United States Patent

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[54] **APPARATUS FOR ELECTRICALLY CHECKING THE CONTINUITY OF A COATING**
3 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **324/32,** 340/260
[51] **Int. Cl.** **G01r 29/12,** G08b 21/00
[50] **Field of Search** 324/32; 73/150; 340/259, 260

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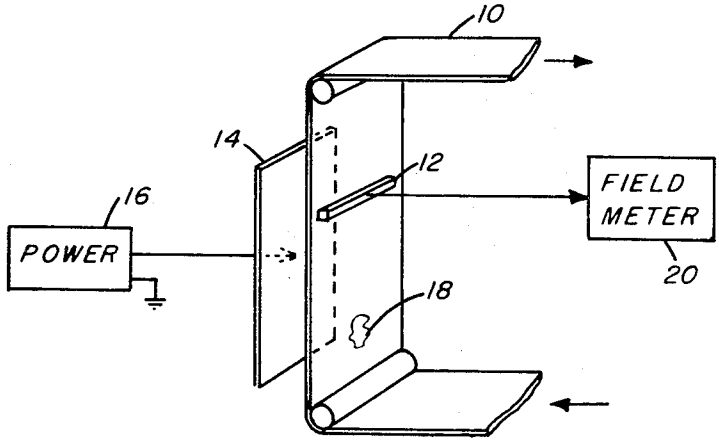
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ABSTRACT: The aqueous coating on a triboelectrically chargeable web is employed, before such coating dries, to shield the charged web from a field meter, thereby to detect skips in the coating.



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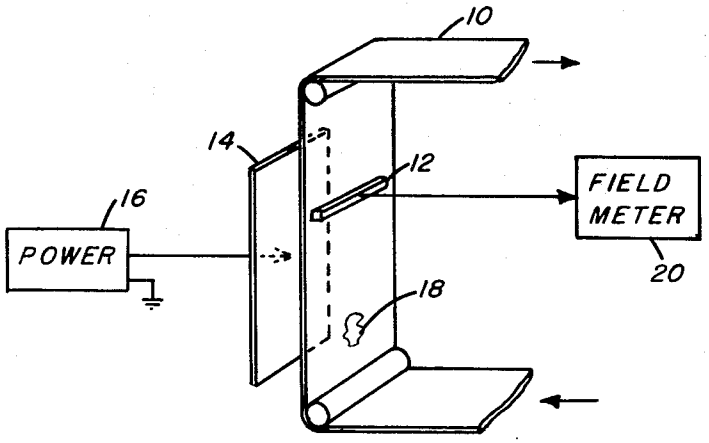


