

Dec. 8, 1959

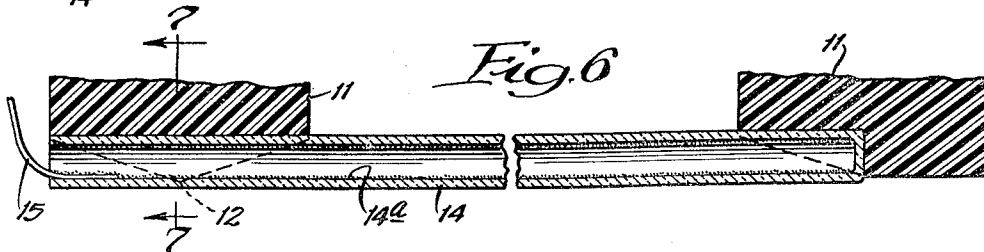
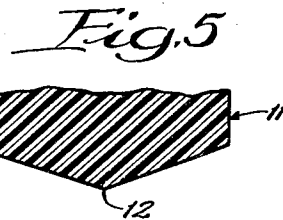
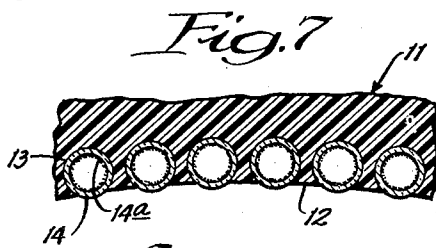
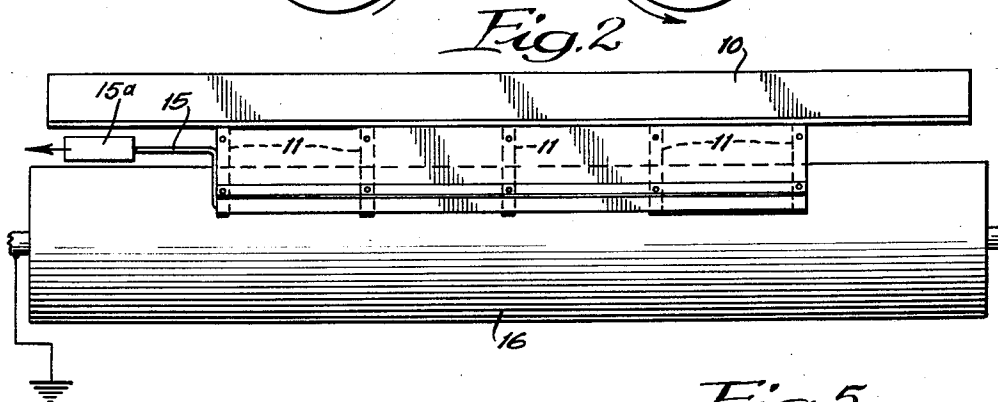
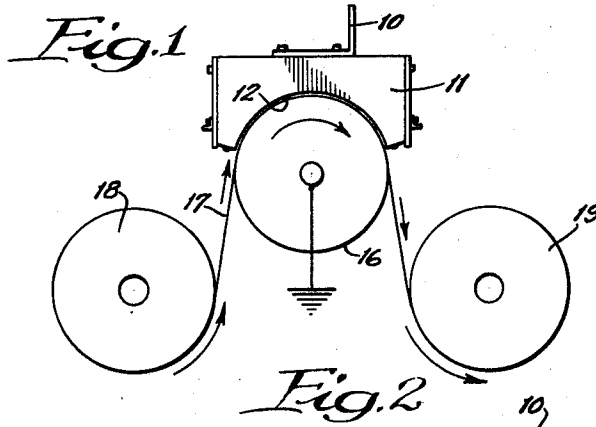
M. F. KRITCHEVER

2,916,620

ELECTROSTATIC DISCHARGE TREATING APPARATUS

Filed Oct. 26, 1956

2 Sheets-Sheet 1



INVENTOR:

Mathew P. Kritchever,

BY *Dawson, Tilton & Graham,*
ATTORNEYS.

