACES

Archibald F. Meston, Middlesex Borough, N. J., assignor, by mesne assignments, to Behr-Manning Corporation, a corporation of Massachusetts

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24 Claims. (Cl. 91—8)

This invention relates to the production of pile-surfaced materials and is particularly directed to apparatus and methods of operation adapted for the efficient production of such materials involves positioning an adhesive coated foundation material in an electric field and supplying pile-forming fibers thereto while in said field. It has been found that improvements in the effectiveness of the production of pile-surfaced materials by said process may be obtained by the use of novel forms of apparatus and methods of operation which will be more particularly described hereinafter.

Among the novel features and objects of the present invention are included the use of a unidirectional electric field, the provision of electrodes adapted to provide an electric field substantially free of corona discharge, the disposition of the electrodes whereby the surface to be piled is positioned above the pile-forming material so that the material is moved upward against gravity in depositing it on the surface, the provision of means for continuously or intermittently agitating the upper electrode and/or object being coated to effect the removal of surplus pile-forming material and prevention of treeing of the material, the provision of one or more traveling belts or the like for bringing the pile-forming material into the electric field, and the intermittent application of potential between the electrodes, which is advantageous in causing agglomerated or flocculated masses of fibers to break up.

These and other features and objects of the invention will be more particularly described for the purpose of illustration with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic sectional elevation of a system of apparatus embodying the principles of the invention;

Fig. 2 is a diagrammatic plan of an electrical circuit adapted for practicing the invention; and

Fig. 3 is a fragmentary section of a modified form of the invention providing a plurality of fiber supplying means.

In Fig. 1 the electric field which causes the deposition of the pile-forming fibers is set up between the two electrodes 1 and 31. These electrodes, as shown, are formed with relatively smooth, flat surfaces and rounded edges in order that a strong field of, for example, 4,000 to 50,000 volts (peak) per inch can be set up between them without the formation of corona discharge. The avoidance of corona discharge results in an improved uniformity of deposition. For purposes of convenience electrode 1 is preferably held at ground potential, while electrode 31, insulated from ground as will be later described, is continuously maintained at, or is intermittently brought to high potential by connecting it to a high potential current source through conductor 30. The electric field set up is unidirectional, the upper electrode preferably being negative with relation to the bottom electrode.

The sheet material 32 upon which the pile is to be formed is shown passing over the bottom surface of electrode 31. Sheet 32 need not actually touch electrode 31, but it is convenient to have it pass across the surface of that electrode with sliding contact, as shown. A belt 2, is used to carry the pile-forming fibers into the electric field. This passes over electrode 1 around pulleys 3 and 4 and under a tightening idler 5 which is held against the inner surface of the belt by springs 6. A driving mechanism, not shown, such as a variable speed motor and reduction gear, turns pulley 3 at a speed which moves the belt through the electric field at the desired rate. The speed of travel of the feed belt may be widely varied. Increasing its speed relative to the speed of web 32 increases the heaviness of the pile formed on the latter. Excess material which is not attracted to and deposited upon sheet 32 falls into hoppers 7 to be reused later. Straddling the hoppers are uprights, two of which are shown at the far side at 8, supporting a transverse member 8 upon which electrode 1 rests. Uprights 8 include jackscrews 8' which make possible any desired adjustment of the distance between the electrodes and their relative position.

It is desirable that the pile-forming material, for example rayon flocks, be spread evenly over belt 2 which carries it into the electric field. Belt 2 is preferably an electrical conductor but it may be of canvas or other poorly conducting material. It passes under apparatus 11 consisting of a supply hopper 12 with a bottom of wire screen 13 of relatively coarse mesh and with a scraping device 14 which revolves around rod 15, scraping screen 13 twice in each revolution, and two dependent smaller hoppers 16 and 17, each of which has a screen bottom and an agitator or scraper. Hopper 17 is shown with end cover removed to illustrate the construction, the screen being indicated at 18 and the scraper at 19. Ordinarily a cover is over the end of hopper 17 similar to that shown at 20 which covers the end of hopper 16. Sliding plates 21 and 22 permit the closing of hopper 16 or 17, respectively,

when there is need for removing an end cover to remove unscreenable masses of material that have collected. In operation hopper 12 is filled evenly from end to end with pile-forming material. Scraper 14 is turned either manually or by a power device so that the material is scraped through 13 in semi-broken up condition and falls into hoppers 16 and 17. Scraper 19 in hopper 17 and a similar scraper in hopper 16 work the material through the fine screens in the bottom of these hoppers and it is disseminated evenly over moving belt 2.

