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OPTICAL APPARATUS

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2 Claims. (Cl. 88—28.93)

This invention relates to optical apparatus and in particular to optical rear projection screens and the like and to a fabric suitable for the construction of such screens.

In U. S. Patent No. 2,086,729 I have described the production of optical projection screens, such as are used, for example, in cinematography, from a textile fabric, for example a cellulose acetate fabric, coated with an artificial film-forming material, for example polymerised vinyl acetate, so that the interstices between the threads are filled.

According to the present invention, fabrics suitable as screening material for optical rear projection screens are made by a process which comprises swelling the yarns of a textile fabric to close up the interstices in the fabric and impregnating said yarns with a non-volatile translucent or transparent substance. The term "impregnating" is used to make it clear that the non-volatile translucent or transparent substance penetrates into the interior of the yarns instead of merely remaining as a coating on the outside.

It is of advantage for the fabric to be plain woven and both weft and warp should, at least after swelling and impregnation have the same properties, qua light transmission. This is facilitated by employing a fabric in which not only are there the same number of ends in warp and weft but both are of the same material and same denier.

Preferably the fabric is formed from yarns of cellulose acetate or other artificial film-forming substance and the non-volatile translucent or transparent substance is a plasticiser for the film-forming substance. Instead of or in addition to a plasticiser, however, another film-forming substance may be employed, preferably one soluble in a swelling agent for the substance of the yarns. For example, a fabric of cellulose acetate may be swollen and doped with a solution of polyvinyl acetate in alcohol.

By the process of the invention for the fabric base, the threads even of a loosely woven fabric, can be so swollen that the interstices are filled by the material of the fabric itself rather than by external deposits of the plasticiser or like acting substance. Moreover, the swollen fabric by virtue of its undulating substantially continuous surface behaves as though composed of innumerable small lenses arranged side by side. Light is transmitted much more evenly through a screen produced in this way than through one comprising a similar fabric coated, but not impregnated and swollen, with a film-forming dope, particularly when the fabric is somewhat loosely woven. The invention enables more open or loosely woven fabrics to be employed than is possible in the absence of a swelling agent for the fabric base without undesirable irregularities in the intensity of an image thrown on the screen. This possibility of using relatively loosely woven fabrics is of advantage in enabling light of lower intensity than would otherwise be possible, to be used in forming the image. The advantage is of special importance in connection with television reception screens on which an image is to be traced by a moving pencil of light so that the amount of light available for illumination is limited.

The fabric base employed is, as indicated above, preferably a plain woven fabric. Besides having an equal number of ends per inch in both directions it should be evenly woven of threads of uniform denier. These qualities are not, however, as important in producing the screens of the present invention as they are when the swelling agent for the fabric base is absent. A jappe fabric of cellulose acetate has given particularly good results. More tightly woven fabrics, for example cellulose acetate taffeta, are less satisfactory in that their use involves greater absorption of light in creating the image on the screen.

The swelling is preferably effected simultaneously with impregnation, by the use of solutions of the non-volatile translucent or transparent substance in a swelling agent for the material of which the fabric is composed. The swelling agent may be a single liquid or a mixture of liquids, for example, a mixture of a solvent for the fabric base with a diluent therefor. Thus, for example, in the case of cellulose acetate, the swelling agent may comprise methyl or ethyl alcohol or a mixture of acetone, dioxane or methylene ethylene ether with water or benzene. The non-volatile translucent or transparent substance is preferably a plasticiser for the fabric base. Among plasticisers which may be employed when the fabric base is cellulose acetate are dimethyl phthalate, diethyl phthalate, dimethoxy ethyl phthalate, diethoxy ethyl phthalate, ethyl ethoxyethyl phthalate, ethyl oxyethyl phthalate, methyl ethoxyethyl phthalate, triacetin, diglycerol tetra-acetate, trichlorbutyl phosphate, dimethyl tartrate, dibutyl tartrate, diamyl tartrate and diethyl oxalate. The plasticiser may play an important part in effecting and maintaining the swelling of the fabric and it is therefore an advantage to employ a plasticiser having a high affinity for the fabric base. Thus, the plasticisers

specified above are to be preferred when the fabric base is cellulose acetate to plasticisers having a lower affinity for cellulose acetate such, for example, as tricresyl phosphate and tributyl phosphate which, if used at all, should be used in admixture with one of the plasticisers referred to above, especially triacetin.

As indicated above, the plasticiser may be replaced by a film-forming substance. This should preferably have an affinity for the fabric base. Thus, for example, when the fabric base is cellulose acetate, the film-forming substance with which the fabric is impregnated may be another ester or ether of cellulose, for example, cellulose propionate, cellulose butyrate, cellulose acetate propionate, cellulose acetate butyrate, cellulose acetate nitrate, cellulose acetate nitrate propionate, methyl cellulose, ethyl cellulose or benzyl cellulose; or it may be a cellulose acetate of different solubility properties from the fabric base; or again, it may be a film-forming polymerised unsaturated ester or ether such as polyvinyl acetate, polyvinyl chloride, polyvinyl chloracetate, polymerised methyl methacrylate, or a co-polymer of two or more of such esters.

