March 28, 1961 R. J. MANN ET AL 2,976,713

APPARATUS FOR COLORING TEXTILE MATERIALS

Filed Aug. 7, 1957

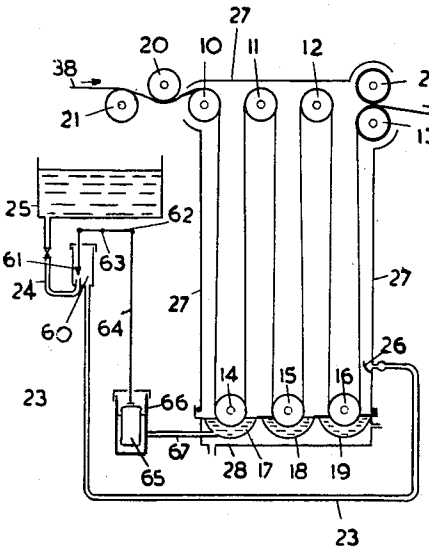


FIG. 1

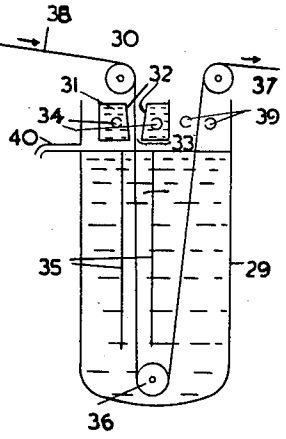


FIG. 2

United States Patent Office 2,976,713 Patented Mar. 28, 1961

2,976,713

APPARATUS FOR COLORING TEXTILE MATERIALS

Ralph James Mann, Spondon, near Derby, and James Adam Grant, Wollaton Park, Nottingham, England, assignors to British Celanese Limited, a corporation of Great Britain

Filed Aug. 7, 1957, Ser. No. 676,763
Claims priority, application Great Britain Aug. 23, 1956
1 Claim. (Cl. 68—22)

This invention relates to the colouring of textile material consisting of or containing cellulose acetate fibres.

We have found that the cellulose acetate content of textile materials comprising fibres of cellulose acetate can very satisfactorily be coloured with any of a large range of dyes by a relatively short contact with a solution of the dye in a mixture comprising water, a lower fatty alcohol and a lower fatty acid in suitable proportions. Sulphuric acid or hydrochloric acid or other strong mineral acid may also be present. Following the relatively short contact between the dye solution and the material, the latter should be washed with water and then may be dried.

The dyes may be such as display little or no affinity for the cellulose acetate when presented thereto in the form of conventional aqueous baths. Thus we may use direct cotton dyes, acid wool dyes, sulphonated metallised dyes and unsulphonated metallised dyes, including both unsulphonated metallised dyes substantially insoluble in water, and unsulphonated metallised dyes which are soluble in water and dye wool from neutral or slightly acid baths. As mentioned above, the dye liquids may contain sulphuric acid, this being particularly useful when sulphonated dyes are employed. By the new process it is possible to obtain on cellulose acetate dyeings of extremely good resistance to washing or similar wet treatment.

By the term "lower fatty alcohol" we mean methyl, ethyl, normal-propyl and isopropyl alcohols. By the term "lower fatty acid" we mean formic acid or acetic acid.

In the case of colouring textile material of acetone-soluble cellulose acetate, the alcohol content of the dye liquor may be 100–250 grams per litre, especially 120–160 grams per litre, the lower fatty acid content 150–250 grams per litre, particularly 170–220 grams per litre, and the sulphuric acid content where employed, up to 6 or 8 grams e.g. 2–6 grams per litre. Preferably, when formic acid is present, the content thereof does not exceed 160 or 180 grams per litre, but formic acid is advantageously present to the extent of at least 100 grams per litre. It is preferred that the content of lower fatty alcohol and lower fatty acid together should not exceed 400 or 450 grams per litre.

The concentrations of the lower fatty alcohols and the lower fatty acids may be such as would, at the temperature employed and if the action of the dye liquor were continued for as long as 15 minutes or 30 minutes, so plasticise the material as to render manipulation on a commercial scale very difficult or even impossible.

