Stripped colorations are produced on dyeable substrates in continuos or sheet form by applying a plurality of dyestuff streams to the substrate at selected points across its width while the substrate is moved longitudinally relatively to the points of application, and then passing the substrate between nip rollers, the rate of application of the dyestuff streams being so controlled that on passage through the nip the dyestuffs are squeezed into the substrate to form non-overlapping longitudinal stripes of the desired widths.

2 Claims, 3 Drawing Figures
APPARATUS FOR PRODUCING STRIPED COLORATIONS ON DYEBLE SUBSTRATES IN CONTINUOUS FORM

This invention relates to a novel process whereby substrates in continuous or sheet form, such as textiles and like fibrous materials, may be colored in reproducible striped patterns without recourse to conventional printing machines and techniques.

According to the present invention there is provided a process for the production of striped colorations on dyeable substrates in continuous or sheet form by applying a plurality of streams of dyestuff solutions or suspensions to the substrate at selected fixed points across the width thereof while the substrate is moved in a longitudinal manner relatively to the points of application, and thereby passing the substrate between nip rollers or like pressure-applying means, each dyestuff stream being continuously applied to the substrate at each of the said points in an amount which can be completely absorbed by that part of the substrate which passes beneath and immediately to each side of the point of application of that stream, so that on passage through the nip the dyestuff is separated into the substrate to form non-overlapping longitudinal stripes of the desired respective widths.

In performing the process of the invention, the distances between the points of application of the dyestuff streams and the rates of application of the individual streams are thus selected so that for each stream there is available a band of substrate of sufficient width to allow the dyestuff solution or suspension freely to spread laterally under the influence of the applied pressure to the extent which the absorptive power of the substrate determines, without overlapping of adjacent streams taking place. There is thus 100 percent utilization of each dyestuff applied to the substrate. It may be arranged that two or more adjacent streams just meet, or that a band of undyed substrate separates each colored stripe from its neighbors, according to the type of pattern which is required.

It will be appreciated that the widths of the stripes may be altered either by varying the rate of supply of a dyestuff stream to its point of application to the substrate or by varying the speed of movement of the substrate, or both. A variation in the speed of movement of the substrate will, of course, produce a proportional change in the widths of all the colored stripes, while a variation in the rate of supply of one or more dyestuff streams relative to that of the other streams will produce a differential broadening or narrowing of certain of the stripes only. By a combination of such adjustments, any desired pattern of stripes can be produced at will. The widths of the stripes can also be influenced by the pressure applied to the substrate by the nip rollers, but in practice this is a factor which is less susceptible to accurately controlled variation and it is found more satisfactory to operate with a constant pressure setting and to adjust the pattern in the way described.

The process of the invention can be applied to a wide variety of substrates provided that these are in continuous or sheet form. Thus it may be applied to fibrous materials, which include yarns and rovings, webs such as paper and non-woven fabrics, and woven or knitted fabrics, as well as to films and other sheet material. Such substrates may be composed of natural, artificial or synthetic polymeric materials or blends thereof. Natural polymeric materials include cellulose materials such as cotton and linen; artificial polymeric materials include regenerated cellulose materials such as viscose rayon, and cellulose esters such as cellulose secondary acetate and triacetate; synthetic polymeric material includes polymides such as nylon, polysters such as polyethylene terephthalate, and polyamides or amion polymers or amides. The invention is particularly of interest for the coloration of natural or regenerated cellulosic materials and their blends with synthetic polymeric materials such as polysters.

The dyestuffs used in the coloration process will normally be those usually associated with dyeing processes for the substrate being colored, e.g. disperse dyes in the cases of polyamides, polysters and cellulose acetates and vat or reactive dyes in the case of cellulosic materials. The process may be employed so that a single dyestuff is applied from solution or suspension to the substrate at all the points of application, or so that different colored dyestuffs are applied at different points. Variegated striped patterns may also be obtained when the composition of the solution or suspension which is applied to the substrate at a given application point is made to vary with respect to the dyestuff present, and hence to the color which is imparted to the substrate. The dyestuff solutions or suspensions may advantageously contain thickeners, whereby their absorption by the substrate following application thereto may be retarded until the streams are spread out in controlled fashion by passage through the nip.

The process of the invention may be performed with the aid of a modified padding machine, the modification consisting in the provision of suitable means for applying the streams of dyestuff solutions or suspensions to the substrate. Such means may consist, for example, of jets or conduits whereby the solution or suspensions are conveyed directly to the surface of the substrate from storage vessels, optionally with the incorporation of valve means to control the rate of flow of each stream. A preferred application means, however, consists of an inclined plane the lower edge of which is maintained in contact with the substrate across its entire width and in trailing relationship thereto, the upper surface of the inclined plane being divided with a number of spaced troughs or channels, terminating at its lower edge, into which dyestuff solutions or suspensions may be continuously discharged so that they flow on to the substrate from the aforesaid lower edge.

