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FOREIGN PATENTS

566,892 1/1945 Great Britain..... 29/132
 637,417 5/1950 Great Britain..... 29/132

OTHER REFERENCES

"Industrial Plasticizers" by Ibert Mellan

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[54] NONCHARGING ROLLER

7 Claims, 2 Drawing Figs.

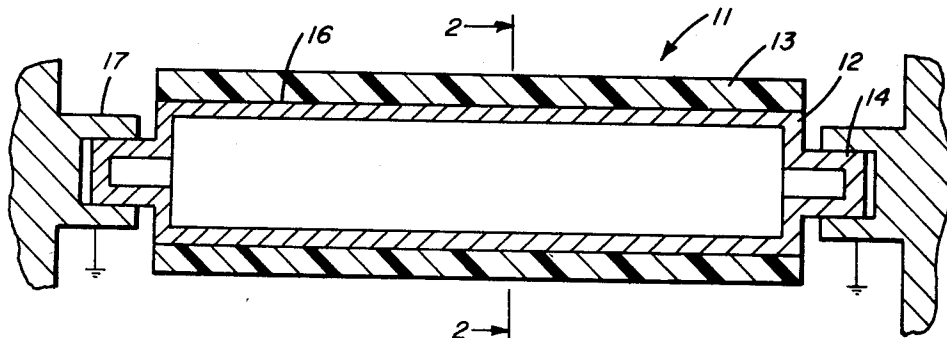
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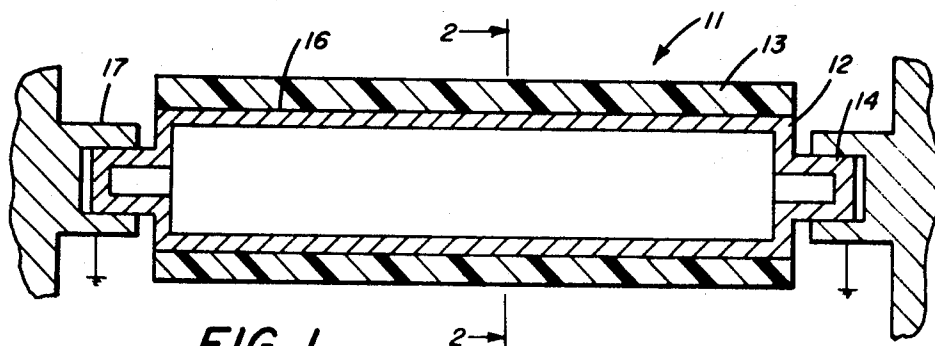
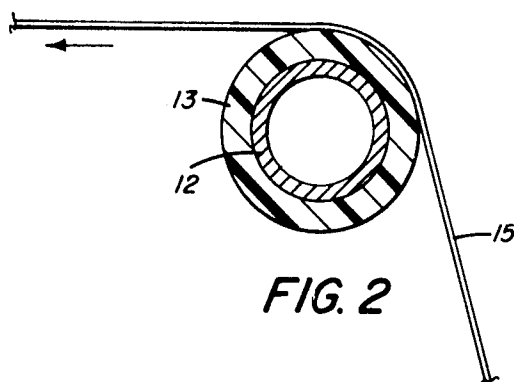
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UNITED STATES PATENTS

2,353,462	7/1944	Harkins.....	317/2 X
2,925,088	2/1960	Roscoe.....	29/132 X
3,370,846	2/1968	Semenhuk.....	317/2 X

ABSTRACT: A device for guiding and handling an article such as a web so that the transfer of static electric charge to or from the web is kept to a minimum when the web and the device are in moving contact. In one embodiment the device comprises a roller with an electrically grounded conductive inner member and an outer member of an elastomeric plastic comprising a mixture of a vinyl chloride resin and alkyl phthalyl alkyl glycolate. The device is particularly useful in the guiding of photographic film since the elastomeric properties of the plastic prevent slip between the device and the web and contact of the film with the device will result in very little static charge being imparted to the film. The device is also antistatic in that no appreciable charge will accumulate on its surface when in use.





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NONCHARGING ROLLER

BACKGROUND OF THE INVENTION

This invention relates to devices for guiding or handling articles under conditions where the handling of the article by the device may result in the transfer of static electric charge to or from the article. More particularly this invention relates to the guiding and handling of webs under conditions where a static electric charge may be imparted to the web by the guiding device.

