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Rosenthal

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[54] **ELECTRODE METHOD FOR THE SURFACE TREATMENT OF THERMOPLASTIC MATERIALS**

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[51] **Int. Cl.** **C08f 47/22,** H01t 19/00

[58] **Field of Search** 204/165, 164, 212, 204/223, 312, 323

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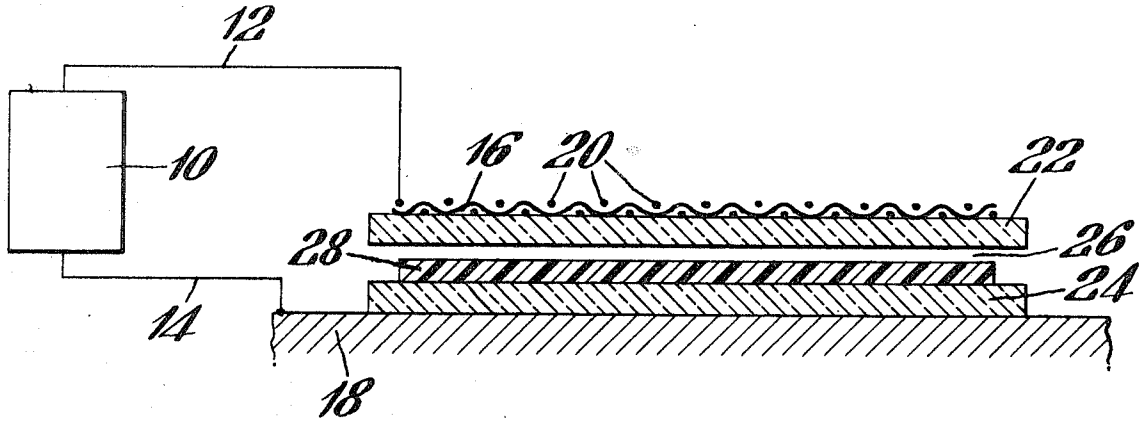
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[57] **ABSTRACT**

In the corona discharge surface treatment of a thermoplastic material body wherein said body is positioned in an air gap between a pair of electrodes across which a high voltage is impressed, the improvement which comprises employing as one of said pair of electrodes a wire mesh comprising a plurality of relatively small diameter conductors spaced to provide a uniform high gradient field and the other of said pair of electrodes being a solid base electrode.