The number of troughs or channels will correspond in general to the number of individual dyestuff streams. Preferably the troughs or channels are of U- or V-section, in order to contain the streams of solution of suspension in the narrowest width possible until they are taken up by the substrate. The lower edge of the upper surface of the inclined plane should be maintained in close contact as possible with the substrate, in order to produce smooth striped colorations of the sharpest definition. Conveniently the solutions or suspensions may be so discharged from an equal number of jets communicating with suitable storage vessels optionally by way of flow-controlling valve means. These jets may advantageously be mounted upon one or more lateral supports which are capable of reciprocating motion in a direction transverse to the alignment of the array of troughs or channels (that is to say, transverse to the direction of motion of the substrate), so that two or more different dyestuff streams may be arranged to flow alternatively down any given trough or channel and so give rise to variegated colored stripe effects. It is however, important to arrange that the change-over of supply from one dyestuff solution or suspension to another into a given channel should be instantaneous, so that there is no interruption in the flow of the stream which is applied to the substrate.

By means of the process of the invention, reproducible color stripes can be produced in which the width and spacing of the stripes are comparable in constancy with those obtained by conventional printing techniques. The present process has the advantage over such techniques that a markedly increased depth of penetration of the dyestuff into the substrate is achieved, and on a wide variety of substrates duplex type patterns are produced (that is to say, both the face and the back of the substrate are dyed to color extents). The present process is also advantageous in that it calls for only simple equipment which can readily be adjusted so as to produce a wide variety of different striped patterns, thereby avoiding the need for an individually engraved roller to be fashioned for each different pattern required.

The process of the invention is of particular interest for the coloration of textile fabrics consisting of cellulosic material or of blends thereof with non-cellulosic material such as synthetic polyester material, using vat dyes or reactive dyes. The vat dyes may be applied as a suspension or a solution of either the leuco or the stabilized leuco form. In the first of
these cases the vat dyes can be fixed on the textile material by first drying the pigmented fabric and then passing it through a cold alkaline reducing solution followed by a heating or steaming step and the usual oxidation treatments. In the latter cases, the dyestuff can be fixed by submission to the usual oxidation treatments. Reactive dyestuffs, whose us is preferred because of their simplicity of application, may be fixed by a number of methods applicable to these dyestuffs. For example, the dyestuff may be applied from a neutral solution on to a fabric already impregnated with alkali and dried; alternatively the dye may be applied from neutral solution and fixed by subsequent immersion of the textile material in an alkaline saline bath, optionally aided by a short steaming or heating step in the cases of dyestuffs of lower activity. Alternatively, the dyestuff may be applied in an alkaline solution and fixation effected by heating, steaming or allowing to stand in a moist condition for a suitable period of time, dependent on the alkalinity of the solution and the nature of the reactive dye. These solutions can contain the usual additives, e.g. thickeners, wetting agents and small amounts of neutral electrolytes. This procedure is well-suited to all types of cellulose-reactive dyes, for example, those containing di- and tri-chloro-pyrimidine, methanesulphonylpyrimidine, dichlorophthalazine, dichloropyridazine-sulphatoethylsulphone and, above all, mono-or di-chloro-s-triazine reactive groups.

The invention is illustrated but not limited by the following example:

EXAMPLE

Three dyestuff solutions are prepared, each containing 3 g/l of a high viscosity sodium alginate and the stated quantities of one of the following dyestuffs or mixture of dyestuffs:

i. 10 g/l of the 1:1 copper complex of 6-(dichloro-s-triazinyl)-N-methylamino-2-[4'-(2',5',8'-disulphophenylazo)-3'-methyl-2'-hydroxyphenylazo]-1-naphthol-3-sulfonic acid

ii. 20 g/l of 1-(4'-sulphophenyl)-3-carboxy-4'(4'-dichloro-6-(s-triazinylamino)-2'-sulphophenylazo)-pyrazolone and 0.8 g/l of 1-amino-4'(4'-dichloro-s-triazinylamino) anilino-anthraquinone-2,3',5'-trisulphonic acid

iii. 12 g/l of 6-(dichloro-s-triazinyl)-N-methylamino-1-hydroxy-2,2'-azanaphthelene-1,3',5'-trisulphonic acid and 1.5 g/l of 1-amino-4'(4'-dichloro-s-triazinylamino) anilino-anthraquinone-2,3',5'-trisulphonic acid

These three solutions are applied to a length of mercerized poplin, which has previously been impregnated with an aqueous solution containing 30 g/l of sodium carbonate and then dried, using the apparatus which is illustrated schematically in the accompanying drawings.