It is well known in industry that in the handling of webs or the like by passing the webs over rollers or in sliding or moving contact with other apparatus members, particularly under conditions of high speed, a considerable amount of static electric charge will be imparted to the web. This is particularly troublesome in the manufacture of photographic film since the electrified film tends to electrostatically attract dust particles to the film. Attempting to clean the film by brushing or rubbing usually results in higher charges which further increase the difficulty of removing the dust. This problem is serious to the manufacturer of the film who seeks to produce a dust-free film and to the laboratory technician who handles processed films, particularly when there is dust on negative film in the printing process. In addition, if emulsion-coated films become electrified beyond a critical value, discharges occur and fog and other markings are produced on the film.

Various procedures and devices have been suggested in the past for preventing the buildup of charge on the web. Many of these involve the chemical treatment of the web as, for example, in the photographic industry where there is applied to photographic film a separate layer known as an antistatic layer. In addition to surface treatment of the web there has also been suggested the use of guiding devices including a metal support with a special plastic covering thereon for contact with the web. Such a device is disclosed by Wilson in U.S. Pat. No. 2,996,646. Although these procedures and devices have advanced the state of the art in combating the problem of electrification of webs, there is as yet no procedure or apparatus which can satisfactorily entirely combat the problem.

It is important to distinguish the problem of electrifying the web and that of electrifying the roller or guide means. As stated above, the photographic film industry as well as other industries involving the coating of webs have the problem of preventing dust from being electrostatically attracted to the web. The textile industry on the other hand has long known the problem of electrification of the roller or guide means when a web slidably contacts the roller at high speed. It has been found that when the roller is electrostatically charged it tends to attract roving ends and other portions of web material and this causes "lapping-up" or "eye Browing" of the material on the roller, which requires repeated stopping of the machine for cleaning. A number of suggestions have been made for combating the problem of the production of charge on the roller or guide means in the textile industry. These devices are generally known as "anti static" devices and an example of such a device may be seen in U.S. Pat. No. 2,860,382 issued to Garrett. It should be appreciated that the "antistatic" devices as used in the textile industry, for example, do not necessarily possess the noncharging characteristics of desired guide devices which may be used in the photographic industry. Thus a device may have the ability to prevent the buildup of charge on itself but yet may impart considerable charge to a web passing over it. An example illustrating this distinction is in the use of a grounded metal roller. Such a roller may be considered an "antistatic" roller since any charge imparted to the roller by a web passing thereover at high speeds will be immediately transmitted to the ground. However, such a roller cannot be considered a "noncharging" roller since it imparts substantial charge to the web.

Although a device which has "antistatic" properties is important in the photographic industry for preventing the production of light by static discharge it is very important that the device, in addition, have "noncharging" properties as this

too prevents the production of light by static discharge as well as the attraction of dust to the web.

In order for a guide device to give satisfactory performance there are various other qualities which the device must possess. Thus, besides being "antistatic" and "noncharging" the device must also be relatively resistant to wear and tend not to collect dirt. In the case of a drive or cyclometer roller the device must also be highly frictional to prevent slip between the roller and the web to be guided.

Thus, development of a device which is noncharging, antistatic, highly frictional, nonwearing and noncollecting of dirt represents a significant advance in the state of the art.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide means which may be utilized in the guiding and handling of webs with the result that there is substantially prevented the buildup of static electric charge both on the device and on the web. It is another object of the invention to provide a guiding device which does not modify substantially the static electric charge on an article to be guided. It is still a further object of the invention to provide a guiding device for the handling of webs that is noncharging, antistatic, nonwearing, noncollecting of dirt, and having a high coefficient of friction for preventing slip between the device and the webs.

More particularly the device comprises a guide means for minimizing the transfer of electric charge to or from an article with which it is in moving contact, the guide means including a conductive member and an elastomeric plastic member attached to the conductive member and forming the article-contacting surface of the guide means; the plastic member being comprised of a mixture of a vinyl chloride resin and at least one alkyl phthalyl alkyl glycolate. The elastomeric properties of the plastic give the surface of the plastic a high coefficient of friction and thus slip is prevented between the guide means and the article to be guided. It will be appreciated, therefore, that the novel device may be advantageously used as a drive or cyclometer roller, since the absence of slip permits a driving relationship to exist between the roller and a web.