The sheet to be coated is usually supplied in a roll as shown at 24. This roll is suspended in an elevated position so that the sheet, before entering the electric field between electrodes 1 and 31, can be coated with adhesive by such apparatus as that shown, comprising an applying roll 25 which is coated with adhesive by a supply roll 26 which is rotated partly submerged in liquid or semi-liquid adhesive in trough 27. Other suitable means may be used for coating the surface of the sheet, but the above has been found very satisfactory for several common types of adhesive. A roll 28 assists in supporting sheet 32 as adhesive applying roll 25 presses against it.

Electrode 31 is supported at one or more points depending upon its width. When treating material 2 to 3 feet wide two supports are ordinarily necessary. These supports depend from angles 33 which extend transversely to but above sheet 32. The angles in turn depend from insulating means 34 which may be rods or bars of Bakelite composition or other insulating material having appreciable tensile strength. The support itself consists of a flange or yoke 35 in which there is suspended a member 36 which in turn is fastened to boss 37 attached to the back surface of electrode 31. Springs 38 and 39 hold member 36 in a yielding position within flange 35. A hole extends part way through member 36 and inserted into this hole to within say ⅛" of the bottom thereof is a member 40 which is utilized as a hammer when it is desirable to shake or vibrate 31. Spring 41 is of such length and stiffness that it supports the weight of member 40 and keeps it from resting on the bottom of the hole within member 36. Hammer 40 is operated by a solenoid 42 which, when energized, pulls down on core 43 which in turn pushes down on insulating rod 44 compressing spring 41 and causing the bottom of hammer member 40 to strike the bottom of the hole within 36.

Sheet 32, after being drawn between the electrodes and having a pile deposited on it, passes as 32' over rolls 45, 46, 47, 48, 49 and 50 and is rolled upon mandrel 51 or is otherwise disposed of. Some or all of these rolls are mechanically rotated. By using appropriate controls known to the arts, but not shown in the figure, the rotating means can be operated interdependently with the result that the sheet is kept taut where desired and caused to sag, as at 52, 53, where desired. Between roll 45 and mandrel 51 are positioned the auxiliary means for drying and combing the piled sheet. The specifications and arrangement of the necessary equipment will vary with the adhesive used and other factors. In most cases a dryer immediately follows the depositing means and this may take the form of a chamber 60 with inner walls 61 comprising radiating surfaces which receive and reflect heat furnished by electric resistance units 62. If valuable solvents are evaporated from the adhesive while the sheet is passing through chamber 60, suitable condensing or absorbing equipment can be provided to collect them, but ordinarily the vapors evolved are conducted to atmosphere by simple ventilating means. If the adhesive is of the nature of rubber latex it is desirable to vulcanize it after drying. Apparatus suitable for this purpose can be placed on a platform 63 above the depositing apparatus, as indicated by numeral 64. After cooling, provided by movement through loops 52, 53, the pile is combed or brushed by means of 54, the loose fibers are shaken off by rotating rapping device 55, and any other finishing operations, not indicated, such as shearing, are performed. In rolling or folding the finished product care is taken to not damage the pile, and to this end spacing strips are inserted and other precautions known to the velvet trade are taken.

Electrodes 1 and 31 may be flat and parallel, but advantages have been found in so shaping and positioning the electrodes that they are farther apart at the side where the pile material enters than on the opposite side. This causes the fabric being formed to be subjected to a progressively stronger field as it passes along and is being built up with additional fibers. A very strong field in the initial stage of deposition is more apt to cause the fibers to flatten against the adhesive on the sheet than is a weak field; while a strong field at the final stage of deposition is advantageous in that it forces additional fibers down into an already built up pile.

Certain difficulties in operation may be encountered when a strong electric field exists constantly between electrodes 1 and 31. Some of the fibers mat together and others string out or "tree" between the electrodes if the field is maintained continuously, and the desired result of keeping the fibers in parallel arrangement and projecting one end of each fiber into the adhesive may not be obtained. It has been found advantageous to lower the potential at which the upper electrode is held, or to reduce it to ground potential intermittently, for example, every few seconds. While the electric field is weak, the upper electrode is advantageously vibrated or shaken to remove unattached or loosely held fibers. A satisfactory cycle consists of from two to ten seconds with a strong field and one to three seconds with a weak field or no field at all. An electric circuit for furnishing such conditions is shown in Fig. 2.

Fig. 2 illustrates an electric circuit and control which may be used in energizing the apparatus shown in Fig. 1. Alternating current at low potential (115 or 230 volts) is supplied through leads 70 and 71. Lead 71 is connected through a voltage control resistance 72 to one end of the low voltage winding of step up transformer 80. It is also connected through a shunt lead 79 to one end of solenoid 42. Lead 70 contacts through brush 73 with a slip ring 68 on drum 66. Connected to ring 68 by conductor 74 are other rings or surfaces 67 and 69 for making contacts with brush 75 and brush 77 which connect through leads 76 and 78, respectively, to transformer 80 and solenoid 42. When drum 66 is rotated, transformer 80 is intermittently energized as is solenoid 42. It is not difficult to arrange the contacts on drum 66 and rotate it at such speed that transformer 80 is energized for say four seconds and then de-energized for one second while solenoid 42 is being intermittently energized to rap electrode 31 two or more times.