FIG. 1

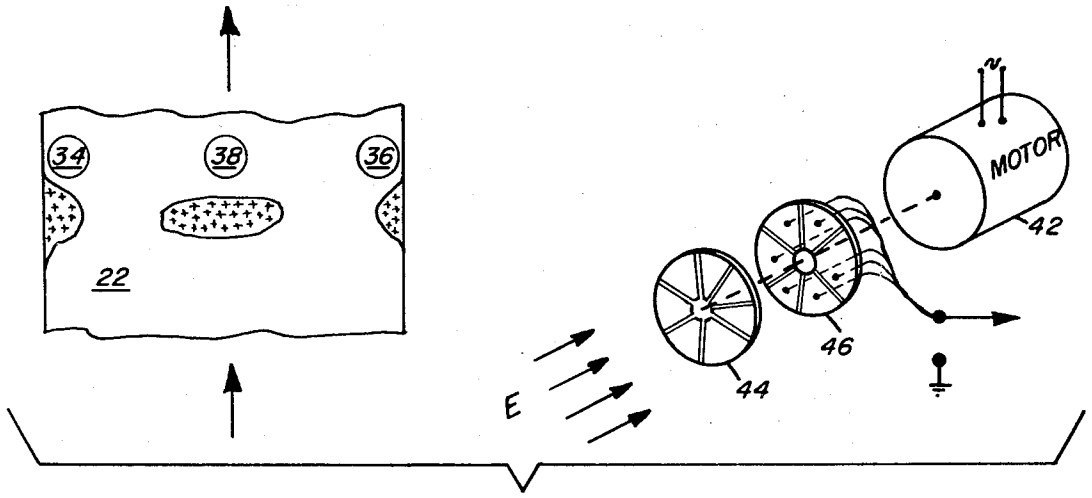


FIG. 3

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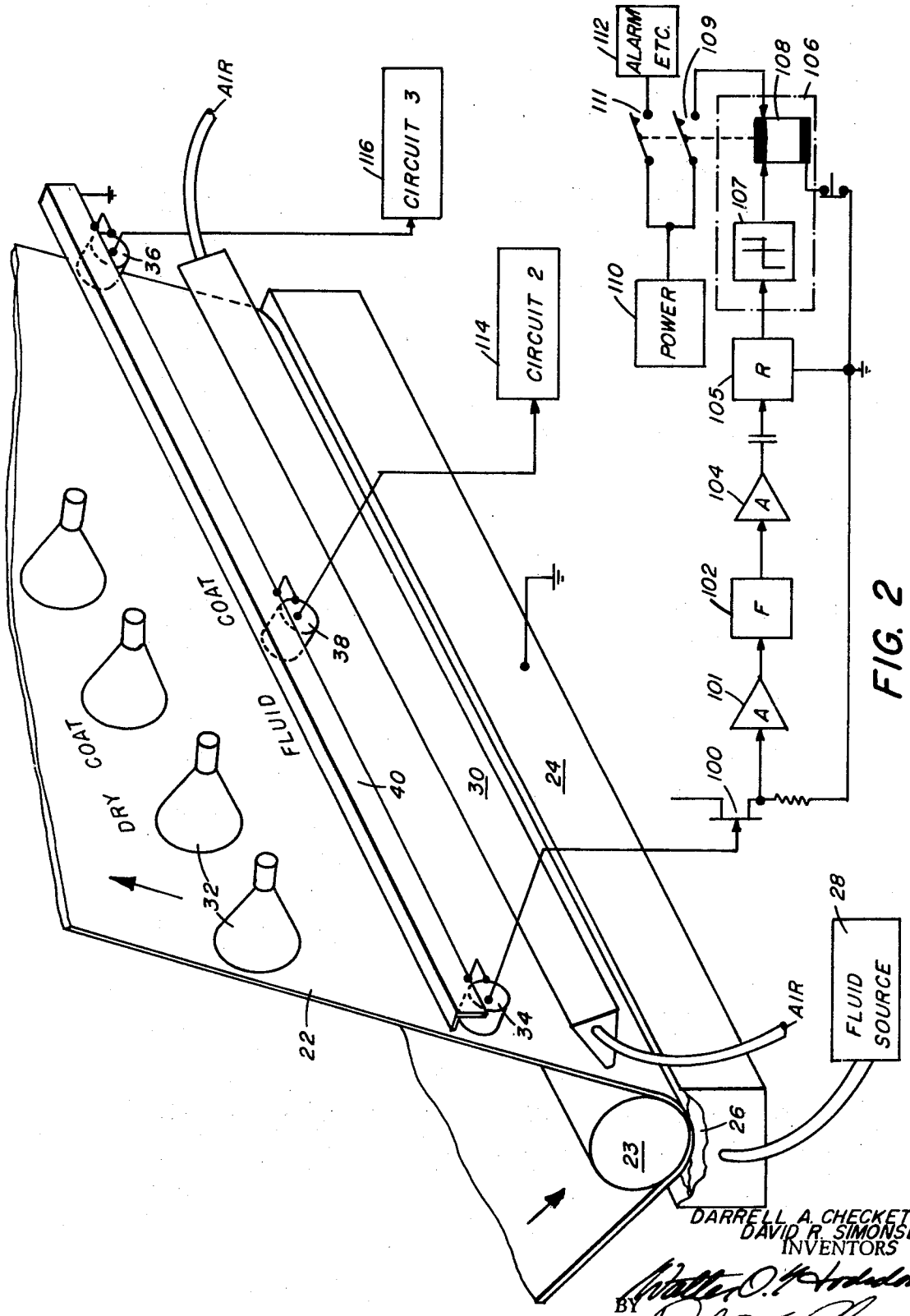


FIG. 2

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APPARATUS FOR ELECTRICALLY CHECKING THE CONTINUITY OF A COATING

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates in general to web handling and checking apparatus; and in particular the invention provides apparatus and methods for inspecting and examining webs which may become electrically charged, and which webs are thereafter coated with a layer which is, at least sometimes, electrically conductive.

The invention is especially useful in the manufacture of photographic film such, for example, as that having a polyethylene terephthalate base.

2. Description Relative to the Prior Art

In the manufacture of polyethylene terephthalate based photographic film, a subcoat is placed on the base to assure proper coating thereof with photographic emulsion. Discontinuities in the subcoat (hereinafter called subskips) will result in ruined, or at least low quality, film because the emulsion coat thereof will not securely adhere to the base in the region of such subskips; and therefore, when developing such film, the coated emulsion will wash off such base.