BRIEF DESCRIPTION OF THE DRAWING

The invention and its objects may be more fully understood from the following description, when it is read with reference to the accompanying drawing, in which:

FIG. 1 is a longitudinal cross section of one embodiment of the present invention, the device being in the form of a roller.

FIG. 2 is a transverse section taken along line 2—2 of the embodiment illustrated in FIG. 1 and further illustrating the guiding of a web.

In the embodiment illustrated in FIG. 1, roller 11 is shown comprised of an inner conductive member 12 of metal carrying an outer layer 13 of plastic and metal stub axles 14 for supporting the roller on a grounded frame 17 of a conveyor system. Although the inner conductive member 12 has been described as being comprised of metal, it will be understood that any material which has a volume resistivity of no more than 1×10^{10} ohm-cm. is sufficiently conductive to be used for the inner member. The outer layer of plastic 13 is comprised of a mixture of an elastomeric vinyl chloride resin plasticized by at least one alkyl phthalyl alkyl glycolate. The preferred plastic composition is a mixture by weight of approximately 79 percent vinyl chloride resin, 19.3 percent butyl phthalyl butyl glycolate and 1.7 percent ethyl phthalyl ethyl glycolate. It is believed that the plasticizer renders the outer layer of plastic slightly conductive and thus any charging on the roller itself will be transmitted through the inner member to the ground.

FIG. 2 illustrates the novel roller device 11 in contact with and guiding a web 15 in the direction indicated. The roller will be grounded by placement of the stub axles 14 in a metal frame 17, for example. In the use of the roller 11, the web 15 will contact only the plastic layer 13 which substantially covers the entire area of the web-supporting surface 16 of the

inner member 12. Thus it is apparent that no direct contact between the inner member 12 and the web 15 will be made.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the preferred form of the invention the novel device may take the form of an aluminum roller with a covering layer of plastic. The device may be fabricated in accordance with the following procedure:

An aluminum roller 1½ inches in diameter and 5 inches long is cleaned, and on the cylindrical surface there is forced a piece of plastic tubing having a 2 1/10 inch outer diameter. The surface of the tubing is then ground to a roll diameter of 2.0 inches. The plastic tubing used is comprised of a flexible elastomer of vinyl chloride resin plasticized by an alkyl phthalyl alkyl glycolate and more particularly comprises by weight approximately 79 percent vinyl chloride resin, 19.3 percent butyl phthalyl butyl glycolate, and 1.7 percent ethyl phthalyl ethyl glycolate. This tubing is commercially available from Mayon Plastics, a division of Kennedy Mayonnaise Products, and may be purchased under the trade name Mayon Food Grade R206. Another tubing which may be used is Tygon Tubing, which is commercially available from U.S. Stoneware Company and is essentially of the same composition.

Various film surfaces were tested against the roller fabricated by the procedure described in the above example. These films were conditioned overnight at 75°F and 50 percent relative humidity before testing. Tests were conducted at 60° angle of wrap of film belt around the test roller, 500 grams tension and with belt speeds at 120 and 240 feet per minute on an apparatus similar to that described by H. W. Cleveland, "A Method of Measuring Electrification of Motion Picture Film Applied to Cleaning Operations," 55 J. SMPTE 37-44, July 1950. The results of these tests are as follows:

Table 1

Film Surface	Belt Speed (FPM)	Equilibrium Potential V_e (Volts)	τ_{RP}
Type 3,490, tested emulsion coated surface	120	+ 500	4.24
	240	+ 200	6.39
Kodak Royal Blue Medical X-ray Film tested on emulsion surface wound inside the stockroll	120	- 75	3.04
	240	+ 250	4.13
Kodak RP/S X-Omat Medical X-ray Film tested on emulsion coated surface	120	+ 125	2.32
	240	- 50	2.92
Kodak Verichrome Film tested on emulsion coated surface	120	- 150	7.18
	240	- 150	9.45
Type 5222 tested on emulsion coated surface	120	- 125	3.64
	240	- 125	5.74
Type 5302 tested on emulsion coated surface	120	- 50	3.64
	240	+ 50	5.15
Kodacolor-X Film tested on emulsion coated surface	120	+2,000	5.37
	240	+2,200	9.49
Kodacolor-X Film tested on Pelloid side	120	+ 750	6.63
	240	+ 550	8.58
Kodak Phototypesetting film tested on emulsion coated surface	120	- 150	7.18
	240	- 150	9.45
Kodak Phototypesetting tested on Pelloid side	120	- 300	6.15
	240	- 175	8.58

The charging imparted to film when it is passed over a roller is in accordance with the equation $V=V_e(1-e^{-n/\tau_{RP}})$ where V represents the voltage on the belt.

