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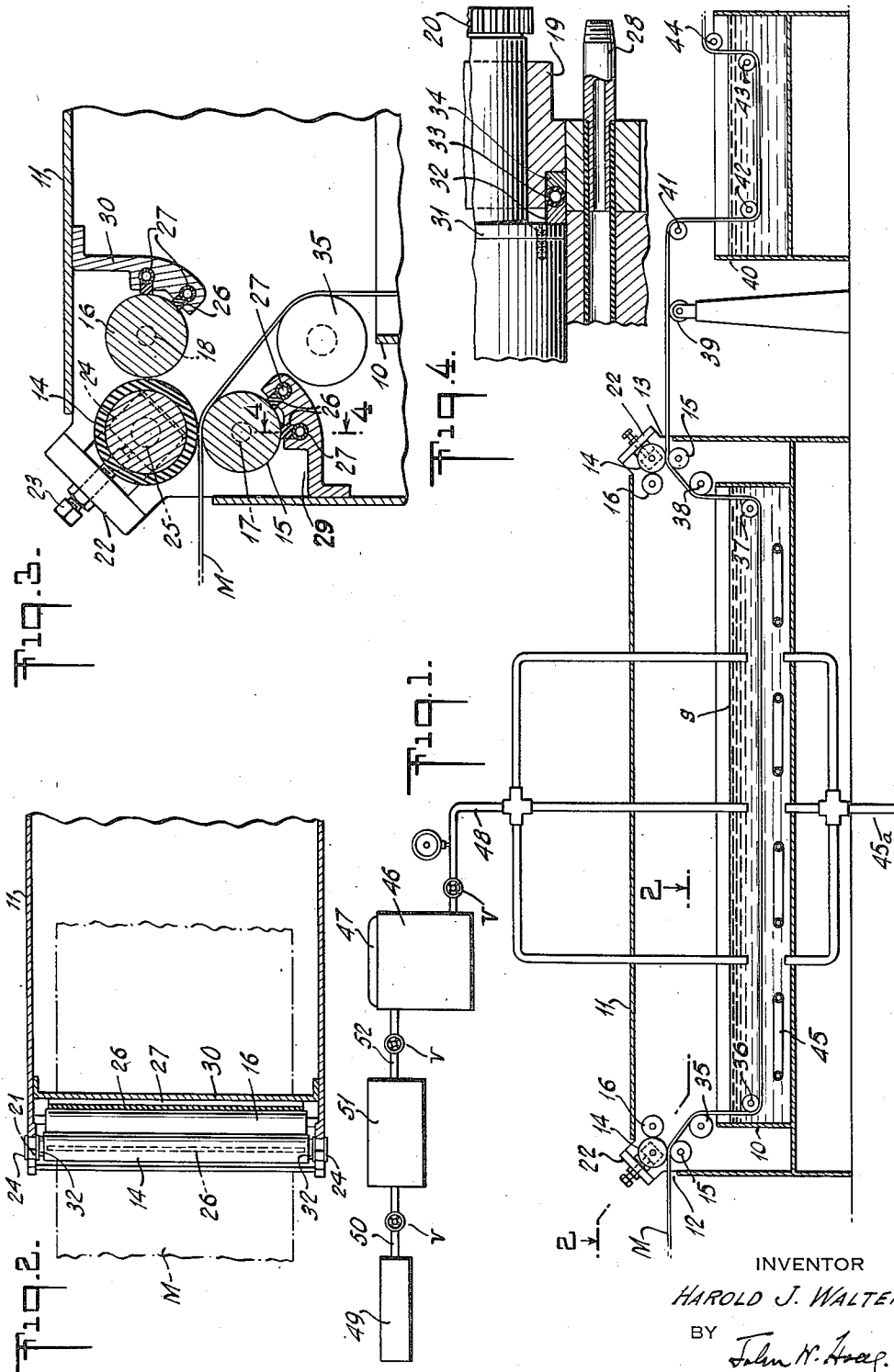
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METHOD OF DYEING WOOLEN AND OTHER NITROGENOUS TEXTILE MATERIAL

