Nov. 12, 1940. H. A. WINTERMUTE 2,221,338

DEPOSITION OF MATERIAL

Filed Oct. 21, 1936 2 Sheets-Sheet 1

Fig. 1.

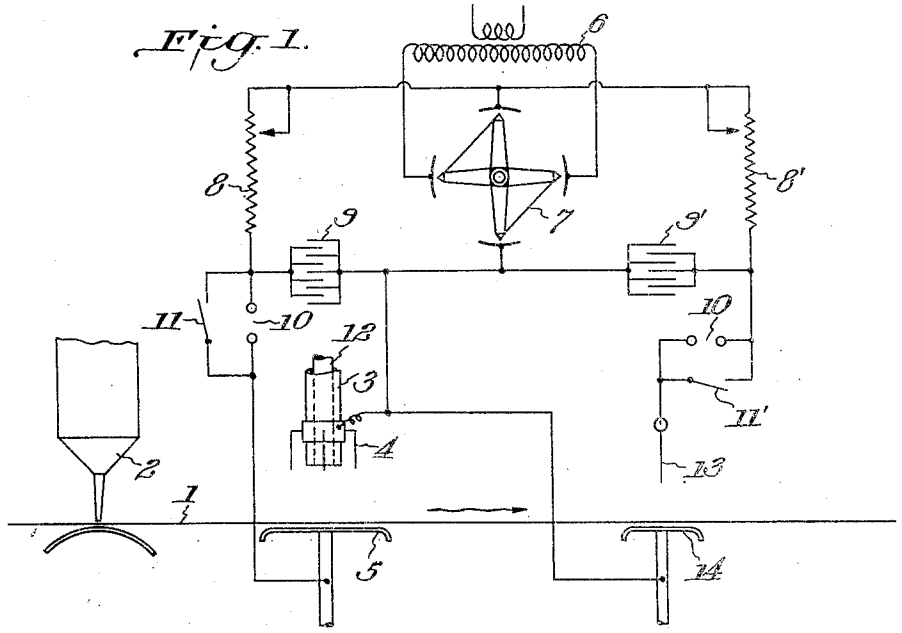
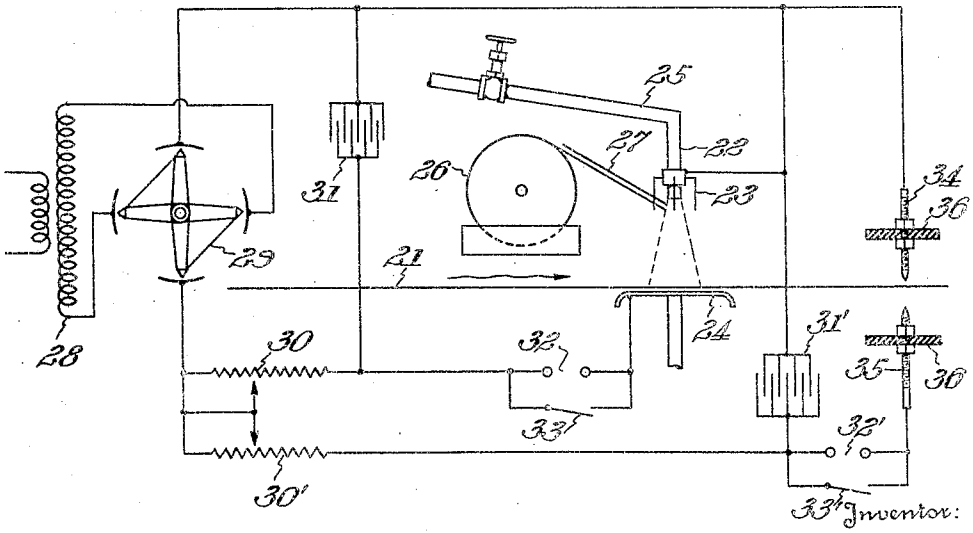


Fig. 2.



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Fig. 3.

