April 21, 1936. E. K. CARVER 2,037,704

CURING CELLULOSE DERIVATIVE SHEETING

Filed May 5, 1933

Fig. 1.

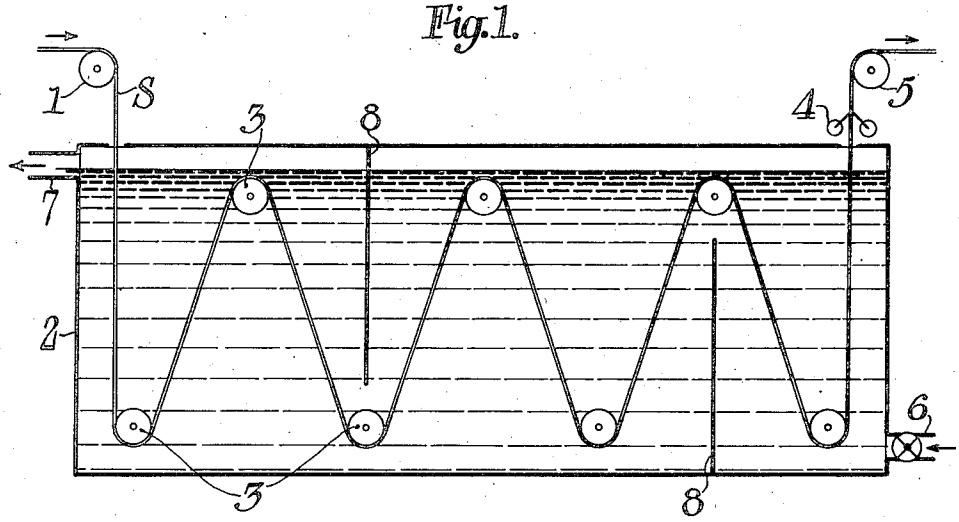
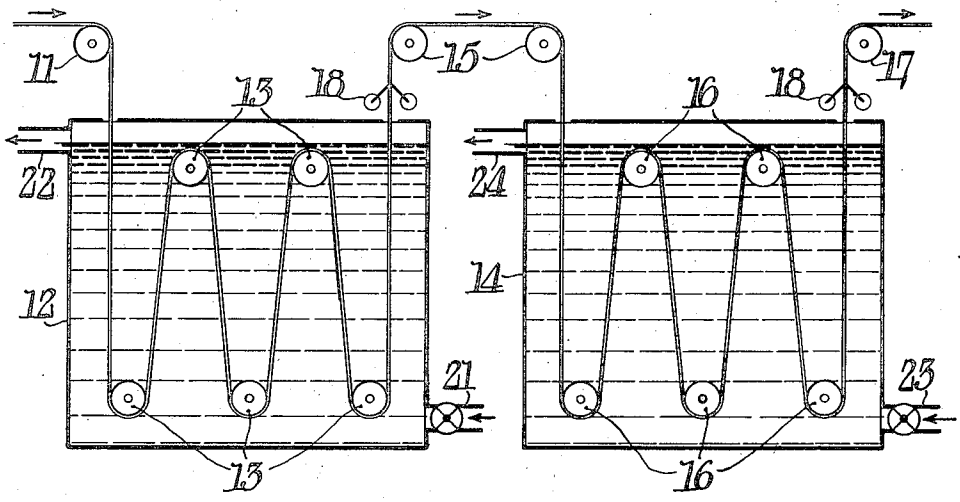


Fig. 2.



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Patented Apr. 21, 1936 2,037,704

UNITED STATES PATENT OFFICE

2,037,704

CURING CELLULOSE DERIVATIVE SHEETING

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Application May 5, 1933, Serial No. 669,538

9 Claims. (Cl. 18—51)

This invention relates to a method of curing cellulose derivative sheeting and more particularly to the treatment of cellulose derivative sheeting with a water bath to remove solvent or solvents from the sheeting, such water bath treatment being termed "water-boxing." Such treatment reduces the shrinkage which would otherwise take place in the sheeting when later, in the form of photographic film, it is subjected to the usual photographic processing baths.

In subjecting cellulose derivative sheeting to water-boxing for the removal of solvents from the sheeting (either single sheeting stock or laminated stock) I have found that the higher the temperature of the water bath, the more efficient the removal of solvent from the sheeting. I have found, however, that too high a water-bath temperature will cause blushing of the cellulose derivative sheeting where the sheeting contains a very large percentage of certain solvents, such for instance as where the sheeting contains more than 1½ to 2% acetone.