Filed Dec. 30, 1943

2 Sheets-Sheet 1



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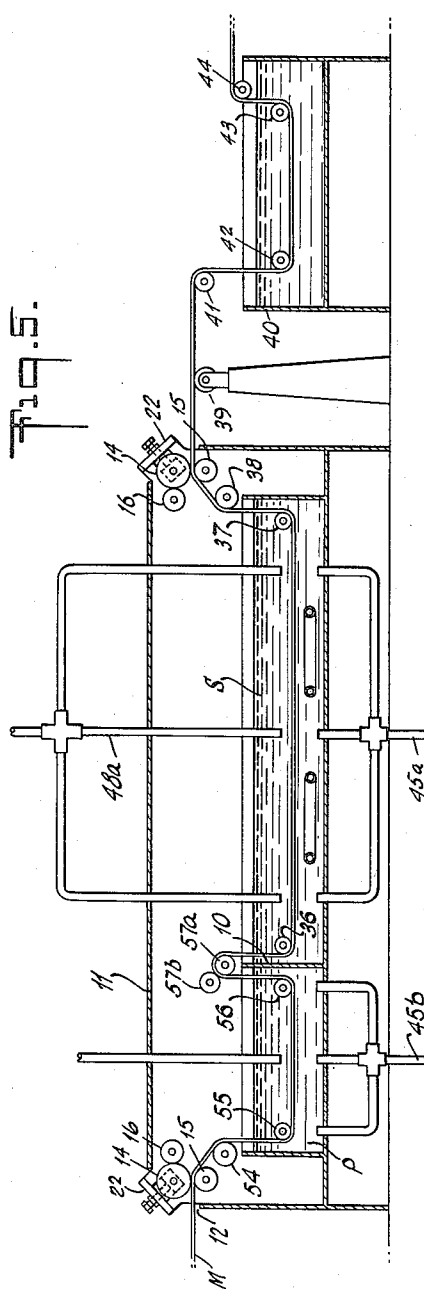
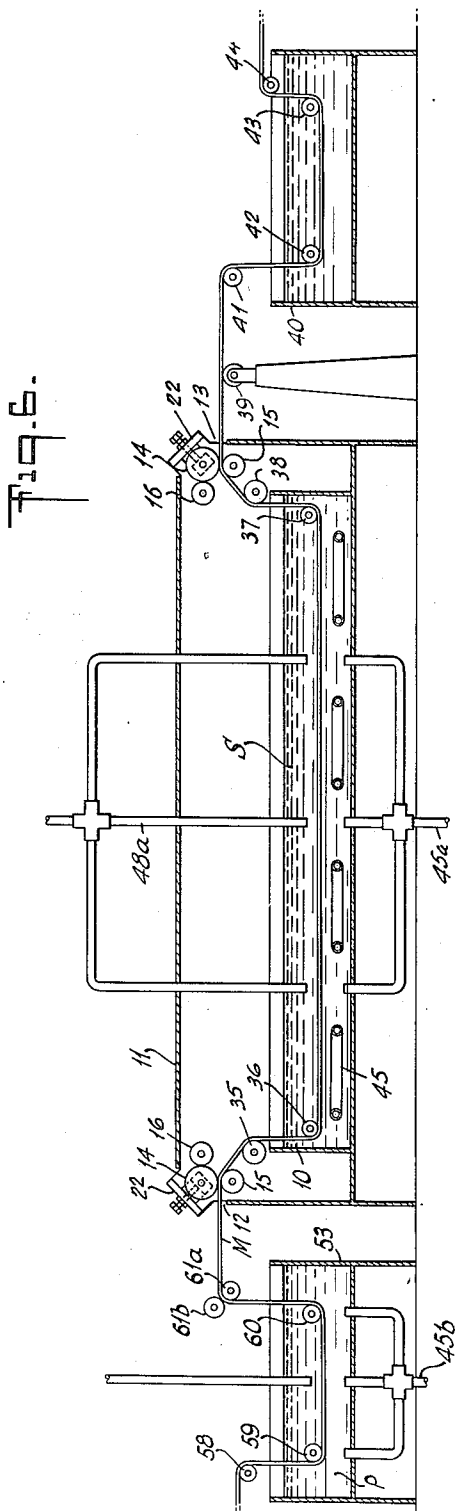
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METHOD OF DYEING WOOLEN AND OTHER
NITROGENOUS TEXTILE MATERIALSHarold J. Walter, Uxbridge, Mass., assignor to
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11 Claims. (Cl. 8-54)

This invention relates to the dyeing of textile materials, and is a continuation-in-part of my co-pending application Serial No. 423,431, filed December 18, 1941.