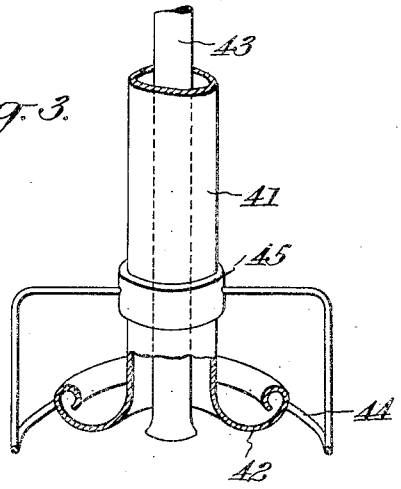


Fig. 4.

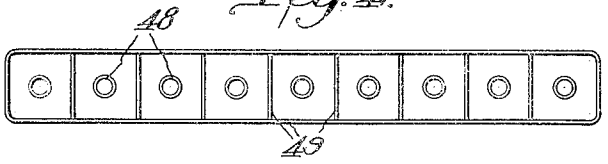
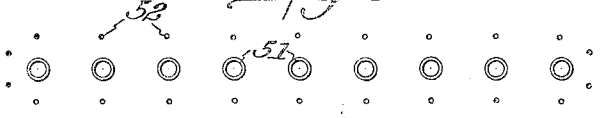


Fig. 5.



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UNITED STATES PATENT OFFICE

2,221,338

DEPOSITION OF MATERIAL

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Application October 21, 1936, Serial No. 106,863

21 Claims. (Cl. 91—8)

This invention relates to the deposition of materials, particularly for the formation of coatings by depositing finely divided materials on surfaces. The invention comprises novel methods and apparatus for effecting the deposition of a wide variety of materials, and is particularly adapted to the deposition of materials which are supplied to a surface to be coated dispersed in or associated with a current of air or other gas.

A principal purpose of the invention is the provision of methods and apparatus for the efficient and economical deposition of materials.

A further purpose of the invention is to provide methods and means whereby the loss of materials and unhealthful atmospheric conditions attendant on the deposition of finely divided materials may be avoided.

Another purpose of the invention is the provision of methods and means for the removal of static charges from coated materials, particularly in conjunction with coating process utilizing electrical methods of deposition or an electrical method of treating the coating material before, during or after deposition.

The invention is not limited to the deposition or coating of any particular type of material, but it is of special value in the deposition of poorly conducting materials to form coatings or impregnations upon a base material. It may be utilized, for example, in the deposition of fibrous particles upon an adhesive covered base to form a simulated pile surface, or it may be used in connection with the deposition of finely divided particles of wax on the surface of freshly printed paper or the like to prevent offsetting of the printed matter on adjacent sheets.

The invention includes the use of corona discharges to aid in the deposition of the materials and to prevent the escape of the materials into the surrounding atmosphere. This is effected by providing a curtain of corona discharge around the area within which the material being deposited is to be confined. In this manner the particles are given an electric charge which is utilized in confining the particles to the desired area and preventing the loss into the surrounding atmosphere. This is particularly desired in operations where the materials are borne to the area of deposition in a current of carrier gas, such as air, as the air flowing away from the area tends to carry away relatively large amounts of the material. This may be wholly or largely prevented by means of the invention.

In this and other methods of depositing involving the use of electrical charges the base upon which the materials are deposited tends to accumulate an electrical charge which is usually disadvantageous in the subsequent handling and treatment of the material and may cause a definite hazard. The invention includes the use of corona discharges to remove such accumulated charges, thereby eliminating hazards and difficulties in handling the material.