In the drawings:

FIG. 1 is a side view of the apparatus and
FIG. 2 is a front view seen from point A in FIG. 1.

In the apparatus, which consists essentially of a padding mangle with associated taking-off and taking-up rollers and means for delivering the dyestuff solutions to the fabric, the fabric 1 is drawn continuously from a taking-off roller 2, from where it passes below the lower edge of an inclined dyestuff delivery plane 3, then through the nip rollers 4 and 5 of a padding mangle and in finally wound up on a taking-up roller 6, an impermeable film 7 being fed in from a roll 8 so as to separate adjacent layers of the fabric 1 on the roller 6 and thus prevent marking off whilst the fabric is still moist. The inclined plane 3, which lies at an angle of 45° to the fabric 1, is provided with upstanding ribs which divide its surface into four channels 10 terminating at its lower edge, and above each channel located a dye delivery device consisting of a jet 11 connected by a feed duct 12 through a control valve 13 to a storage vessel 14 for dyestuff solution. Each valve 13 is of the simple on/off type and the rate of flow of the solution is set by a suitable choice of the size of the jet 11 at 25cc/min. The vessels 14 of the two middle dye delivery devices are charged with solution iii described above and the vessels of the two outer devices are charged with solution ii and i respectively. The fabric 1 moves at approximately 24yds/min.

When the apparatus is in operation, the dyestuff solutions are allowed to run down their respective channels 10 on to the moving fabric 1 and as the latter passes between the nip rollers 4 and 5 the bands of solution so applied are squeezed into the fabric to produce stripes of color of uniform width approximately 18mm. The striped poplin collected on the roller 6 is allowed to stand at 20°-25° C for 2 hours, then washed off in the usual way in a bath containing 1 g/l of a detergent and 1 g/l of hexamethylene tetramine.

The resultant fabric displays two central stripes of flame color and outer stripes of blue and gold, each pair of stripes being separated by bands of white with clearly defined boundaries between the dyed and undyed areas.

In an improved form of the apparatus shown in FIG. 1 and FIG. 2, the surface of the inclined plane 3 which lies between each pair of ribs 9 is slightly recessed towards the center, so that the channels 10 are of a shallow U-shape in cross section. In this way the movement of the dyestuff streams down the channels is more effectively controlled.

In FIG. 3 of the accompanying drawings, there is shown a view corresponding to that of FIG. 2 of a modified form of inclined dyestuff delivery plane with its associated delivery devices. In this case the ribs 9 attached to the plane 3 are in the form of triangular baffles, so that the surface of the plane is divided up into a plurality of equally spaced inverted triangular troughs 10, the apexes of which are cut away so as to provide outlets for the dyestuff solutions at the lower edge of the plane. The apexes of the baffles 9 are however fully pointed, so as to provide a sharp demarcation between one trough and the next. A plurality of dye delivery devices similar to those previously described are mounted above the plane 3, but with the difference that the jets 11 are held, at a mutual spacing equal to the spacing of the apexes of the baffles 9, in a rigid support 15 which is arranged for reciprocating motion (the driving means is not shown) with an amplitude equal to the distance between the apexes of two adjacent baffles or a multiple thereof. The feed ducts 12 are made of flexible material to accommodate this motion. The vessels 14 of the dye delivery devices are in this case charged with dyestuff solutions of color which readily blend with each other, and by reciprocating the support 15 in the manner described color streams of regularly varying composition can be made to flow down each of the troughs 10, so giving rise to variegated stripe effects on the fabric 1. The equal spacing of the jets 11 and the apexes of the baffles 9 ensures that there is no interruption in the flow of dyestuff solution down any of the troughs as the source of supply is continually alternated.

What we claim is:

1. Apparatus suitable for the production of striped colorations on dyeable substrates in continuous form which comprises the combination of a padding machine and means for applying a plurality of streams of liquid dyestuff compositions to the substrate before passage through the padding machine, an inclined plane the lower edge of which is maintained in contact with the substrate across the entire width thereof and in trailing relationship thereto, the upper surface of the plane being provided with a number of spaced channels terminating at the said lower edge, and a number equal to the number of channels, of jets from which the liquid dyestuff compositions are continuously discharged into the said channels.

2. Apparatus as claimed in claim 1, wherein the jets are mounted upon at least one lateral support which is capable of reciprocating motion in a direction transverse to the alignment of the channels, so that at least two different dyestuff streams flow alternately down any given channel.