Heretofore the dyeing of nitrogenous fibers or unions thereof for textile uses has been carried out according to long established practice at temperatures below 212° F., or in temperature ranges having 212° F. as the upper limit. This is true not only of wool and worsted cloth, yarn, and top, but also of nitrogenous fibers generally (both natural and artificial, and including animalized fibers, and fibers of polyamide type).

In a few instances dyeing has been undertaken in a kier where the fibers have been exposed to temperatures in excess of 212° F. for a long period of several hours. I do not know of any instance where nitrogenous textile fibers have been treated in this way, but in any event it is well known that exposure to a high temperature for the long period of time incident to kier treatment injures and destroys the strength of fibers particularly nitrogenous fibers and renders them unfit for textile uses. Furthermore kier treatment is a batch operation which has the several disadvantages referred to below.

Accordingly it is an object of the invention to provide a simple, efficient and practical method of accelerated dyeing of nitrogenous textile fibers and unions thereof.

Another object is to provide a method by which a desired shade may be duplicated for a given nitrogenous cloth or fiber more readily and with more accurate results than has heretofore been possible.

Another object is to provide a method whereby a length of nitrogenous cloth or textile fibers or yarn may be dyed with a period of contact between the cloth, fibers, or yarn and the dye solution which is much shorter than has heretofore been used in the trade.

Another object is to provide a method of dyeing basic nitrogenous textile materials in which the dye solution may be efficiently employed and conserved while employing dye concentrations on the order of from two to four percent of the dye solution by volume, or even higher.

It has heretofore been customary in dyeing woolen or worsted cloth, top, or yarn and other nitrogenous fibers and strips of cloth to employ a batch operation wherein the dyeing vat has been loaded with material for a long period of several hours. A batch operation is not only inefficient in time but the packing and pressing of material

in the dyeing chamber creates problems of uneven dyeing of the material which are exceedingly hard to solve.

Accordingly it is a further object of this invention to overcome the disadvantages inherent in dyeing wool and woolen materials and other nitrogenous textile materials, and materials comprising wool or other nitrogenous textile materials as heretofore carried out and to provide a simple, practical method for the dyeing of wool and woolen materials and other nitrogenous textile materials and materials comprising wool or other nitrogenous textile materials, continuously, and in open form.

Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the several steps and relation and order of each of said steps to one or more of the others thereof, all as will be pointed out in the following description, and the scope of the application of which will be indicated in the following claims.

The invention will best be understood if the following description is read in connection with the drawings in which,

Figure 1 is a side view, partly in cross section, of means by which the method disclosed herein may be performed;

Figure 2 is a top plan view taken on the line 2-2 of Figure 1;

Figure 3 is an enlarged detail view of the upper part of one end of the chamber and air-sealing means shown in Figure 1, and is also a side elevation partly in cross section;

Figure 4 is a vertical, transverse section taken on the line 4-4 of Figure 3;

Figure 5 is a side view similar to Figure 1 showing a plurality of aqueous baths in a closed chamber; and

Figure 6 is a view similar to Figures 1 and 4 showing a plurality of aqueous baths one of which is outside of the closed chamber.

Where the term cloth is used herein it will be understood to include any continuous length of cloth, top and the like.

In Figures 1, 4 and 5 a length of material M in open form is shown passing through an aqueous bath 10 contained in a closed chamber 11. As will be explained the desired dye may be introduced into this bath separately from the cloth as illustrated in Figure 1, or it may be padded onto the cloth either outside or inside chamber 11 as illustrated in Figures 5 and 6 respectively and carried with the cloth into bath 10. In

either case the cloth is passed through the aqueous bath 10 in the presence of the desired dye, the bath being heated to a temperature in excess of 212° F. as will be pointed out. The length of material passes into and out of chamber 11 through wall opening or dies, 12 and 13 respectively, which are sealed in any suitable practicable way to provide a chamber in which temperatures on the order of 295° F. or even higher may be maintained. As illustrated herein the sealing means of each of the wall openings 12 and 13 comprise a roll 14, which preferably has a facing of rubber or rubber-like material, and has a resilient surface, and the power rolls 15 and 16. The power rolls 15 and 16 are respectively supported on shafts 17 and 18 each of which extends through bearings 19 in the respective side walls of chamber 11, and a gear 20 may be provided at one end of each of said shafts respectively for connection to any suitable source of power.