The dye liquids may with advantage contain a small proportion of a wetting agent, for example isopropyl naphthalene sulphonic acid or an acid sulphate of a fatty alcohol containing 8 or more carbon atoms. A very suitable wetting agent is the acid sulphate mixture obtained by the action of sulphuric acid on a mixture of aliphatic monounsaturated hydrocarbons containing from about 8 to about 14 carbon atoms in the molecule.

A dye liquid very suitable for the purposes of the present invention comprises the dye and water and contains

200 ccs. per litre of isopropyl alcohol (86% strength by weight), 120 ccs. per litre of formic acid (85% strength by weight), 80 ccs. per litre of acetic acid (98% strength by weight), 4.5 grams per litre of sulphuric acid (98% strength by weight) together with, if desired, 2 ccs. per litre of "Teepol 530." Such a bath contains about 138 grams per litre of isopropyl alcohol, 122 grams per litre of formic acid, 83 grams per litre of acetic acid and 4.4 grams per litre of sulphuric acid all calculated as anhydrous substances.

The time of contact between the dye liquid and textile material may be from 5 to 60 seconds and in general very satisfactory results can be obtained with mixtures containing the above specified proportions of ingredients by using a time of contact of 10 to 30 seconds. The time of contact need not exceed about 2 minutes but may be longer.

The dye liquids may be employed at temperatures in the neighborhood of that of the atmosphere, e.g. at 20 to 35° C. and particularly 25 to 35° C.

Following the contact between the material and dye liquor, the action of the latter on the material is conviently terminated by washing the material with water.

In the textile materials coloured according to the new process, the cellulose acetate may be in the form of continuous filaments or in the form of staple fibres. The materials may be woven or knitted fabrics (including carpets), yarns, bundles or tows of continuous filaments, rovings, slivers, laps or loose staple fibre. The textile material may consist wholly of cellulose acetate fibres or they may be in part of these fibres and part of fibres of other substances, for example fibres of natural or regenerated cellulose, wool or other animal fibres, or fibres of fibre-forming polyamides, such as the well-known nylon 6 or nylon 66. In general when colouring such mixed material, fibres of natural or regenerated cellulose remain substantially uncoloured. Wool likewise undergoes little coloration, but fibres of nylon 6 or nylon 66 are usually strongly coloured and often to substantially the same degree as the cellulose acetate fibres.

Various methods may be employed for effecting the relatively short contact between dye liquid and cellulose acetate material, but continuous treatment methods are preferred. Indeed, the dye liquids used according to the present invention are particularly suited for continuous processes of colouring by reason of the very short time of contact with the material that is sufficient for effecting satisfactory coloration of the latter. Thus the textile material may be padded with the dye liquid, for example on a padding mangle of the kind in which the material is given a short passage through the dye liquor and is then squeezed between rollers so as to leave a predetermined proportion of dye liquid thereon; the material may then be passed from the padding mangle directly to a washing device in which it is washed with water; the rate of travel of the material and the path of the material from the point at which it first meets the dye liquor, should be such as to afford the requisite time of contact.

If a time of contact of 20 seconds or more is required and say a speed of 10 yards per minute is employed, a conventional padding mangle being used, the material is flooded with dye liquor only at the outset of the period of contact. We have found that from the point of view of uniformity and penetration much better results can be obtained if the arrangements for contacting the travelling material with the dye liquor are such that the latter floods the fabric at a point well along its path, for example at least half-way along its path, while in contact with the dye liquor. To this end the material may be run through a body of the dye liquor so that it is in contact with the latter for at least half the total time of contact desired.

