Patented Sept. 4, 1928. 1,683,315

UNITED STATES PATENT OFFICE.

RAY L. STINCHFIELD, OF ROCHESTER, NEW YORK, ASSIGNOR TO EASTMAN KODAK COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

PROCESS OF MAKING ANTISTATIC NITROCELLULOSE FILM

No Drawing. Application filed October 9, 1926. Serial No. 140,695.

This invention relates to processes for making anti-static nitrocellulose film. One object of the invention is to provide a simple, inexpensive, easily controlled process of this nature which is harmless with respect to base of the film and to its photographic layers. Another object of the invention is to provide a process of making anti-static nitrocellulose film which does not involve the use or loss of volatile organic solvents or require special or expensive organic coating materials.

The majority of motion picture films comprise flexible, transparent, nitrocellulose bases on which are located light-sensitive photographic layers. In the case of negative films the latter layers are especially sensitive to light and to electrical discharges. Under certain conditions, met with in practice, electric discharges are liable to take place during the use of negative film; and when the latter is developed, undesirable spots called "static" appear on the film where the electric discharges took place. It is possible, but not usual, for such spots to appear even on nitrocellulose film having a less sensitive positive emulsion.

Various alterations in the film have been suggested for the prevention or minimizing of these harmful electric discharges. These alterations have generally been in connection with the unsensitive or "rear" side of the film base, and have either included the use of volatile organic solvents, or special organic coating materials or both.

I have found that motion picture film, either negative or positive, having a nitrocellulose base, may be simply and inexpensively rendered anti-static by superficially hydrolyzing the rear face of the film base by the application of an alkaline solution, thus avoiding the waste or expensive recovery of organic solvents and likewise avoiding the necessity of coating the rear face with any organic or cellulosic materials. The process is very simple and involves only the use of a dilute alkaline solution, such as an aqueous solution of ½ to 5% of one of the hydroxides,—NH_4OH, NAOH, and KOH. Numerous tests have shown that only a few hours' treatment of the rear face of the film with a dilute alkaline solution will render anti-static even the most sensitive negative motion picture film on nitrocellulose base.

I shall now describe several examples of my invention, but it will be understood that the latter is not limited to the details thus given, except as indicated in the appended claims. The treatment is preferably performed on the nitrocellulose base before the latter is coated with the emulsion. While it is essential that the rear face be treated, there is no harm and a slight benefit as regards static, if the other face of the nitrocellulose base, on which the light-sensitive photographic emulsion is to be coated, is also superficially saponified at the same time.

The alkaline solution may be applied to the film base by any of the methods and apparatus customarily employed in the art for applying liquids to film. For example, where both the surfaces of the nitrocellulose base are to be superficially saponified, the film may be immersed in the dilute alkaline solution. Where only one face of the film is to be treated, the alkaline liquid may be applied to it by floating the film on the surface of the alkaline liquid with only one face in contact, or by applying the liquid to the face by means of a roll over which the film is moved, or by means of brushes or wicks against which the rear face of the film is carried. Where the film base is saponified on both faces by immersion, it is, at the end of the treatment, washed by an immersion in water or by spraying of water or by passing through a countercurrent of water. Thereupon it is dried and coated with sensitive emulsion in the usual way.

When the solution of alkali is applied to only one face of the film, it is convenient to suspend the film, while such face is wet with the solution, in contact with moist air, that is, an atmosphere of high or nearly saturated humidity. This keeps the wetted face from drying during treatment. After the nitrocellulose at such face has been superficially saponified by the solution, it is washed with water and dried. This washing may be by means of a spray or a flotation method or a wick or a brush or any other suitable way of applying liquid to only the one face of the film. The film may be also washed by an immersion, spray, or countercurrent system which touches both faces, but I prefer to confine the washing to the treated face only.

While it is preferable, when working on a manufacturing scale, to treat the rear face of the film base by my process before said base is coated with the photographic sensitive

emulsion, nevertheless, it is practical to render anti-static otherwise finished and coated nitrocellulose motion picture film by the application of my process to its rear face. Scrupulous care must be taken to prevent the treating liquid from reaching the sensitive emulsion on the front face. The system of applying the liquid to the rear face only, while guarding the front face, may be one of those customarily employed for dyeing one side only of motion picture films, these being well known to those skilled in the art.

It has been found that a simple aqueous solution of hydroxid of a concentration from ½ to 5% strength is preferable, the best hydroxids being NH_4OH, NAOH or KOH. The use of an aqueous solution of ammonium hydroxid has the very great advantage that it does away with any difficulties about washing, because both the water and the ammonia volatilize away when brought into a drying atmosphere. On the other hand, the use of an ammonium hydroxid solution is best confined to the treatment of the nitrocellulose base before it is coated with the sensitive emulsion. If it is used in treating film which already carries an emulsion, very great precaution must be taken to prevent the ammonia fumes from fogging the emulsion. A 3% solution of any one of the named hydroxids is a good working strength. Thus a motion picture film has been rendered substantially anti-static by having its rear face hydrolyzed by three hours' contact at room temperature with a 3% solution of KOH. Aqueous solutions of NAOH and ammonium hydroxid of equivalent alkalinity will operate successfully within about the same time. Even a shorter treatment, say, for instance, of one and one-half hours, gives a very useful effect and the action may be considerably prolonged without any injury to the film. In all cases the treatment must be stopped before the transparency and flexibility of the film are impaired. There is no danger of impairing the transparency or flexibility of ordinary nitrocellulose films under the conditions stated above.

It will be obvious that in place of aqueous solutions of hydroxids, I may substitute an alcoholic solution, but I prefer to employ the aqueous solutions, because they are cheaper and do not involve loss or expensive recovery of a volatile organic liquid. When an aqueous solution is emplóyed, a small amount of alcohol, say 20% of the weight of the water, may be employed as a penetrant, but this is not essential. Likewise the liquid may be warmed somewhat above room temperature to hasten the action. This is useful, but care must be exercised to stop the action before the transparency and flexibility of the film are impaired.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The process of lowering the static tendency of flexible, transparent, static-producing nitrocellulose film which includes treating the rear face of said film with a solution of an alkali until it is superficially hydrolyzed, the treatment being stopped before its flexibility and transparency are impaired.

2. The process of lowering the static tendency of flexible, transparent, static-producing nitrocellulose film which includes treating the rear face of said film with an ammonia solution until said face is superficially hydrolyzed, said solution being volatilized from said face before the flexibility and transparency of said film are impaired.

3. The process of lowering the static tendency of flexible, transparent, static-producing nitrocellulose film which includes treating the rear face of said film with an aqueous solution of soluble alkali hydroxid, until said face is superficially hydrolyzed, stopping the treatment before the transparency and flexibility of said film are impaired and removing the excess hydroxid from said face.

4. The process of lowering the static tendency of flexible, transparent, static-producing nitrocellulose film which includes treating the rear face of said film with an aqueous solution of ammonium hydroxid until said face is superficially hydrolyzed, stopping the treatment before the transparency and flexibility of said film are impaired, and volatilizing the water and ammonia from said treated face.

Signed at Rochester, New York, this 5th day of October, 1926.

RAY L. STINCHFIELD.