The roll 14 of each set of closure rolls is mounted in slots or slideways 21 provided in the portions of the chamber wall which as shown herein are obliquely related to the body of the chamber 11 at the top of its ends respectively. A removable closure member 22 is provided at the top of each of said end portions of the chamber 11 which may be removed to permit withdrawal of roll 14 from chamber 11. Means for adjusting the position of each roll 14 along the slideway 21 is provided and may consist of adjusting screw means 23 extending through the removable closure member 22 into contact with the bearing member 24 provided on the trunnions 25 at the ends of roll 14.

The rolls 14, 15, and 16 are disposed in a triangular arrangement in which both rolls 15 and 16 are positioned to press against the resilient face of roll 14 and as has been explained the latter may be adjusted toward or away from rolls 15 and 16 as may be required.

Cross seal members 26 are provided, abutting against rolls 15 and 16 respectively. As illustrated herein the cross sealing means comprises any suitable compressible material which is adapted to expand at right angles to the pressure applied by the tubular portion 27 which is preferably of a resilient material such as rubber thereby providing an effective sealing between itself and the roll against which it is pressed. The ends of the tubular portion 27 of each cross seal member 26 may be supported at its ends upon preferably rigid supporting members 28 extending through the respective side walls of chamber 11, one of which may, if desired, be hollow so that air may be introduced therethrough into the said tubular portion.

The cross sealing means for roll 15 is shown herein as being supported in a bracket 29 extending inwardly from the end wall of chamber 11, and the cross sealing means for roll 16 is shown as being supported in a bracket 30 depending from the upper portion or top of chamber 11.

As stated above the trunnions 25 at the ends of each roll 14 are slideably seated in the slideways 21 provided within chamber 11. The ends of shafts 17 and 18, for rolls 15 and 16, respectively, which extend through the opposite side walls of chamber 11, may be provided at their ends with wear rings 31 to take the wear of the sealing material pressed against them. The sealing material may comprise a metal ring 32, a tubular, preferably resilient, sealing ring 33,

which may if desired be pneumatic in character, and the metal ring 34, interposed between the end wear ring 31 and the wall of chamber 11 which may be recessed to provide a seat for the sealing means.

A continuous strip of material M passes into chamber 11 in open form through the aforesaid wall opening or die 12, between roll 14 and power roll 15, over idler 35 into the aqueous solution S contained in bath 10, under idlers 36 and 37 in the solution S, over idler 38, and out of the chamber 11 between resiliently faced roll 14 and power roll 15, of the set of rolls closing wall opening 13, and through the wall or die opening 13, over idler 39, into a rinsing bath where any dye not taken up by the material is washed off. The rinsing bath is identified as 40 and rollers 41, 42, 43 and 44 are shown by which the material M may be guided through the rinsing bath.

Coils 45 are provided in the bath 10 through which steam is circulated to heat the aqueous bath solution S to the desired temperature, and the branched conduit 45a is preferably provided by which compressed air may be introduced at various points under the surface of the aqueous solution in bath 10 to agitate the solution as an aid in promoting uniformity of the solution.

A reservoir 46, which may have a removable top 47, and communicates with the bath 10 through conduit 48 is illustrated as positioned for convenience at a point outside chamber 11. To insure flow from the reservoir to the bath 10 a compressor 49 is provided connected by conduit 50 to pressure tank 51 which in turn is connected to reservoir 46 by conduit 52. In each of the conduits 48, 50, and 52 a valve V is provided for regulating the pressure in the system and the flow between the reservoir 46 and the bath 10. Any substance to be mixed into the aqueous bath 10 may be prepared in reservoir 46. This substance will be a selected dye if the dye is to be introduced into bath 10 separately from the material to be dyed, or, if the dye is to be padded onto the material before it reaches bath 10 and introduced into bath 10 along with the material to be dyed, the substance will be an agent to prevent bleeding of the dye from the material in bath 10 without substantially impeding the penetration of the dye into the material.