The provision of a curtain of discharge about an area to be coated, for example, may advantageously be effected by providing attenuated discharge elements about the member supplying the gaseous current utilized to carry the coating material. These discharge elements, which may consist for example, of a plurality of points or of one or more wires or edged members, are so positioned with respect to an electrode member of extended surface that upon impressing a high potential voltage across the space between the discharge elements and the extended electrode member a curtain of corona discharge emanates from the discharge elements in the direction of the extended electrode. By suitably positioning the elements the curtain of corona can be caused to substantially surround or "fence off" any desired area. It is desirable to impress a unidirectional potential between the electrodes and particularly advantageous results are obtained by the use of a pulsating current characterized by a series of unidirectional impulses of steep wave front. This type of current supply has the advantages over alternating or oscillating impulses and over ordinary unidirectional pulsating current having sine wave characteristics, that it permits the use of higher voltages without causing arc-over, often to the extent of 150% to 200%. The corona discharges produced by this type of current supply have a much greater ionizing effect on the air or other gas, thereby increasing the effectiveness of the curtain. A further advantage of this type of current is that the corona discharge is formed in a substantially continuous line along the wire or discharge edge instead of in spaced tufts of discharge such as are produced by ordinary forms of current supply.

For the same reasons the steep wave front impulses have been found to be particularly advantageous for the energization of the charge eliminating means.

For the purpose of illustrating the invention it will be further described with reference to the accompanying drawings in which:

Fig. 1 is a diagrammatic showing of apparatus embodying the principles of the invention;

Fig. 2 is a diagrammatic showing of a modified embodiment of the invention;

Fig. 3 is a detail fragmentary view in partial section of a supply nozzle constructed in accordance with the principles of the invention; and

Figs. 4 and 5 are plan views of modified forms of supply members constructed in accordance with the principles of the invention.

The apparatus illustrated in Fig. 1, is adapted, for example, to the production of pile surfaced materials by the deposition of fibrous particles, such as rayon flock, on a suitable base, and its operation will be described with reference to the production of such materials.

A base material 1, for example, a web of textile fabric or of paper, is passed, preferably in continuous manner, through the apparatus in the direction of the arrow. An adhesive is supplied to the upper surface of the base by means of coating device 2. The adhesive is not necessary when depositing particles which have adhesive qualities.

The base material then passed through an electric field established between electrodes 3, 4 forming a supply nozzle, and opposing plate electrode 5. The electrodes are energized by means of a circuit including transformer 6, rectifier 7, resistance 8, condenser 9, and spark gap 10. This circuit provides impulses of steep wave front. By closing switch 11 ordinary high voltage unidirectional pulsating current is provided.

Finely divided material, such as rayon flock, is supplied through duct 12 of the nozzle 3 by means of a carrier current of air. The material enters the zone of deposition between the opposing electrodes and is deposited on base 1 both by impact and by electrical deposition. The attenuated electrode members 4 provide a curtain of corona discharge surrounding the zone of deposition which effectively prevents the current of air from carrying undeposited material out of the zone of deposition.

The electrical charge carried by the deposited particles to the base material is removed by passing the base through a further electric field wherein the material is subjected to the action of a corona discharge of opposite polarity to the first field. The second field is established between attenuated electrode 13 and opposed plate electrode 14, although electrodes of other forms such as opposed point or edge electrodes may be used. The electrodes are energized with sharp wave front impulses by means of a circuit including transformer 6, rectifier 7, resistance 8', condenser 9' and spark gap 10'. The spark gap may be eliminated from the circuit by closing switch 11' thereby providing ordinary rectified high potential current.

In the form of apparatus shown in Fig. 2, which is particularly suitable for depositing self-adhesive materials such as wax, the web of base material 21 is passed through the apparatus in the direction of the arrow, first passing through an electrical field established between nozzle 22 carrying attenuated electrodes 23 and opposing plate electrode 24. A stream of air, preferably heated, is supplied to the nozzle through duct 25, and wax is fed to the stream of air by means of feeding drum 26 and feed trough 27.

Unidirectional high potential impulses of sharp wave front are supplied to the electrodes by means of a circuit including transformer 28, rectifier 29, resistance 30, condenser 31 and spark gap 32. The spark gap may be eliminated from the circuit by closing switch 33.