For instance, a fabric may run through the dye liquor in a tank the latter containing guide rolls providng for the fabric a path of say 10 feet or more. Again a fabric may be passed down one limb and up the other limb of a U-shaped container having the dye liquor therein, or it may be passed horizontally through a shallow tray containing the dye liquor. At the exit end the fabric may be passed through squeeze rolls and thereafter led to a device for washing the fabric with water and, if necessary, for neutralising any residual acid. The dye liquor content of the tank, U-shaped container, or tray, should remain substantially constant while the fabric is being passed through it. To this end the necessary make-up dye liquor is fed continuously to the container, preferably at or near the point at which the fabric leaves the latter. It is advantageous to distribute the inflowing dye liquor more or less uniformly across the width of the fabric. Bundles or tows of continuous filaments or other products having sufficient strength may be treated similarly. Again loose staple fibre may be coloured by passing it through the dye liquor as a layer on a suitable support, for example a band of wire mesh.

It is in practice difficult to devise continuous-treatment devices of the foregoing types in which the liquid content of the container (in relation to the rate of passage of material) is sufficiently small for the economical colouring of small batches of material, say 100 lbs. or less. It will be appreciated that the tank or other container must hold its full charge of dye liquor up to the end of processing if uniform colouring is to achieved, and this amount of liquor represents a serious loss when a small batch of material only is processed. Thus a tray 10 feet long, 40 inches wide and 1 inch deep, such as would be desirable when processing 40 inch wide fabric at 30 feet per minute with a 20 second time of immersion, would contain a standing charge of the order of 150 lbs. of dye liquid; this quantity would be sufficient, if it could all be used up, to process approximately 150 lb. of fabric or say 600 yards if the fabric weighed 4 ounces per square yard.

We have found that, without sacrificing speed and uniformity of dyeing, a very great reduction in the minimum quantity or standing charge of dye liquor required to process a fabric of given width can be effected if the fabric is given 2 or more very short passes through bodies of dye liquid with an intervening run or runs through air to make up the desired total time of contact between the material and the liquor. In this way for instance, the standing charge may be reduced to a small fraction of that otherwise necessary, e.g. to one-fifth or one-tenth or less. This renders possible the economical processing of correspondingly smaller batches of fabric. As the fabric passes through the bodies of dye liquor the necessary make-up liquor is advantageously fed to the final body, the earlier bodies being maintained by overflow from later bodies counter to the travel of the fabric. The point at which final flooding of the fabric with the dye liquor is effected is preferably at least half-way along the path of the fabric while in contact with dye liquor. In practice it has been found convenient and effective to use three bodies of dye liquor; following passage through these the fabric may be squeezed to a predetermined liquor content and then forwarded directly into water. The same principle may be used when processing textile materials other than fabrics.

A form of apparatus in accordance with this invention is shown in the accompanying drawing in which

Figure 1 is an end view of the dyeing apparatus, and

Figure 2 is a similar view of a washing apparatus suitable for use in conjunction with the apparatus of Figure 1.

The dyeing apparatus comprises a series of upper rollers **10, 11, 12, 13,** preferably driven, and a series of lower rollers **14, 15, 16** which are respectively at least partly within troughs **17, 18, 19** adapted to contain dye liquor; each trough advantageously fits closely around part of the circumference of the associated roller; preferably the clearance between the lower part of the roller and the trough is not substantially more than the minimum desirable for easy passage of the fabric beneath the rollers, e.g. ¼ inch. Using a 3 inch diameter roller 40 inches long the volume of liquid required to fill the trough up to the axis of the roller may be as little as 2 litres, representing 4 lbs. or so of dye liquor and need not be more than 3 or 4 litres. The fabric enters the device via forwarding rollers **20, 21,** passes over the first upper roller **10,** travels down and under the lower roller **14,** through the associated trough **17,** up and over the next upper roller **11** and so on through the series of rollers and troughs. The fabric leaves over the upper roller **13** which preferably co-acts with a further roller **22** to squeeze the fabric so that the latter continues forward carrying a predetermined proportion of dye liquor. In order to maintain the level of liquor in the troughs means are provided for feeding dye liquor to the last trough **19** from which it overflows to the preceding trough **18** and so on, thus maintaining the levels in all the troughs. Conveniently the feed to the last trough **19** is controlled by the level of liquid in the first trough **17.** Thus, a feed line **24** from a supply tank **25** protrudes into a chamber **60.** A valve **61** is adapted to fit into the end of the feed line **24,** the valve being connected to one end of a lever **62** pivoted at **63;** the other end of the lever **62** is connected to a rod **64** which extends vertically downwards towards a float **65** in chamber **66.** This chamber **66** is directly connected by a pipe **67** to trough **17** so that when the level of liquor in trough **17** reaches a predetermined point the float **65** lifts rod **64** and so tips the lever **62** about its pivot **63** to force valve **61** into the end of the feed line **24** thus cutting off the liquor supply in the main feed line **23.** In place of the float-operated valve any other device for attaining the same end may be employed. It is desirable that the liquid fed to the last trough should extend uniformly along the length of the trough, that is parallel to the width of the fabric. To this end the liquid may be fed from line **23** to a small trough **26** disposed above and parallel to the trough **19** and permitted to overflow into the latter. The whole series of upper and lower rollers may be enclosed in a suitable casing **27** in order to minimise loss by evaporation of components of the dye liquor. The troughs **17, 18** and **19** may be provided with a water jacket **28** for temperature control purposes.