In the modification of the invention illustrated in Figure 1 in which the dye is introduced into the aqueous bath separately from the cloth, the dye solution may be prepared in reservoir 46, before the start of a run of material. For this purpose a small amount of water may be added to the chosen dye to form a paste which is then mixed with water in the reservoir. The volume of dye solution prepared will of course be determined by the amount of material comprising the run. When the dyeing solution has been prepared valve V in conduit 48 is opened, compressor 49 is actuated and valves V in conduits 50 and 52 are opened if they are not already opened. In some cases it may be desirable to keep a constant flow of dye solution from the reservoir to the dye bath throughout the entire period of the run. Thus if any variation in the concentration of the dye solution in the dye bath should occur it may be readily compensated for by a corresponding change in the concentration of the dye liquor in the reservoir. On the other hand it may sometimes be desirable to supply the entire contents of the reservoir to the dye bath at the start of a run and to mix another dye solution preparatory to another run while the first run is being

made. This may be desirable where two or more comparatively short runs are to be made.

Sufficient dye material is supplied to the reservoir so that a solution of the desired concentration and pH may be supplied to the dye bath 10 to maintain therein a solution of substantially constant concentration and pH throughout the whole dyeing operation.

In the embodiment of my invention illustrated in Figures 5 and 6 the procedure will be the same as that described above in connection with the modification of the invention described in Figure 1 except that the selected dye, instead of being introduced into bath 10 separately from the cloth, as for example by being initially mixed in reservoir 46 and introduced into bath 10 through conduit 48, is padded onto the cloth before the cloth is introduced into bath 10, but in all the embodiments of the invention illustrated herein, in Figures 1, 5 and 6, the penetration of the dye into the material being dyed, and the chemical union between the dye and the material, is accomplished and accelerated within chamber 10, like numerals being employed in all of the drawings to indicate like parts. The dye may be padded onto the material in any suitable way as for example by being brought into contact with a dye solution long enough to become soaked with the dye solution, as for example by being initially passed through a preliminary bath of dye solution P contained in dye vat 53. As illustrated in Figure 5 dye vat 53 is contained within closed chamber 11 whereas in Figure 6 dye vat 53 is illustrated as positioned exteriorly of chamber 11.

As illustrated the vat 53 may be of substantially smaller dimension than vat 10 with the result that the volume of dye solution left in vat 53 after the completion of a run of material will be comparatively small. Thus the preliminary step of padding the dye onto the material to be dyed effects an economy of the dye stuff employed, and, particularly in the case of short runs of material, a substantial saving may be effected.

It will be noted that where the padding step is performed exteriorly of chamber 11 the dye will be subjected to the temperatures in excess of 212° F., used in chamber 11, only for the time required for a given point on the cloth to move through chamber 11, and this is an exceedingly short period which for the purpose of example and illustration of the working of my invention is described herein as requiring a period of time of say from one-quarter minute to five minutes depending on the material being dyed and the shade desired.

Where the padding is performed in a dye vat 53 contained within chamber 11 the small volume of dye vat 53 results in the dye molecules being exhausted and removed from vat 53 rapidly and frequently, so that there is a high turn over of the dye molecules introduced into vat 53, and the average time that a dye molecule is present in vat 53 is very short, and the total amount of time that the average dye molecule is present within chamber 11, and passing both through dye solution P in vat 53 and through the aqueous solution S in bath 10, is sufficiently short to permit substantially all dyes to be used without danger of impairment by exposure to the high temperatures employed in chamber 11.

When the dye is initially padded onto the cloth and introduced into the aqueous solution S in bath 10 along with the cloth an agent or

agents capable of preventing bleeding of the dye from the padded material, without substantially impeding the penetration of the dye into the cloth, is introduced into bath 10 separately from the cloth.