The wax particles are caused to deposit on the web and are prevented from leaving the zone of deposition with the current of air passing off laterally by means of the curtain of corona discharge set up between attenuated electrodes 23 and plate electrode 24.

The accumulated charge on the web is removed by subjecting it to corona discharge of opposite polarity between electrodes 34 and 35, which are adjustably mounted in insulating supports 36. The supply circuit includes transformer 28, rectifier 29, resistance 30', condenser 31' spark gap 32' and switch 33'.

In the apparatus of Figs. 1 and 2, the current supply to both the deposition zone electrodes and the charge removing electrodes can be supplied from a single condenser-spark gap set but flexibility of operation is gained by the arrangement illustrated.

Fig. 3 shows in detail a feeding nozzle which is particularly suitable for the deposition of fibrous materials, such as flock fibers. The lower end 42 of the nozzle 41 is expanded and rounded back so as to avoid the formation of corona discharge immediately adjacent the flock fibers which are fed through supply duct 43. The curtain of corona discharge is formed from attenuated wire discharge electrode 44 which is suspended from the nozzle by means of adjustable collar 45.

Figs. 4 and 5 show nozzle arrangements provided with a plurality of nozzles which may be positioned in the apparatus, for example, so as to extend across a wide web of base material.

In Fig. 4 nozzles 48 are surrounded by edge discharge elements 49 which may be formed of wire or of strips of metal.

In Fig. 5 nozzles 51 are surrounded by point discharge elements 52.

In both cases the discharge elements form a curtain of corona discharge which fences in the material issuing from the nozzle and effectively prevents it from being carried away from the zone of deposition.

I claim:

1. In the deposition of particles of material upon a base by means of a carrier gas stream, the improvement which comprises surrounding the zone of deposition with corona discharge.

2. In the deposition of particles of material upon a base by means of a carrier gas stream, the improvement which comprises surrounding the zone of deposition with corona discharge generated by high potential impulses of steep wave front.

3. In the deposition of particles of material upon a base by means of a carrier gas stream, the improvement which comprises surrounding the zone of deposition with corona discharge and thereafter removing accumulated electrical charges from the material by subjecting it to the action of a second corona discharge of opposite polarity.

4. A method of depositing material on a base which comprises dispersing the material in a stream of gas, bringing the material to the base in said stream of gas, surrounding the stream of gas at the zone of deposition with a curtain of corona discharge and thereafter removing accumulated electrical charges from the material by subjecting it to the action of a second corona discharge of opposite polarity.

5. A method of depositing material on a base

which comprises passing the base through a high potential electric field, bringing the material to be deposited into said field and surrounding the zone of deposition with a curtain of corona discharge.

6. A method of depositing material on a base which comprises passing the base through a high potential electric field, bringing the material to be deposited into said field, and surrounding the zone of deposition with a curtain of corona discharge generated by high potential impulses of steep wave front.

7. A method of depositing material on a base which comprises passing the base through a high potential electric field, bringing the material to be deposited into said field, surrounding the zone of deposition with a curtain of corona discharge and thereafter removing accumulated eletcrical charges from the material by subjecting it to the action of a second corona discharge of opposite polarity.

8. A method of removing electrical charges from a web of material which comprises subjecting it to the action of a corona discharge generated by unidirectional high potential impulses of steep wave front.

9. Apparatus for depositing particles of material upon a surface comprising a conduit for supplying the material adjacent the surface, attenuated electrodes positioned adjacent the mouth of said conduit, an extended surface electrode opposed to said attenuated electrodes, and means for impressing high potential across said electrodes sufficient to produce corona discharge from said attenuated electrodes.

10. Apparatus for depositing particles of material upon a surface comprising a conduit for supplying the material adjacent the surface, attenuated electrodes positioned adjacent the mouth of said conduit, an extended surface electrode opposed to said attenuated electrodes, and means for impressing pulsating high potential across said electrodes sufficient to produce corona discharge from said attenuated electrodes.