As already indicated, the action of the dye liquor on the fabric or other material is conveniently and advantageously terminated by washing the material with water. For use in conjunction with the roller and trough device described above, a convenient washer is one of the kind in which a fabric is carried vertically downwards into a body of water by the flow of water over two weirs, one being disposed on each side of the fabric. Such an apparatus is shown in Fig. 2 and comprises a tank **29,** a roller **30** above said tank and a trough **31** below the roller and extending parallel thereto across the tank **29.** A pair of weirs **32** extend lengthwise within said trough and their lower ends terminate at or below the edges of a slot **33** in the bottom of the trough, with which edges they form a liquid-tight joint. Perforated pipes **34** for feeding water into the trough **31** extend along the latter, one on each side of the weirs **32.** Below the trough **31** a pair of baffles **35** extend vertically downwards into the tank towards a roller **36** disposed near the bottom of the latter. A third roller **37** above the tank is provided to guide away the fabric **38** fed downwardly between the weirs and under the bottom roller. Spray pipes **39** may be provided for spraying water on to the two sides of the fabric immediately above the water level in the tank. An overflow **40** for water is provided in the side of the tank remote from the spray pipes **39.**

As already mentioned, the dyes employed in our new colouring process may be acid wool dyes. Examples of

such dyes are, for instance, Azo Rubinol 3 GP, Croceine Scarlet 3B, Coomassie Blue GL, Artol Blue B, Carbolan Yellow 4 GS, Carbolan Crimson 3 BS and Alizarin Brilliant Green G. Again direct cotton dyes may be employed, for example Chlorazol Fast Red F, or cellulose acetate disperse dyes. The new process is however of especial value for the application of metallised dyes to cellulose acetate materials.

The metallised dyes form a well known class of dyes and are compounds of dyes of mordant dyeing character with metals such as chromium, copper, cobalt, nickel, and certain other metals, particularly those of atomic weight between 50 and 66. The most useful products seem to be those derived from chromium or cobalt. In the metallised dye the metal is in complex combination, that is to say the metallised dye does not, with water, yield ions of the metal. The parent dyes are usually azo dyes, particularly azo dyes in which an azo group unites two carbon atoms one of which is directly attached to a carbon atom carrying a hydroxyl group while the other is directly attached to a carbon atom which carries a hydroxyl group, an amino group, a carboxyl group, or a carboxymethoxy group, —OCH_2COOH but preferably a hydroxyl group. The carbon atoms attached to the azo group and the adjacent carbon atoms carrying the hydroxyls or other groups referred to above may form part of benzene or heterocyclic rings or of open chains. Such azo dyes may be of the kind obtainable by coupling a diazotised orthoaminophenol with 2-naphthol or a nuclear substitution product thereof having the 1-position free for coupling or a 1-naphthol which couples in the 2-position or with a para-alkyl phenol or with a 3-methyl-5-pyrazolone or with an arylamide of acetoacetic acid. In the metallised products, the metal is attached to the dye molecule via the groups carried by the carbon atoms adjacent to those united by the azo group and probably also via the azo group itself. Metallised dyes may also be derived from dyes similar to the azo dyes referred to above but in which the azo group is replaced by an azomethine group —N=CH—. Such azomethine dyes may be obtained by condensing ortho-aminophenols with ortho-hydroxy aromatic aldehydes.