A steady pull on the fibers while they are being deposited or attached is desirable and the energy impulses set up by transformer 80 are rectified by

any practical means before they reach electrode 31. A Lemp type mechanical rectifying switch has given satisfactory results, but in Fig. 2 a hot cathode type of rectifying tube 81 is shown for this purpose. It is known that two tubes with a double winding on the transformer or four tubes properly connected will permit the use of both sides of the voltage wave, but tests have shown that satisfactory results can be obtained with one tube through which one side only of the voltage wave passes if electrode 31 is well insulated. Electrodes 1 and 31 and the air between make up a condenser which tends to even out the current supply, and rectifying tube 81 prevents any of the current from returning to the transformer and so reducing the voltage impressed across the electrodes. Where it is desirable to reduce the voltage across the electrodes frequently, say by grounding electrode 31, the disposal of a high capacity charge is an inconvenience and in such cases condenser 82 is not provided. Instead, a grounding switch actuated by, or, at least, in synchronism with, drum 66 is connected to line 30.

Fig. 3 illustrates a modification of the invention whereby the pile-forming fibers may be supplied in two separate successive portions. Electrode 90 and web 93 correspond to electrode 31 and web 32, respectively, of Fig. 1. The corresponding lower electrode 1 of Fig. 1 is represented in Fig. 3 by two separate electrodes 91 and 92, each cooperating with separate supply belts 94 and 95 to supply pile-forming materials in successive portions. When desirable one of the belts may be positioned to supply the fibers with closer spacing to the surface to be coated than to the other. Through the greater flexibility of operation made possible by the modification of the invention shown in Fig. 3 it is possible to obtain pile surfaces of increased thickness of pile and uniformity.

Non-uniformity of pile may not be objectionable or may be desirable in some instances and the results obtained from electrodes which have not been carefully shaped and positioned to prevent corona discharge and local highly stressed electric fields may be satisfactory. But carefully conducted experiments made to determine the shape of electrodes best suited for the production of evenly formed piles have shown that distinct advantages reside in those just described.

I claim:

1. Apparatus for the production of pile-surfaced materials comprising a plurality of electrode means, circuit elements connecting said electrode means to provide an electric field therebetween, the opposing faces of said electrode means being free from elements of small radius of curvature, means for positioning an adhesive-coated web of foundation material in said field adjacent one of said electrode means, and means for supplying pile-forming fibers adjacent the other of said electrode means.

2. Apparatus for the production of pile-surfaced materials comprising a plurality of electrode means, circuit elements connecting said electrode means to provide an electric field therebetween, the radii of curvature of the elements of the opposing faces of said electrode means being so large that no corona discharge is developed at potential differences of from 4,000 to 50,000 volts per inch, means for positioning an adhesive-coated web of foundation material in said field adjacent one of said electrode means, and means for supplying pile-forming fibers adjacent the other of said electrode means.

3. Apparatus for the production of pile-surfaced materials comprising a plurality of electrode means, circuit elements connecting said electrode means to provide an electric field therebetween, the opposing faces of said electrode means being positioned at an acute angle to each other, means for positioning an adhesive-coated web of foundation material in said field adjacent one of said electrode means, and means for supplying pile-forming fibers adjacent the other of said electrode means.

4. Apparatus for the production of pile-surfaced materials comprising a plurality of electrode means, circuit elements connecting said electrode means to provide an electric field therebetween, the opposing faces of said electrode means being positioned at an acute angle to each other, means for passing an adhesive-coated web of foundation material through said field adjacent one of said electrode means and in the direction of the apex of the angle formed by the electrode means, and means for supplying pile-forming fibers adjacent the other of said electrode means.

5. Apparatus for the production of pile-surfaced materials comprising superposed electrode means, circuit elements connecting said electrode means to provide an electric field therebetween, the lower of said electrode means comprising a plurality of electrode members positioned at different distances from said upper electrode means, means for positioning an adhesive-coated web of foundation material in said field adjacent the upper electrode means, and means for supplying pile-forming fibers adjacent each of said lower electrode members.

6. In an apparatus for the production of pile-surfaced materials by electrostatic deposition including opposed electrode members, means for impressing an intermittent unidirectional potential across said electrode members.

7. In an apparatus for the production of pile-surfaced materials by electrostatic deposition, opposed electrode members, and electrical connections therebetween including automatic means for impressing a unidirectional potential of intermittently varying strength across said electrode members.