To assure against subskip-type film defects and thereby provide high quality products, it has been the prior practice to direct a widthwise ribbon of light, through the subcoated polyethylene terephthalate base, onto an array of photocells which are shifted, widthwise of the web, back and forth a certain frequency. On occurrence of a subskip, the light ribbon is modulated, thereby to produce an alarm signal for indicating the subskip. Subskip detection by this procedure leaves something to be desired, primarily because it is directed to examination of the whole of a coated web, and not to the coat itself in particular. Innocuous specks and streaks, or the like, in an otherwise good polyethylene terephthalate web base will modulate the above indicated light ribbon just as easily as will a subskip; and so there is much false alarming with prior art subskip detector apparatus. False alarms, while being objectionable from the standpoint that they cause wasted effort and attendantly higher products costs, are especially undesirable because they create nonreliance, on the part of machine attendants, in their subskip detector apparatus. So, as will happen, attendants will often ignore legitimate subskip-produced alarms simply because they have been too frequently fooled by false alarms. This is perhaps the most serious indictment of the prior practice since it serves to diminish the assurance of finished products which are of the highest possible quality.

SUMMARY OF THE INVENTION

The invention takes into account that when a triboelectrically charged web is coated with a conductive layer (i.e., one having a resistance which is under approximately 150 megohms per square centimeter), the charge on such web is shielded, on its coated side, by means of such coat; and that therefore the coat is question may be used to detect skips in itself. In implementing the invention, it has been recognized that subskips almost always occur at any of three widthwise locations (either edge, or center) of such web; and so examination for subskips across an entire web is unnecessary. As presently preferred, the invention is employed to check for subskips in an aqueous gel which is coated on a web by means of a hopper. By virtue of its being handled, the web becomes charged; and such charge is shielded "so long as the subcoat is "fluid," i.e. electrolytically conductive. The invention suggests the disposition fluid," three field meters—two edge and one center—to look for charge on the coated web, through its fluid coat, and "before such coat "dries." Respective circuits are provided to respond to the field meter outputs, thereby to indicate the presence and locations of subskips.

An object of the invention is to provide improved apparatus and methods for use in conjunction with web handling.

Another object of the invention is to provide improved apparatus and methods for assuring the proper application of electrically conductive coatings to triboelectrically chargeable webs.

Another object of the invention is to provide improved apparatus and methods for detecting skips in an electrically conductive coating on an electrically chargeable web.

Another object of the invention is to provide apparatus for detecting skips in a coating on a web by examining the edges and center of such web.

Another object of the invention is to provide, in a system for, or in a process for, coating a solution having a resistance less than 150 megohms per square centimeter on a triboelectrically chargeable web, the provision for checking for skips in such coating by examining the charge on such web as seen through such coating.

The invention will be described with reference to the figures wherein:

FIG. 1 is a diagram illustrating a basic concept according to the invention,

FIG. 2 is a perspective view, partially in schematic block form, illustrating a presently preferred embodiment of the invention, and

FIG. 3 is a diagram useful for illustrating how subskips occur, and how they are detected.

FIG. 1 has been presented to facilitate description of the preferred embodiment of the invention as in FIGS. 2, 3; and to indicate that the invention has wider implications and, as such, may find use in other processes. FIG. 1 shows a web **10** being conveyed past an inspection station at which a probe **12** is located. The web **10** may be a metal band; or it may be laminar bands of paper and metal as might be employed in the manufacture of capacitors, etc. The probe **12** is disposed proximate the metal band and looks at an electric field emanating from an electrically conductive plate **14**. The plate is excited by means of a power source **16**. So long as the metal band is continuous, the probe **12** is shielded from the plate **14**, and as such cannot see the field. When a break, such as that indicated at **18**, passes beneath the probe **12**, however, the shielding is interrupted, thereby causing the probe to apply a signal to a field meter **20** to register the web break.

With the above as background, reference should now be had to FIG. 2. A web **22** of polyethylene terephthalate material which is to be prepared for coating with a photographic emulsion is conveyed by means of a roller **23** past a hopper **24**. The hopper **24** applies an aqueous solution **26** to the web, and such aqueous solution serves as a subcoat for the photographic emulsion, thereby to assure adhesion of the emulsion to the web. The web **22** moves past the hopper **24** in the direction of the bold arrows indicated on the web. As in common practice, the level of the aqueous solution is maintained by means of a source **28** thereof. To eliminate excess subcoat from the web **22**, an air knife **30** is employed to blow such excess back into the hopper **24**. The air knife **30**, as is usual, has air under pressure applied to its opposite ends, thereby to provide as even an air-knife action as is possible. A plurality of lamps **32** constitute a drying section for readying the subcoated polyethylene terephthalate web for emulsion coating.

It has been found that skips in the subcoat practically always originate and/or reside at the edges of the web **22**, or at about the center of such web. Edge subskips usually occur, it is believed, as a result of fluid-surface tension; centrally disposed skips in the web subcoat usually result from the air turbulence which is created as a result of oppositely charging the air knife **30** with air.