Even, however, when the fabric is impregnated with a film-forming substance it is of advantage to employ also a plasticiser for the fabric base and this may with advantage be applied in solution in the same solvent as the film-forming substance, the said solvent being a swelling agent for the fabric base. Thus, for example, a cellulose acetate fabric may be impregnated with an alcoholic solution of polyvinyl acetate and one of the plasticisers specified above.

The following examples, in which all the parts are by weight, illustrate the invention.

Example 1

A jap fabric of cellulose acetate artificial silk weighing 1.6 oz. per square yard is run three times through a bath of the following composition:

	Parts
Dimethoxyethyl phthalate	5
Ethyl alcohol	16

at room temperature and at a speed of about 1 yard per minute. After each run the fabric is dried at atmospheric temperature.

After the final drying the fabric is suitably mounted and observed by throwing an image on to it. If the image lacks uniformity of illumination, the fabric is run through a further alcoholic bath of the same plasticiser but of only half the concentration until on drying the desired uniformity of illumination of an image cast on the screen is obtained.

Example 2

A fabric identical with that of Example 1 is sprayed on one side only with four coats of the following solution:

	Parts
Polyvinyl acetate of medium viscosity	10
Ethyl alcohol	48
Acetone	16
Butyl alcohol	16
Trichlorobutyl phosphate or triacetin	5

If a high degree of resistance to fire be required, triacetin is not used and the proportion of trichlorobutyl phosphate is increased to 8 parts. The fabric is tested as described in Example 1 and a further coat of the solution is given if required.

Example 3

A fabric identical with that of Example 1 is run through a bath of the composition of the spraying solution in Example 2 at a speed of about 1 yard per minute until the weight has been increased by about 1.5 oz. per square yard. The fabric is tested as described in Example 1 and may be given a further coating if necessary.

Example 4

The process is carried out as in Example 3 except that the fabric is drawn from the bath past a doctor blade adapted to remove or reduce the coating on one side of the fabric.

In consequence of the conformation produced by the swelling it is not essential to apply finely divided light-dispersing or refracting substances to the fabric in order to produce a desirable matt effect. If desired, however, the impregnating solution may contain such substances, for example finely ground quartz, zinc oxide, titanium oxide, barium sulphate or other white or colourless pigmentary substances. Or a coating or coatings containing such substances may be applied to the doped fabric. The following examples illustrate the application of such coatings.

Example 5

A fabric obtained according to any of the preceding examples is sprayed with the following mixture:

	Parts
Cellulose acetate	60
Dibutyl tartrate	32.7
Tricresyl phosphate	5.9
Acetone	108
Ethyl alcohol	47.2
Benzene	50.8
Ethyl lacetate	45
Silica	30

This coating imparts a matt surface to the screen material. The coating may be applied so that the density thereof diminishes from the centre towards the edges of the screen in order to avoid any danger of the so-called "hot-spot effect" but this precaution is, in general, unnecessary with the screens of the invention.

Example 6

The process is carried out as in Example 5, except that the coating solution for producing the matt effect has the following composition:

	Parts
Cellulose acetate	100
Dibutyl tartrate	30
Tricresyl phosphate	20
Acetone	108
Ethyl alcohol	47.2
Benzene	56
Diacetone alcohol	27
Diglycerol tetra-acetate	100
Zinc oxide	100

The invention has been described above with particular reference to the use of cellulose acetate as the fabric base. Other fabric bases can, however, be employed and among these, the film-forming substances referred to above in connection with the impregnation step are of particular importance.

Having described my invention, what I desire to secure by Letters Patent is:

1. Process for the production of fabric rear projection screens, which comprises swelling a jap fabric weighing 1.6 ounces per square yard, the

warp and weft yarns of which are of substantially the same denier and of cellulose acetate, by treatment with a liquid containing a volatile organic swelling agent for the material, a plasticizer having a high affinity for the cellulose acetate and polyvinyl acetate followed by evaporation of the organic swelling agent leaving the plasticizer and the polyvinyl acetate in the fabric so as to effect a reduction of the interstices in the fabric.

2. An optical rear projection screen comprising a jap fabric weighing 1.6 ounces per square yard, the warp and weft yarns of which are of substantially the same denier and of cellulose acetate, the yarns of said fabric being permanently swollen and containing a plasticizer having a high affinity for the cellulose acetate, whereby the interstices of the fabric are reduced and said fabric being doped with polyvinyl acetate.

WILLIAM HENRY MOSS.

CERTIFICATE OF CORRECTION.

Patent No. 2,294,477. September 1, 1942.

WILLIAM HENRY MOSS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 39, for "Ethyl lacetate" read --Ethyl lactate--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 29th day of September, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)