V_e represents the equilibrium potential which is the maximum potential which the roller can impart to the film passed over it.

τ_{RP} represents the number of roller passes to reach 63.2 percent of V_e .

n represents the number of roller passes.

The tabulated results show that the roller does not charge or discharge to any appreciable degree the web transported over it. The results further show that many roller passes are required to bring the voltage on the web to only 63.2 percent of the equilibrium potential. Although the equilibrium potentials may seem high it will be appreciated by those skilled in the art that these values are relatively low for a roller tested under these conditions especially when compared with the potential required for sparking, which is about 2,000 volts.

The results may further be appreciated by calculating the rise in potential per roller pass. This calculation may be approximated by using a straight line approximation for the curve $V=V_e(1-e^{-n/\tau_{RP}})$ within the region ($n=0, V=0$) to ($n=\tau_{RP}, V=0.632 V_e$). The equation for this straight line is $V=0.632 V_e/\tau_{RP}(n)$

and using any of the values in table 1 the rise in potential per roller pass may be estimated. For example, taking the first test values for the type 3490 film, it can be seen that the potential increase per roller pass $V=0.632(500)(1)/4.24=74.5$ volts. This increase is relatively low, especially when compared to other known devices which are "antistatic," highly frictional, nonwearing, and noncollecting of dirt. All of these properties make this device highly suited for use as a guide means for webs or other attenuated materials.

While I have illustrated my invention with particular reference to rolls used in the manufacture of film, it may also be used in photographic equipment such as in cameras or in film processing devices. In addition, the invention may be used in nonphotographic applications where a noncharging guiding or handling surface is required. Thus, the may be utilized in areas where stationary and/or nonrotating guides are used but where it is desired to minimize the amount of electric charge imparted to the guided article. The invention may also find use in the guiding and handling of charged articles where it is desired to maintain a charge on the article since the device has the ability not to substantially alter the charge on the article passed over it.

It is believed apparent from the foregoing description that improved means have been provided for guiding and handling an article under conditions where static electricity may be transferred to or from the article.

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 within the spirit and scope of the invention.

I claim:

1. A roller for minimizing the transfer of electric charge to or from a web with which it is in driving relationship, comprising:

an inner electrically conductive member;

an outer layer of elastomeric plastic material carried by said member and forming the web-contacting surface of said roller;

said outer layer of elastomeric plastic being comprised of a vinyl chloride resin and at least one alkyl phthalyl alkyl glycolate.

2. The invention of claim 1 wherein said outer layer of elastomeric plastic is comprised of a vinyl chloride resin, butyl phthalyl butyl glycolate and ethyl phthalyl ethyl glycolate.

3. The invention of claim 2 wherein said outer layer is comprised by weight of approximately 79 percent vinyl chloride resin, 19.3 percent butyl phthalyl butyl glycolate and 1.7 percent ethyl phthalyl ethyl glycolate.

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4. A guide means for minimizing the transfer of electric charge to or from an article with which it is in moving contact, said guide means comprising:

an electrically grounded electrically conductive member:

An elastomeric plastic layer carried by said member and forming the article-contacting surface of said guide means;

said elastomeric plastic layer being comprised of a vinyl chloride resin and at least one alkyl phthalyl alkyl glycolate.

5. The invention of claim 4 where said elastomeric plastic layer is comprised of a vinyl chloride resin and butyl phthalyl butyl glycolate and ethyl phthalyl ethyl glycolate.

6. A roller for minimizing the transfer of electric charge to or from a web of light-sensitive photographic film with which

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said roller is in driving relationship, said roller comprising:

an inner electrically conductive member having a surface for supporting a web;

an outer layer of elastomeric plastic material covering said supporting surface and forming the web-contacting surface of said roller;

said outer layer of elastomeric plastic being comprised of a vinyl chloride resin and at least one alkyl phthalyl alkyl glycolate.

7. The invention of claim 1 wherein said outer layer of elastomeric plastic is comprised of a vinyl chloride resin and butyl phthalyl butyl glycolate and ethyl phthalyl ethyl glycolate.

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