If the parent dyes contain sulphonic groups the products are water-soluble (as alkali metal salts) and dye wool from aqueous baths though the latter must usually be strongly acid. If on the other hand the parent dye is free from sulphonic groups and the metallising is effected with about 1 atomic proportion of metal to each molecule of monoazo dye or azomethine dye, products of little or no water-solubility are in general obtained. Products which are water-soluble as alkali metal salts can however be obtained by metallising 2 molecular proportions of a suitable unsulphonated dye with suitable metal; in this way products can be obtained which dye wool from neutral or weakly acid baths. Such 2:1 dye/metal complexes may be derived from two molecular proportions of a single dye or from one molecular proportion of each of two different dyes. The water-solubility of such products can be enhanced without loss of the property of dyeing from a neutral or weakly acid bath, by including in the molecule of the dye suitable groups, for example sulphonamide groups e.g. —SO_2NH_2 or —$SO_2NR_1R_2$ where R_1 and R_2 are alkyl groups, sulphone groups e.g. SO_2CH_3, or hydroxyl groups, the said hydroxyl groups being so disposed with respect to other groups as not to invite combination with the metallising metal. An account of some such metallised azo dyes which dye wool from neutral or weakly acid baths is given by Schetty in the Journal of the Society of Dyers and Colourists, December 1955, pages 705–724.

A large number of metallised dyes are commercially available. Thus sulphonated products which dye wool from strongly acid baths are sold under the trade name Neolan (Ciba) while products which dye wool from neutral or slightly acid baths are sold under the trade names Cibalan (Ciba) and Irgalan (Geigy). Again products soluble in organic liquids such as alcohol and acetone but in the main insoluble in water are sold under the trade names Orasol (Ciba), Irgacet (Geigy), and Zapon (B.A.S.F.).

The following are illustrative of the metallised dyes which can be employed in accordance with the invention and in particular in the procedures outlined above.

(1) Product obtained by metallising with one atomic proportion of chromium, one molecular proportion of the azo dye from diazotised 4-nitro-2-aminophenol and 2-naphthol (brown).

(2) Product obtained by metallising with one atomic proportion of chromium or cobalt, one molecular proportion of the azo dye from diazotised 4-nitro-2-aminophenol and 1-phenyl-3-methyl-5-pyrazolone (red-orange or orange).

(3) Product obtained by metallising with one atomic proportion of chromium, one molecular proportion of the azo dye from diazotised 4-nitro-2-amino-phenol and acetoacetic anilide (yellow).

(4) Product obtained by metallising with one atomic proportion of chromium, one molecular proportion of the azo dye from one molecular proportion of diazotised 4-nitro-2-aminophenol and one molecular proportion of 1:5-dihydroxy-naphthalene (violet).

(5) Product obtained by metallising with one atomic proportion of chromium one molecular proportion of the azo dye from diazotised 4-nitro-2-amino-phenol and 1-(meta-sulphonamido-phenyl)-3-methyl-5-pyrazolone (orange).

(6) Product obtained by metallising with one atomic proportion of chromium, two molecular proportions of the azo dye from diazotised 4-methyl-2-amino-phenol and p-cresol (reddish violet).

(7) Product obtained by metallising with one atomic proportion of chromium, two molecular proportions of the azo dye from diazotised 2-aminophenol and 2-naphthol (violet).

(8) Product obtained by metallising with one atomic proportion of chromium, two molecular proportions of the azo dye from diazotised 2-aminophenol-4-sulphonamide and 5:8-dichlor-1-naphthol (reddish blue).

(9) Product obtained by metallising with one atomic proportion of cobalt, two molecular proportions of the azo dye from diazotised 2-aminophenol-4-sulphonamide and 5:8-dichlor-1-naphthol (bordeaux).