8. In an apparatus for the production of pile-surfaced materials by electrostatic deposition, opposed electrode members, and means associated therewith for agitating one of said electrode members.

9. In an apparatus for the production of pile-surfaced materials by electrostatic deposition including opposed electrode members, means for impressing a unidirectional potential of intermittently varying strength across said electrode members, and means for agitating one of said electrode members during the intervals of decreased potential.

10. In an apparatus for the production of pile-surfaced materials by electrostatic deposition including superposed electrode members, rapping means for agitating the upper of said electrode members.

11. In an apparatus for the production of pile-surfaced materials by electrostatic deposition including superposed electrode members, electrically actuated rapping means for intermittently agitating the upper of said electrode members.

12. A process for the production of pile-surfaced materials which comprises positioning an adhesive-coated web of foundation material between superposed electrodes and adjacent the upper of said electrodes, supplying pile-forming

fibers adjacent the upper surface of the lower of said electrodes, and intermittently impressing a unidirectional electric potential across said electrodes.

13. A process for the production of pile-surfaced materials which comprises positioning an adhesive-coated web of foundation material between superposed electrodes and adjacent the upper of said electrodes, supplying pile-forming fibers adjacent the upper surface of the lower of said electrodes, impressing an electric potential across said electrodes and subjecting said web to agitation.

14. A process for the production of pile-surfaced materials which comprises positioning an adhesive-coated web of foundation material between superposed electrodes and adjacent the upper of said electrodes, supplying pile-forming fibers adjacent the upper surface of the lower of said electrodes, impressing an electric potential across said electrodes and subjecting said web to intermittent agitation.

15. A process for the production of pile-surfaced materials which comprises positioning an adhesive-coated web of foundation material between superposed electrodes and adjacent the upper of said electrodes, supplying pile-forming fibers adjacent the upper surface of the lower of said electrodes, and impressing an electric potential of intermittently varying strength across said electrodes.

16. A process for the production of pile-surfaced materials which comprises positioning an adhesive-coated web of foundation material between superposed electrodes and adjacent the upper of said electrodes, supplying pile-forming fibers adjacent the upper surface of the lower of said electrodes, impressing an electric potential of intermittently varying strength across said electrodes and subjecting said web to agitation in the intervals of decreased potential.

17. In a process for the production of pile-surfaced material, the step comprising establishing an electrical field extending in a substantially vertical direction, coating a surface to be piled with adhesive and positioning in it the upper portion of said electric field with the coated surface directed downwardly, supplying pile-forming elements to the electric field below said surface and jarring from the surface pile-forming elements electrostatically raised to the surface but not firmly attached thereto.

18. Apparatus for forming pile surfaces comprising electrode means insulated from each other, means for establishing an electric field between said electrodes including a source of current and means for converting said current into periodically varying impulses of different electrical characteristics from said current and means for introducing pile-forming material into said electric field.

19. Apparatus for forming pile surfaces comprising electrode means insulated from each other, means for establishing an electric field between said electrodes including a source of alternating current and means for converting said alternating current into periodically varying impulses of different electrical characteristics from said alternating current and means for introducing pile-forming material into said electric field.

20. The method of producing pile-surfaced sheet material which comprises providing an electrical field of intermittently varying strength, positioning an adhesive-surfaced foundation material in said field and supplying pile-surface forming fibers to said field.

21. The method of producing pile-surfaced sheet material which comprises providing an electrical field of intermittently varying strength, passing an adhesive-surfaced foundation material through said field and supplying pile-surface-forming fibers to said field.

22. A process for the production of pile-surfaced materials which comprises establishing an electrical field between spaced electrodes, conducting an adhesive-coated web of foundation material betwen said electrodes, supplying to said field pile-forming fibers of a character which tend to tree therein, while impressing an electrical potential across the electrodes, and subjecting the web to agitation as it is conducted through the field, whereby treeing is minimized.

23. In an apparatus for the production of pile-surfaced materials by electrostatic deposition, opposed electrode members, means for establishing an electrical field between said members, means for positioning an adhesive-coated web of foundation material between said electrode members, means for supplying to said field between said electrode members pile forming fibers which tend to tree therein, and means for agitating the web of foundation material while it is positioned within said field, whereby treeing is minimized.

24. The method of producing pile-surfaced sheet material which comprises providing an electrical field of intermittently varying strength, positioning an adhesive-surfaced foundation material in said field, supplying pile-surface forming fibers to said field, and agitating the foundation material while in said field.

ARCHIBALD F. MESTON.

CERTIFICATE OF CORRECTION.

Patent No. 2,173,078. September 12, 1939.

ARCHIBALD F. MESTON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 5, before the word "involves" insert by a process which; and second column, line 32, for "member 8" read member 9; 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 21st day of November, A. D. 1939.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.