3 Claims, 2 Drawing Figures



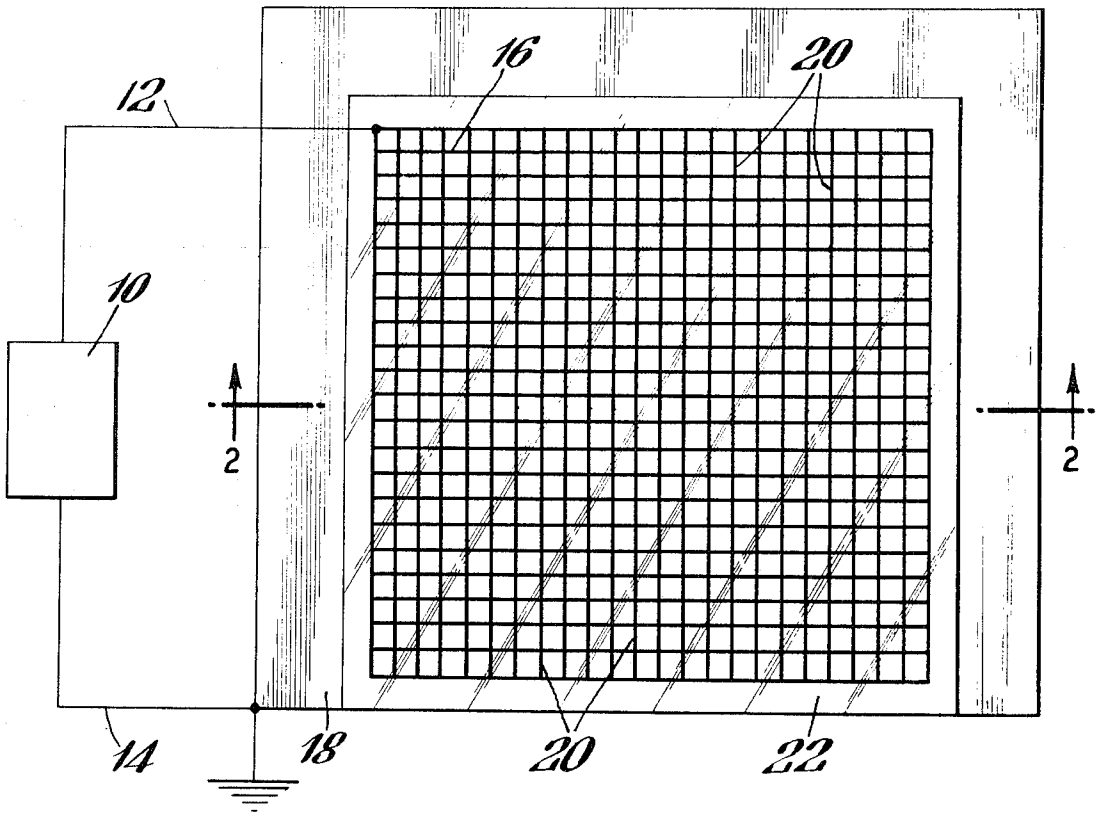


Fig. 1

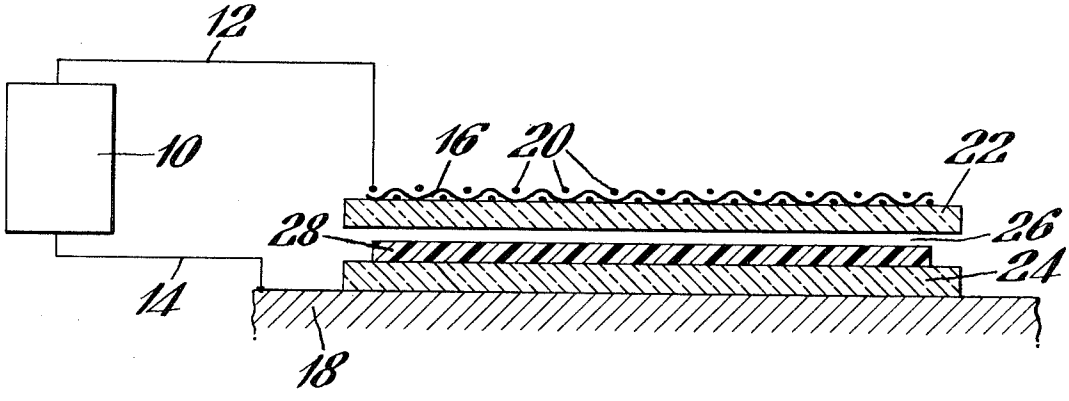


Fig. 2

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ELECTRODE METHOD FOR THE SURFACE TREATMENT OF THERMOPLASTIC MATERIALS

The present invention relates to the corona discharge surface treatment of thermoplastic materials and, more particularly, to such treatment of surfaces of thermoplastic material bodies to improve their adhesion to printing inks, paints, coatings, and bodies of other materials.

While prior systems for effecting such corona discharge surface treatment, employing bar, knife edge, flat and curved plate electrodes, produced generally adequate results, they provided problems in uniformity of distribution of corona discharge across the entire body surface to be treated with consequent non-uniformity in surface treatment.

It is, therefore, the prime object of the present invention to provide a corona discharge surface treatment system having improved uniformity of treatment distribution.

Other aims and advantages of the invention will be apparent from the following description and appended drawings.

In accordance with one aspect of the present invention, a process is provided for the corona discharge surface treatment of a thermoplastic material body, wherein said body is positioned in an air gap between a pair of electrodes across which a high voltage is impressed, and carrying out such treatment while employing as one of said pair of electrodes a wire mesh comprising a plurality of relatively small diameter conductors spaced to provide a uniform high gradient field and as the other of said pair of electrodes, a solid base electrode.

As employed herein, the term "wire mesh" is understood to mean a screen or wire cloth electrode comprised of a plurality of relatively small diameter conductors which are positioned in a uniformly-spaced manner so as to provide a uniform electrical field when the impressed voltage is applied. An electrode, wherein the plurality of conductors are arranged in two transversely crossing sets, is preferred. It is to be understood, however, that the wire mesh electrode may consist of a wire mail mesh which may generally conform to the shape of the surface to be treated. Such a chain mail wire mesh electrode may be employed as long as the air gap spacing necessary for corona discharge film treating is provided.

Such wire mesh electrode system provides the following operational advantages:

1. It is possible to see the corona discharge and thereby assuring uniformity by permitting the adjustment of power output to achieve visual uniformity.

2. The wire mesh, because of the small radius wires producing high voltage gradients, provides many nucleation sites for the corona discharge streamers. There appears to be a tendency to uniformly distribute the discharge and equalize the effects on variations in the air-gap and dielectric (thickness of the body being treated).

3. A wire mesh electrode permits the free flow of the air or other gas supporting the discharge.

4. A wire mesh electrode assists in proper electrode cooling and power dissipation.

5. A deformable wire mesh electrode can be made to readily conform to the surface contours of the body surface to be treated.

It has been found that some thermoplastic materials, particularly those filled with other materials such as fiberglass and electrically conductive materials such as carbon black, metal powders or fibers and the like, exhibit a dielectric weakness and cannot support the electrical voltages normally encountered in a corona discharge (i.e., 8,000 to 30,000 volts). Tracking along the glass fibers and dielectric inhomogenieties are believed to be the cause for this dielectric weakness. Therefore, a buffer dielectric is preferably employed to aid in the voltage stress equalization. This dielectric also provides for corona dispersion. For flat electrodes, glass is an ideal dielectric for this purpose, but materials such as "Hypalon" (a commercial synthetic rubber having a good corona and ozone resistance), ceramics and polyester films can also be employed. The buffer dielectric is a practical accessory to mask dielectric weaknesses, but is not an essential aspect of this invention. Glass plates may be desirably positioned both between the base electrodes and the material being treated and between the wire mesh and the air gap in which the corona discharge is maintained. It is, however, to be noted that dielectric buffer plates do contribute electrical losses to the treating system.