Dec. 8, 1959

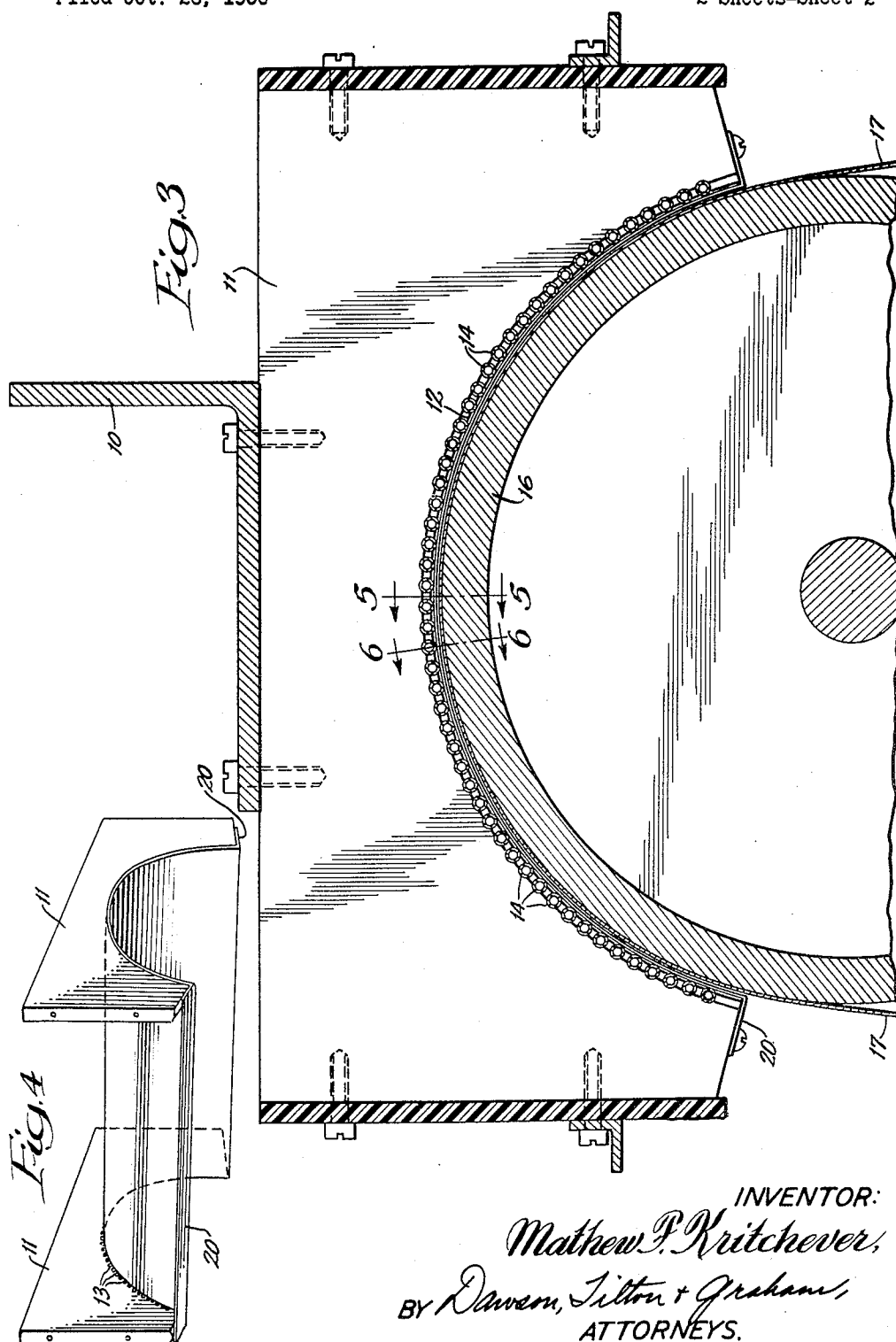
M. F. KRITCHEVER

2,916,620

ELECTROSTATIC DISCHARGE TREATING APPARATUS

Filed Oct. 26, 1956

2 Sheets-Sheet 2



INVENTOR:

Matthew F. Kritchever,

BY Dawson, Tilton & Graham,
ATTORNEYS.

1

2,916,620

ELECTROSTATIC DISCHARGE TREATING APPARATUS

Mathew F. Kritchever, Glencoe, Ill., assignor of twenty-five percent to Horace Dawson, Evanston, Ill.

Application October 26, 1956, Serial No. 618,486

5 Claims. (Cl. 250—49.5)

This invention relates to an electrostatic discharge treating apparatus and to a method of treating various web materials through the application of an electrostatic field about the web material.

Web materials of various types are treated today by electrostatic discharge means for various purposes. As an example, polyethylene films are treated to render the treated polyethylene surface adherent to inks, decorative material, adhesive, coatings, and various other materials. Also, metal foils such as aluminum foil, tinfoil, copper foil, etc., are normally milled and retain a coating of milling oil, which oil must be removed in order to adhere inks, adhesives, etc. thereto. The application of an electrostatic discharge or electron bombardment has been found effective in dissipating or rendering innocuous the oil coating. For the above and many other purposes, and for the treating of various plastics and other web materials, electrostatic discharge means has been found effective in producing the desired results.