(10) Product obtained by metallising with one atomic proportion of chromium, two molecular proportions of the azo dye from diazotised 2-aminophenol-5-methyl-sulphone and 1-phenyl-3-methyl-5-pyrazolone (yellowish-red).

(11) Product obtained by metallising with one atomic proportion of chromium, two molecular proportions of the azo dye from diazotised 2-aminophenol-4-methyl-sulphone and acetoacetic anilide (red-yellow).

(12) Product obtained by metallising with one atomic proportion of chromium, two molecular proportions of the azo dye from diazotised 2-aminophenol-5-sulphonamide and 1-phenyl-3-methyl-5-pyrazolone (scarlet).

(13) Product obtained by metallising with one atomic proportion of chromium, two molecular proportions of the azo dye from diazotised 2-aminophenol-4-sulphonamide and benzoyl-acetonitrile (brown-red).

(14) Produce obtained by metallising with one atomic proportion of chromium, two molecular proportions of the azo dye from diazotised anthranilic acid and 1-(2':6'-dimethylphenyl)-3-methyl-5-pyrazolone (yellow).

(15) Product obtained by metallising with one atomic proportion of chromium or cobalt, two molecular proportions of the azo dye from 2-amino-phenol-4-sulphomorpholide and 5:8-dichlor-1-naphthol (chromium compound—dull violet; cobalt compound—red violet).

(16) Product obtained by metallising with one atomic proportion of chromium, two molecular proportions of the

azo dye from diazotised 4-chlor-2-aminophenol and 2-naphthol-6-sulphonamide (violet).

(17) Product obtained by metallising with one atomic proportion of chomium, two molecular proportions of the azo-methine compound from 2-aminophenol-4-sulphonamide and 3:5-dichlor-2-hydroxybenzaldehyde (yellow).

(18) Product obtained by metallising with one atomic proportion of cobalt, one molecular proportion of the azo-methine compound from 5-nitrosalicyl-aldehyde and 2-aminophenol.

(19) Product obtained by metallising with one atomic proportion of chromium, two molecular proportions of the azo-methine compound from salicyl aldehyde and 2-aminophenol.

(20) Product obtained by metallising with one atomic proportion of chromium one molecular proportion of the azo dye from diazotised 1-amino-2-naphthol-4-sulphonic acid and 1- or 2-naphthol (blue).

Commercial products

Neolan.—Orange G, Green BL.

Cibalan.—Yellow 2BRL, Yellow GRL, Scarlet GL, Blue BL, Brown 2GL.

Orasol.—Yellow 3R, Orange RW, Red 2B, Navy Blue RB.

Irgacet.—Orange RL, Red 3G, Bordeaux 2BL, Brown 2RL, Brown 3BL, Grey BL.

Zapon.—Fast Yellow G, Fast Yellow R, Fast Bordeaux B.

As already indicated, the textile materials may contain fibres other than cellulose acetate. Such other fibers may be coloured with appropriate dyes before or after the colouring of the cellulose acetate component in accordance with the invention. Thus cotton or regenerated cellulose fibers may be coloured with vat dyes before the cellulose acetate is coloured, or with direct cotton dyes after the cellulose acetate has been coloured. The direct cotton dyes may be such as may have their washing fastness improved by an after-treatment with a copper compound. Again a content of wool may be coloured by means of acid wool dyes, sulphonated metallised dyes applied from strongly acid baths, or by water-soluble unsulphonated metallised dyes such as can be applied from neutral or weakly acid baths. To this end use may be made of an acid dye or a sulphonated metallised dye or unsulphonated metallised dye carried by the material and not taken up by the cellulose acetate. The material carrying the dye liquor used for colouring the cellulose acetate according to the invention may, for instance, be run into water and processed therein for such time and at such temperature and with such additions as are desirable to enable the wool to take up the residual acid or metallised dye.

The invention is illustrated by the following example.

The troughs of the roller and trough machine described above with reference to Fig. 1 of the drawings are charged with dye liquor of the following composition:

Isopropyl alcohol (86% strength by weight)	200 cc.
Formic acid (85% strength by weight)	120 cc.
Acetic acid (98% strength by weight)	80 cc.
Sulphuric acid (98% strength by weight)	4.5 g.
Teepol 530	2 cc.
Orasol Red 2B	3 g.
Water to make 1 litre.	