Buffering the electrodes with dielectric plates, although not essential in the treatment of dielectrics, does provide the significant function of dispersing the discharge, since a dielectric buffer insures that no particular area can imbalance in a current "grabbing" process. In the case of poor dielectrics, such as carbon-loaded materials and metallic foils, buffering is mandatory. Double buffering, as well as double wire mesh electrodes, also contribute to the corona discharge uniformity and distribution, particularly if both surfaces are to be uniformly treated.

In accordance with the apparatus aspect of the present invention, treatment apparatus is provided comprising in electric circuit relation with a generator for corona discharge, a pair of spaced treatment electrodes, one of which is a wire mesh comprising a plurality of relatively small diameter conductors arranged to provide a uniform high gradient field and the other of which is a solid base electrode.

An electrode having a wire mesh of ⅛ inch is typically satisfactory. Too large a wire mesh opening results in a focusing action and produces a cross-hatched treatment pattern. Operability is not believed to be critical within any specific mesh size range.

The thermoplastic body to be corona discharge treated is backed at the grounded side by a conducting base electrode which excludes air from the back side, which is not to be treated. In this connection, it is to be noted that it is not necessary to remove all corona from the back side. Incidental back side treatment is not harmful — merely wasteful. This conducting surface may be an inflatable conducting rubber or a compliant conducting cloth or a conducting foam which deforms with the surface forced up against the underside by the inflatable member. The top side of the other electrode is a wire mesh electrode shaped to conform to the surface of the thermoplastic body to be treated but spaced therefrom by an air gap. This air gap can be from about 1/16 inches to ¼ inches, and should be uniform across its length and width. In the case of flat body treatment, the base plate and wire mesh electrodes may be rigid and flat.

In the drawing:

FIG. 1 is a plan schematic view of corona discharge, top surface, treating apparatus embodying the invention; and

FIG. 2 is a sectional schematic view taken along the line 2—2 of FIG. 1.

Referring specifically to the embodiment of the drawing, generator 10 is provided, having conductors 12 and 14 for energizing treating electrodes 16 and 18, respectively. Treating electrode 16 is a wire mesh electrode having a plurality of uniformly-spaced, relatively small diameter conductors 20 arranged in the transversely-crossing wire mesh sets as shown in FIG. 1. Electrode 18 is a grounded solid base electrode.

Buffer dielectric means 22 and 24 may be provided between each of the treating electrodes 16 and 18, respectively, and the air gap 26.

The thermoplastic material body to be treated 28 is positioned in contact with the solid base electrode 18 or its buffer dielectric means 24, when employed. The material body to be treated may be either statically positioned between the treating electrodes or passed as a continuum (film or the like) through the treating zone between the electrodes.

In examples of the practice of the invention, samples were treated by exposure to a ⅛-inch air gap, single glass buffered wire mesh electrode with a 10 to-the-inch mesh. Power input was 8.2 watts-square inch and (starting with exposures of 15 seconds) it became apparent that one second of exposure was sufficient for adequate treatment. Excellent subsequent adhesion to a foamed polyurethane material was obtained. These examples were carried out on fiberglass-filled polyethylene fiber material.

In another example of the treatment of a more difficult material (polypropylene glass reinforced), a typical power level was 270 watts for 10 minutes over a 4-inch by 10-inch area. This corresponds to 68 watt-minutes per square inch or 9.7 KW-minutes per square foot. As a matter of comparison, the energy density levels for typical polymer films are 1 to 2 watt minutes per square foot. This represents a wide range of treating efficacy which is apparently the result of the surface chemistry. It was not possible to treat this material with solid electrodes under any circumstances.

What is claimed is:

1. In a process for the corona discharge surface treatment of a thermoplastic material body wherein said body is positioned in an air gap between a pair of electrodes across which a high voltage is impressed, the improvement which comprises employing as one of said pair of electrodes a wire mesh comprising a plurality of relatively small diameter conductors spaced to provide a uniform high gradient field and generally conforming in shape to the shape of the surface of said body to be treated, and the other of said pair of electrodes being a solid base electrode, while maintaining a buffer dielectric between the wire mesh electrode and said thermoplastic material body.

2. A process as claimed in claim 1, wherein said thermoplastic body to be treated is maintained during treatment in contact with said base electrode and spaced from said wire mesh electrode to provide an air gap therebetween.

3. A process as claimed in claim 1, wyerein treatment is carried out while maintaining a buffer dielectric positioned between each of said electrodes and said thermoplastic material body.

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