One major problem in the treatment of film, as, for example, polyethylene film, is the breakdown of the dielectric element in the electrode system under constant operational stress. This breakdown occurs at highly varying and unpredictable times, and ordinarily in the wrapping on the supporting ground roll or of the same dielectric material used as a shield around the anode. The material normally used has been any one of a variety of thermoplastic materials having a high dielectric constant and high dielectric strength. For example, a polyamide plastic known as Mylar has been employed because of its dielectric strength of 2700 volts per mil in intermittent service but having only about 450 volts dielectric strength per mil in constant service. Mylar, as well as other plastics, lose some dielectric properties through oxidation, etc., which takes place in continuous service.

Another major problem that stems from the dielectric failure has to do with the electrical balance of the system in order to minimize the operating voltages and thereby avoid unnecessary stress on the dielectric material. To achieve the desired electrical balance, heretofore it has been necessary to consider all elements of the electrical apparatus in developing an electrically balanced design. Consequently, a grounded support roll forming the electrode was as much a part of the electrical aspects of the equipment as the anode and the power source. Likewise, the power source, usually a high voltage transformer, was fitted with suitable filter chokes to eliminate the low frequency components of the discharge and thereby enabling a reduced electrode and anode size for a given operational or surface speed.

An object of the present invention is to provide a solution for the above problems and to provide a system wherein there is substantially no breakdown of the dielectric element during continuous operational stress and further to provide an electrical balance of the system which minimizes the operating voltages and thereby

2

avoids unnecessary stress on the dielectric material. A further object is to provide apparatus in which dielectric covered anodes in the form of small and closely associated tubes are employed to overcome the problems above referred to. A still further object is to provide, in apparatus for the electrostatic discharge treating of web materials, tubes of small diameter which bring about a new effect in the treatment of the web material by providing overlapping treating band areas, greatly facilitating the speed of treatment, while at the same time requiring lower operating voltages and avoiding unnecessary stress on the dielectric material. A further object is to provide a treating mechanism in which the overall dimensions of the anode system are substantially smaller than those required heretofore for equivalent permanence. Other specific objects and advantages will appear as the specification proceeds.

The invention is shown, in an illustrative embodiment, by the accompanying drawings, in which—

Figure 1 is an end elevation of apparatus embodying my invention; Fig. 2, a side elevational view; Fig. 3, an enlarged sectional view of a portion of the structure shown in Fig. 1; Fig. 4, a perspective view of a shield device which may be employed with the apparatus; Fig. 5, an enlarged detail sectional view, the section being taken as indicated at line 5—5 of Fig. 3; Fig. 6, an enlarged detail sectional view, the section being taken as indicated at line 6—6 of Fig. 3; and Fig. 7, a detail sectional view, the section being taken as indicated at line 7—7 of Fig. 6.

In the illustration given, I provide a frame member or spine 10 which is fastened to a plurality of spaced anode supports 11 by bolts or other suitable means. The supports or plates 11 are formed of a dielectric material having structural strength such as, for example, paper-based phenolic-impregnated board (Bakelite). The spaced support members 11 have a lower arcuate surface 12 which is provided with a series of small openings 13 adapted to receive small tubes or anodes 14. The openings 13 are formed near the surface 12 and preferably communicate with the surface so that the tubes will be exposed at a radius less than the radius of surface 12.

The tubes 14 may be formed of any suitable material. I prefer to form the tubes of glass and to coat the inner surfaces of the glass with carbon or any other suitable conductive material 14a. The coating material, which is conductive, must closely and uniformly adhere to the interior surface of the tube to prevent internal arcing and formation of localized resistance points. At one end, the tubes are provided with electrical leads 15 which may extend to a transformer 15a or to a high frequency generator, or some other source of high voltage power. A voltage range between 800 and 150,000 volts is operative, but I normally prefer to use the range of 3500 to 12,000 volts, the voltage being used being dependent upon speed, level of surface change required, etc.

The tubes 14 are arranged in an arc concentric with the arc of the support roller 16 mounted for rotation below the tubes 14, and the web material 17 leaves from a roll 18 around the roller to a rewind roll 19, the roller being driven so as to carry the film. The web material is drawn through the electrode system while in contact with and supported by the rotatable ground roller 16, and may be drawn through by means of the rotation of the rewind roll 19, or roller 16 may additionally be powered.