A woven fabric having its warp and weft comprised of yarns spun from a mixture containing 30% acetone-soluble cellulose acetate staple fibre, 10% of nylon 66 staple fibre, and 60% of viscose staple fibre (all by weight) is run through the dye liquor in the machine and then through the water-washer shown in Fig. 2. The temperature of the dye liquor is 30° C. and the temperature of the wash water 15–20° C. The speed of the fabric is such that 20 seconds elapses between the moment when any given part of the fabric first makes contact with dye liquor and the moment when the same part meets the water in the washer. The fabric is then scoured in 1 g./l. soap solution for 10 minutes at 50° C., rinsed, and dried. A bluish-red shade is obtained on both the cellulose acetate and the nylon 66, the viscose remaining uncoloured.

In this example the Teepol 530 may be omitted or replaced by 1 g./1 of the sodium salt of isopropyl naphthalene sulphonic acid. The Orasol Red 2B may be replaced by any of the following dyes: Azorubinol 3 GP, Cibalan Brown 2 GL, Chlorazol Fast Red F, and the metallised dyes numbered 3 and 10 in the list given above.

The cellulose acetate component of a fabric woven wholly from yarns spun from a 50:50 mixture of acetone-soluble cellulose acetate staple fibres and viscose staple fibres may be coloured similarly.

According to a further feature of our invention the lower fatty alcohol is replaced, wholly or in part, by another neutral water-miscible organic liquid which, in admixture with water, constitutes a swelling agent for the cellulose acetate. Such other liquids include acetone, diacetone-alcohol, and ethyl lactate. Still other liquids which may be employed are the water-miscible ethers, esters or ether-esters of glycol, glycerol or diethylene glycol. In these ethers or esters the etherifying group is preferably a C_1–C_3 alkyl group while the esterifying radical is preferably that of acetic or formic acid. Specific example of such ethers, esters, and ether esters are glycol monomethyl ether, glycol monoethyl ether, glycol monoethyl ether acetate, glycol monoacetate and diethylene glycol mono- or diacetate.

Some of these liquids are solvents for acetone-soluble cellulose acetate and it may be desirable to employ them in proportions of which the maxima are less than those specified above in the case of the lower fatty alcohols, for example one-third to two-thirds of those proportions; further, the content of the liquid and lower fatty acid together should preferably not exceed 300 or 350 g./l. These remarks apply, for instance, to diacetone alcohol.

Thus the alcohol may be replaced by acetone in amount less than 167 g. per litre. By way of example the 200 cc. per litre of isopropyl alcohol in the composition specified in the above example may be replaced by 150 to 200 cc. per litre of commercial acetone containing about 3% by weight of water with very similar results.

Having described our invention, what we desire to secure by Letters Patent is:

Apparatus for treatment of textile fabrics with a dye liquor, said apparatus comprising a series of driven upper rolls, a series of lower rollers, means for feeding a fabric over the upper rollers in succession with intervening passage under a lower roller, a roller co-acting with the last of the upper rollers to squeeze liquid from fabric passing over the latter, a series of troughs, one for each lower roller, each fitting closely around the lower portion of the associated lower roller, means for causing liquid fed into the last trough to overflow into and fill the preceding troughs in turn, a conduit for feeding dye liquor into the last trough, and a valve in said conduit, said valve being operated by means responsive to the level of the liquid in the first trough whereby said level may be maintained substantially constant.

References Cited in the file of this patent

UNITED STATES PATENTS

850,657	Klein	Apr. 16, 1907
1,037,280	Matter	Sept. 3, 1912
1,497,075	Elliott	June 10, 1924
1,857,111	Macadam	May 3, 1932
2,267,117	Mann	Dec. 23, 1941
2,517,751	Woodruff	Aug. 8, 1950
2,552,807	Normand	May 15, 1951
2,641,121	Belcher	June 9, 1953
2,779,183	Fornelli	Jan. 29, 1957