Prior to the subcoat drying section (lamps **32**), but after the air knife, in the direction of web travel, three electric field sensing heads **34, 36, 38** are supported by suitable means on a brace **40**. As is best illustrated in the plan of FIG. 3, two sensing heads **34, 36** are situated at the respective edges of the web **22**; and one sensing head **38** is situated about midway across the web **22**. The sensing heads are preferably less than about 5 inches from the web **22**.

Though the particular form of sensing head constitutes no part of the invention, an understanding of the operation of a presently preferred form thereof is considered helpful for a full appreciation of the invention: A motor **42**, rotates a segmental disc **44**, the segments of which are electrically conductive; and each such segment is electrically connected to the others. A second disc **46**, like the disc **44**, is coaxial with the disc **44**; is adapted to be stationary; and is thus periodically in the complete electrical shadow of the first disc **44** when the first disc rotates. A field E falling upon the disc **44**, as seen by the disc **46**, is modulated at the frequency of the disc **44** rotation multiplied by the number of segments in the disc **44**.

As is well-known, polyethylene terephthalate base is extremely susceptible to triboelectric charging; and voltages (between web and ground) well in excess of 500 volts are common. The invention makes full use of this otherwise objectionable phenomenon by using the charge so produced for the same purpose that the plate **14** of FIG. **1** was employed. Going one step further, the invention employs the conductivity of the subcoat—while such coat is fluid—to shield the web field from the sensing heads **34**, **36**, **38**, the ground path for such shield being via the coat and its source.

As will be apparent from FIG. **3**, the impedance across which each field representative signal is developed is large; and so to detect, say, the signal from the field sensor **34**, a field effect transistor **100**, in a common emitter circuit, is employed for impedance matching purposes, thereby to avoid attenuating the field representative signal. The signal is then amplified by an amplifier **101**.

It was above indicated that the field representative signal is of a frequency equal to the motor (**42**) speed multiplied by the number of disc (**44**) segments. To prevent spurious signals such as the **60** cycle line frequency from adversely affecting subskip detection, a filter **102**, tuned to pass the field signal frequency, is employed; and the output of the filter **102** is applied to an amplifier **104**. Since the field representative signal is an AC signal, it makes no difference, as far as the detection circuit is concerned, whether such signal results from modulating a positive or a negative web-produced field. This feature may be important if the invention is to be employed in other environments and/or with different kinds of webs. A rectifier **105** is provided to convert the alternating field representative signal to its DC equivalent.

A meter relay **106**, functionally representative within dashed lines, includes a dead zone portion **107** and a self-holding relay portion **108**. Meter relays of the type indicated are well known; and the unit known as Compact II, Model 371–K and supplied by API Instruments Company, Chesterland, Ohio 44026, is presently considered preferably. The dead zone portion **107** of the meter relay produces no output signal so long as the signal applied thereto is within certain limits. Thus, if any component **100** to **105** were to fail for any reason; or if the sensor **34** were to produce a field representative signal, the dead zone circuit would produce and apply a signal to actuate the relay **108**. Once the relay **108** is actuated, its self-holding contacts **109** close to assure that power is steadily applied from a source **110** through a relay operated switch **111** to an alarm **112** or similar type circuit.

Circuits **114** and **116**, each like the circuit consisting of elements **100–112**, may be connected to receive the signal from the field sensing heads **36** and **38** respectively, whereby the widthwise location of alarm-producing faults may be determined. It should be noted that if so locating faults is of no importance, the circuits **114**, **116** may be eliminated, the sensing heads **34**, **36**, **38** output leads being all tied to the transistor **100** for alarm purposes.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected with the spirit and scope of the invention.

We claim:

1. In a system for treating a light-transmissive triboelectrically chargeable web of polyethylene terephthalate, said system including, at least in part, means for applying an electrically conductive and light-transmissive aqueous fluid coating to one face of said web, means for drying said fluid coating, thereby making said coating electrically nonconductive, and means for use in moving said web past both said means for applying and said means for drying said coating,

means responsive to electric fields, said field responsive means being disposed, in the direction of web travel, after said means for applying said coating, and before said means for drying said coating, said field responsive means being further disposed proximate, but electrically insulated from, and without touching, the coated face of said web, whereby when a skip occurs in such coating, such skip is detected by said field responsive means which responds to the electric charge on said web which charge has been triboelectrically caused to exist in the web by its movement.

2. The system of claim **1** wherein said means for applying a coating to said web is adapted to apply said coating to said web is adapted to apply said coating across the entire width of said web, and wherein said means responsive to electric fields includes at least three such means disposed, respectively, proximate the opposite edges of said web, and approximately midway across said web.

3. The system of claim **2** including respective alarm means cooperative with said three field responsive means, thereby to indicate not only the occurrence of coating skips, but their general locations as well.