At times, it is desired to treat film or web material having a width less than that of the anode length. I have discovered that in the treatment of polyethylene film, or the like, where the film is less than the length of the anode tubes, a greater power consumption occurs

3

in those areas where the film is not present, while at the same time power suitable for treatment fails to flow through those portions of the anode tubes operating over the film being treated. To adapt the apparatus to the treatment of such film of less length than the tubes, I provide a dielectric shield 20 having greater dielectric strength than the material being treated, which shield is placed outward of the areas being treated and which causes the entire power consumption to be directed toward the treatment of the film web. The shield can be made of any suitable dielectric material such as styrene, Bakelite, Plexiglas, etc.

I have discovered that under given operating conditions, the treatment effect of a small diameter tube is equivalent to the treatment effect of a larger diameter tube. Consequently, it is possible to multiply the treatment action within a given area by placing small tubes close together. I have found that where a small diameter tube is used, the treatment pattern for the necessary term of exposure will provide a treated area wider than the tube width itself. By the suggested close placement of these tubes, an overlapping effect is obtained which in effect multiplies the frequency in the bombardment or discharge field.

By way of illustration, when the anode tube has a diameter of about half an inch, I find that there is beginning to be an overlap in the treating area. When the diameter is greater than this, there is substantially no overlap and, in fact, there may be a gap in the treated area. By reducing the diameter of the tube down to the desired range of approximately 2.7 mm. to 13 mm., full utilization of the treatment effect over the electrode length in terms of web travel direction is achieved; by reducing the tube diameter below 13 mm., the overlap effect is brought into play, and I have found that a given treatment can be effected at a lesser voltage or with the use of fewer small tubes. Unusually effective results are obtained through the giving substantially of a triple overlap through the use of tubes as small as 2.7 to 4 mm.

Wall thickness of the tubes may range from 0.6 mm. to 2 mm., depending upon the specific application. I prefer to employ a dielectric material having a high dielectric strength and dielectric constant. Of those materials ordinarily commercially available, glass, preferably boro-silicate glass, is most suitable because it is available in the form of tubes. Any glass has a high dielectric strength as compared to other dielectric materials, and it does not lose this property in continuous use, unlike some of the less stable dielectric materials. The arcuate arrangement of anode tubes is shown to be very close to the grounded roller support, and I prefer that this distance be substantially less than one-eighth of an inch. It will be understood that when the processed material is not a dielectric material, the shield 20 need not be employed.

While, in the foregoing specification, I have set forth

4

a specific structure in considerable detail for the purpose of illustrating an embodiment of the invention, it will be understood that such details of structure or procedure may be varied widely by those skilled in the art without departing from the spirit of my invention.

I claim:

1. In apparatus for the electrostatic discharge treatment of a web, a grounded roller support for the web, a plurality of dielectric covered anodes in the form of small, closely associated hollow tubes arranged in an arc spaced from said roller and substantially concentric therewith, said tubes having a diameter in the range of 2.7 to 13 mm., means for supplying current to the interior of said anodes at a voltage in excess of 800 volts to form a corona discharge, and means for moving said web over said roller through said corona discharge between said tubes and grounded roller.

2. The structure of claim 1, in which a dielectric shield is movably mounted between the anode tubes and the grounded support roller.

3. In apparatus for the electrostatic discharge treatment of a web, a grounded roller support for the web, a plurality of hollow anode tubes supported in an arc concentric with said roller and spaced therefrom to produce a corona discharge, said tubes having a diameter between 2.7 and 13 mm., a frame support, means for supplying electric current to the interior of said tubes, dielectric plates carried by said frame support and having an arcuate surface above and adjacent the surface of said roller, said spaced plates having near their lower curved surface a plurality of closely-spaced openings receiving the anode tubes, and means for moving said web upon said tubes and roller.

4. The structure of claim 3, in which said dielectric plates are cut away below said tubes to provide openings through which an electrostatic discharge from said tubes may pass.

5. In apparatus for the electrostatic discharge treatment of polyethylene film, a grounded roller support for the film, means for passing the film over said roller, a plurality of anode tubes formed of dielectric material and coated on their interior with a conductor supported in an arc adjacent the roller, means for supplying electric current to the interior coating of said tubes, said arc being substantially concentric with said roller and adjacent to a surface of said roller, said tubes having a diameter in the range of 2.7 to 13 mm., and means for subjecting said anode tubes to a voltage in excess of 800 volts for directing a corona discharge upon said film carried by said grounded roller.

References Cited in the file of this patent

UNITED STATES PATENTS

55	2,778,946	Mayo	Jan. 22, 1957
	2,802,085	Rothacker	Aug. 6, 1957
	2,810,933	Pierce et al.	Oct. 29, 1957