11. Apparatus for depositing particles of material upon a surface comprising a conduit for supplying the material adjacent the surface, attenuated electrodes positioned adjacent the mouth of said conduit, an extended surface electrode opposed to said attenuated electrodes, and an electrical circuit including a source of high potential alternating current, a rectifying device, a capacitance, and a spark gap for impressing pulsating high potential impulses of steep wave front across said electrodes sufficient to produce corona discharge from said attenuated electrodes.

12. Apparatus for depositing particles of material upon a surface comprising a conduit for supplying the material adjacent the surface, attenuated electrodes surrounding the mouth of said conduit, an extended surface electrode opposed to said attenuated electrodes, and means for impressing high potential across said electrodes sufficient to produce corona discharge from said attenuated electrodes.

13. Apparatus for depositing finely divided material on a web comprising attenuated electrodes, an extended surface electrode spaced therefrom, means for passing the web between said electrodes adjacent the extended surface electrode, means for impressing a high potential across said electrodes to establish a curtain of corona discharge extending toward said extended surface electrode and means for supplying a stream of gas carrying finely divided material within said curtain of corona discharge.

14. Apparatus for depositing finely divided material on a web comprising attenuated electrodes, an extended surface electrode spaced therefrom, means for passing the web between said electrodes adjacent the extended surface electrode, means for impressing high potential impulses of steep wave front across said electrodes to establish a curtain of corona discharge extending toward said extended surface electrode and means for supplying a stream of gas carrying finely divided material within said curtain of corona discharge.

15. Apparatus for depositing finely divided material on a web comprising attenuated electrodes, an extended surface electrode spaced therefrom, means for passing the web between said electrodes adjacent the extended surface electrode, means for impressing a high potential across said electrodes to estabilsh a curtain of corona discharge extending toward said extended surface electrode and defining an area of deposition on said web, and means for supplying a stream of gas carrying finely divided material within said curtain of corona discharge.

16. Apparatus for depositing finely divided material on a web comprising attenuated electrodes, an extended surface electrode spaced therefrom, means for passing the web between said electrodes adjacent the extended surface electrode, means for impressing a high potential across said electrodes to establish a curtain of corona discharge extending toward said extended surface electrode, means for supplying a stream of gas carrying finely divided material within said curtain of corona dscharge and means for subjecting said web to a further corona discharge of opposite polarity.

17. Apparatus for depositing finely divided material on a web comprising attenuated electrodes, an extended surface electrode spaced therefrom, means for passing the web between said electrodes adjacent the extended surface electrode, means for impressing a high potential across said electrodes to establish a curtain of corona discharge extending toward said extended surface electrode, means for supplying a stream of gas carrying finely divided material within said curtain of corona discharge and means for removing electrical charges from said web comprising opposed electrodes at least one of which is shaped to emit corona discharge and means for supplying a high potential to said electrodes.

18. Apparatus for removing electric charges from a web of material which comprises opposed electrodes at least one of said electrodes being of attenuated shape, a source of high potential alternating current, circuit elements connecting said source with said electrodes including a rectifying device, a capacitance, and a spark gap for impressing unidirectional high potential impulses of steep wave front across said electrodes sufficient to produce corona discharge from said attenuated electrodes, and means for passing the web between said electrodes.

19. A method of removing electrical charges from a web of material which comprises subjecting it to the action of a substantially continuous line of corona discharge generated by unidirectional high potential impulses of steep wave front.

20. A method of forming a pile surface on a base material which comprises coating a surface of the base with an adhesive, passing the ad-

hesively coated base through a high potential electric field, bringing fibrous material into said field and depositing said fibrous material on the adhesively coated base while surrounding the zone of deposition with a curtain of corona discharge.

21. A method of forming a pile surface on an adhesively coated base material which comprises coating a surface of the base with an adhesive, establishing a high potential electrical field between an electrode and the adhesively coated base, bringing fibrous material into said field and depositing such fibrous material on the adhesively coated base while surrounding the zone of deposition with a curtain of corona discharge.

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