Accordingly, it is an object of my invention to produce substantially non-shrinking cellulose derivative sheeting without causing blushing of the sheeting. A further object of my invention is to provide a process adapted to operate at a high or efficient speed. Other objects will appear upon a further perusal of this specification.

In its broadest aspects, my invention comprises conducting a sheet, which contains a solvent, through a bath in which the sheeting is first subjected to a water bath of one temperature and later subjected to a water bath of a higher temperature. This step-wise temperature treatment may be provided in a number of ways, either by introducing the hot water at the tail end of the travel of the sheeting through the water bath and removing the water from the water-box at a point near the commencement of the travel of the sheeting therethrough, so as to obtain a gradual increase in temperature of the water treatment, or by passing the sheeting through a plurality of water-boxes; the first water-box being at one temperature and the subsequent one or ones being at a higher temperature (either equal or progressively higher temperatures). This will become more apparent from the following description.

The attached drawing is a diagrammatic side elevation of apparatus suitable for carrying out my invention, in which

Fig I is a side elevation of a single water-box designed to carry out my invention, and

Fig. II is a side elevation of means for carrying out my invention involving a plurality of water-boxes.

The sheet S is any cellulose derivative sheeting to be subjected to my water-boxing treatment. This sheeting may be any cellulose derivative, such as cellulose nitrate, cellulose acetate, cellulose acetate propionate or the like. This sheet may be a single thickness sheet, such as produced by the well known process of casting a solution of the cellulose derivative upon a polished wheel or belt, stripping the sheet therefrom, conducting it through air-curing sections and then leading it out from the curing section, or it may be a laminated sheet, such as that resulting from the process described by the Van Derhoef Patent No. 1,540,822. In either case, the sheeting contains 1 to 3, 4 or 5%, or even more, of a solvent, such as acetone, ethylene chloride-alcohol, acetone-methyl alcohol, or the like, which must be removed from the sheet, if a sheet of substantially non-shrinking properties is to be produced.

In the apparatus of Fig. I, this sheeting S is lead over the roll 1 into the water-box 2 in which it is conducted up and down over rolls 3 and out through squeegee 4 and over roll 5, from whence it is conducted through an air-drying cabinet (not shown) which removes water clinging to the sheet, from which cabinet it is led out and wound up on a shaft for further use, such as coating it with a photographic emulsion for producing photographic film. The squeegee 4 may be made of strips of rubber, felt or the like as is well known. Substantially pure water is admitted through the line 6 at the right hand end of the water box 2, a suitable valve being provided for controlling the inflow of water. The water overflow at the upper left hand end of the water-box 2 is conducted by a line 7 to the sewer or to recovery apparatus for recovering the solvents removed from the sheeting S. Suitable baffles 8 may be provided for obtaining more thorough circulation of the water through the water-box and around the suspended lengths of sheeting in the tank, the level of the water being preferably maintained so as to fully submerge the sheeting while it is in the water-box. While ordinary tap water may be suitable for curing sheeting which is not to be used for photographic purposes, it is better to employ distilled water when sheeting is being produced which is to be used in the production of photographic film.

By providing a long water-box, such as illustrated in Fig. I, the water may be admitted through the line 6 at a temperature of for instance 200° F. and by the time it passes over the various baffles in the water-box and overflows through the line 7 it will have been reduced to a temperature of approximately 150° F. for instance, so that the solvent laden sheeting is initially subjected to a temperature of, for instance, 150° F. and, as it passes through the water-box is subjected to water of increasingly higher temperatures until it reaches the outlet,

at which time substantially all solvent has been removed.

In Fig. II is shown a somewhat different modification of apparatus for carrying out my invention. In this modification, I employ a plurality of water-boxes 12 and 14 of shorter design than that shown in Fig. I. The sheeting S enters the water-box 12 over roll 11, being conducted down into the water-box wherein it passes over rolls 13, is conducted out over rolls 15 and down into water-box 14 in which it passes over rolls 16 and out over rolls 17 to air-drying cabinets and wind-up as above described. Squeegees 18 may be provided for each tank, as in the case of the water-box of Fig. I. Water is admitted to the bottom of the water-box 12 at, for instance, 160° F. through the line 21 and overflows from this box through a line 22 at a somewhat reduced temperature. Water is admitted at a temperature of, for instance 200° F. to the water-box 14 through the line 23 and overflows from this box to the line 24. The water-box 14 is merely representative of several water-boxes which may be provided, as for instance, I may have two higher temperature water-boxes or even three, if desired, each one being at a successively higher temperature. For instance, if I employ a total of three water-boxes, I may admit the water to the first water-box at 160° F., to the second water-box at 180° F., and to the last water-box at 200° F. Suitable baffles may, of course, be provided in the water-boxes 12 and 14 in a manner similar to their use in water-box 2.

While the precaution of first treating the film with water at a lower temperature is of more importance (to avoid blushing) in connection with a sheeting containing acetone (such as nitrocellulose sheeting), it is readily apparent that my process is applicable to cellulose derivative sheeting containing any solvent, inasmuch as the higher temperature end of the treatment increases the speed of a process which would otherwise employ the lower temperature. For instance, nitrocellulose sheeting from a methyl alcohol dope is not so susceptible to blushing (even when containing a considerable percentage of solvent) but my process gives an increased speed of water-boxing over that which would result from water-boxing at a single temperature equivalent to my initial temperature.

By employing my process, a sheeting is obtained which has practically no shrinkage when, in the form of photographic film, it is subjected to the usual photographic processing baths. The speed of the sheeting through the water-box, or water-boxes, the temperature of the water employed and the speed with which the water is circulated through the water-boxes depends, of course, upon the results which it is desired to obtain. By increasing the flow of water and the temperature thereof, the solvent can be more thoroughly removed from the sheeting. By decreasing the speed of the sheeting through the water-box, it is retained in the water-box longer and is thus more thoroughly cured. The regulation and variation of all of these factors will be apparent to those skilled in the art and the operator of the process need merely to test the sheeting for shrinkage after it leaves the water-box in order to determine whether substantially all of the solvent has been removed and, if it has not, he may vary any of the factors above outlined to obtain the desired result in accordance with the teaching of my invention. Accordingly, it is to be understood that I am to be limited only by the scope of the claims appended hereto.

What I claim as my invention and desire to be secured by Letters Patent of the United States is:

1. The process of curing cellulose derivative sheeting which contains an appreciable percentage of solvent, which comprises passing the sheeting through a water bath which is maintained at a higher temperature in the latter portion of the treatment than it is maintained in the initial portion of the treatment.

2. The process of curing cellulose derivative sheeting which contains an appreciable percentage of solvent, which comprises passing the sheeting through a water-box in which the water is maintained at a successively increasing temperature with the travel of the sheeting.

3. The process of curing cellulose derivative sheeting which contains an appreciable percentage of solvent, which comprises passing the sheeting through a water-box in which the water is maintained at one temperature and then through a second water-box in which the water is maintained at a higher temperature.

4. The process of curing cellulose derivative sheeting which contains an appreciable percentage of acetone, which comprises passing the sheeting through a water-box in which the water is maintained at a successively increasing temperature with the travel of the sheeting.

5. The process of curing cellulose derivative sheeting which contains an appreciable percentage of acetone, which comprises passing the sheeting through a water-box in which the water is maintained at one temperature and then through a second water-box in which the water is maintained at a higher temperature.

6. The process of curing cellulose derivative sheeting which contains more than about 1½% of acetone, which comprises passing the sheeting through a water-box in which the water is maintained at a successively increasing temperature with the travel of the sheeting.

7. The process of curing cellulose derivative sheeting which contains more than about 1½% of acetone, which comprises passing the sheeting through a water-box in which the water is maintained at one temperature and then through a second water-box in which the water is maintained at a higher temperature.

8. The process of curing cellulose derivative sheeting which contains an appreciable percentage of solvent, which comprises passing the sheeting through a water-box in which the water is maintained at a successively increasing temperature with the travel of the sheeting therethrough within the range of 150 to 200° F.

9. The process of curing cellulose derivative sheeting which contains an appreciable percentage of solvent, which comprises passing the sheeting through a water-box in which the water is maintained at a temperature ranging from about 150 to 160° F. and then through a second water-box in which the water is maintained at a temperature ranging from 160 to 200° F.

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