An example of the successful practice of my invention employing a preliminary padding step is as follows:

Dye was deposited on a piece of worsted cloth by soaking the cloth with a 3% solution of Calcocid Milling Red 3R conc. (C. I. 275) using a padding machine of known construction, and such as is illustrated in Figures 5 and 6. As a result of the padding step the color was only deposited on the surface of the cloth and did not develop the true shade or fastness properties of this dye. The padded cloth was then introduced into closed chamber 11 and into bath 10 containing a solution consisting of 30 parts of sodium acetate and 10.6 parts of acetic acid along with 3 parts of diamyl sodium sulfosuccinate in 300 parts of water, heated to a temperature of 250° F., and the cloth was passed through bath 10 so that the period of contact between a given fiber in the cloth and the highly heated solution S was 50 seconds. After the dyeing step in bath 10 the material passed out of the closed chamber and through a rinsing bath as described in connection with the embodiment of the invention disclosed in Figure 1, and also Figures 5 and 6. The dyed cloth had a bright red shade showing a very satisfactory penetration of the dye into the cloth, and the cloth had very satisfactory fastness properties showing that complete chemical combination between the dye and the fibers of the cloth had been accomplished.

A selected agent or agents may, if desired, be introduced into bath 10 from an external mixing chamber and for this purpose an assembly of a mixing chamber or reservoir, a compressor, a pressure tank, and suitable interconnecting conduits may be provided, if desired, as is illustrated in connection with Figure 1, and a conduit 48a is indicated in connection with bath 10 in Figures 5 and 6 through which a selected agent to prevent bleeding of the dye from the material may be introduced.

Similarly it will be understood that means for supplying dye into vat 53, as through conduit 48b may be provided, irrespective of whether vat 53 is positioned within, or externally of chamber 11, and, at 45b means for agitating dye solution P, are indicated, which means if desired may be similar to branch conduit 45a used for introducing compressed air into bath 10.

From the foregoing it will be understood that in practicing the invention in accordance with the embodiment of the invention illustrated in Figure 5 the strip of material M, after passing into chamber 11 between the entrance sealing rollers, will be guided over a roller 54 into the dye solution P in vat 53, under rollers 55 and 56, and will pass out of vat 53 and between the padding rolls 57a and 57b, and will then be introduced into an aqueous bath S in bath 10, passing under rollers 36 and 37 submerged in solution S, and will pass out of the aqueous bath S over roller 38 and through exit rollers into a rinsing bath as described in connection with Figure 1. And in the embodiment of the invention illustrated in Figure 6 the strip of material will initially be passed into a dye vat 53 located exteriorly of chamber 11, being guided over a roller 58 into solution P in vat 53, and after being guided through solution P under rollers 59 and 60 submerged therein it will pass out

of bath P and between the rolls 61a and 61b and into chamber 11 where it will pass through the entrance sealing rollers and into and through aqueous solution S, and out of chamber 11 into and through a rinsing bath in the manner described in connection with the embodiment of the invention shown in Figure 1.

Where the dye is initially padded onto the material to be dyed the material is preferably kept submerged in solution S in bath 10 after it has been initially introduced into solution S until the penetration of the dye into the material, and the chemical bonding of the dye with the material, has been completed, in order to prevent streaking of the material and non-level dyeing. It has been found that if the material padded with dye is run in and out of the aqueous solution S the dyeing result obtained is not as satisfactory as where the material is kept submerged within solution S until the theoretically opposed dye penetration and dye bonding actions have been fully completed. It is thus preferred, where the dye is initially padded onto the material to maintain the material submerged in the solution S during the greater portion of the period of time it is passing through chamber 11, and especially to keep it submerged in solution S, after it has been initially introduced into solution S, until the penetration and bonding actions are completed.

Irrespective of how the dye is introduced into aqueous solution S in bath 10 I raise the temperature of the aqueous solution in the bath 10 to a temperature which is above, preferably well above, 212° F. The particular temperature above 212° F. selected will depend upon the kind of fabric being dyed and the shade desired, as explained below. I lead the material end to end, in open continuous form, into the air-sealed chamber 11 through the aqueous solution S contained in bath 10, and out of chamber 11 into the rinsing bath 40. After passing through the rinsing bath the material may be dried and folded if desired.

In the performance of my process I prefer to keep the temperature, pressure, and period of contact between the solution S and the material M constant for a given fiber or fiber combination, regardless of the shade desired, and vary the concentration of the dye solution used to give the shade desired under the aforesaid constant conditions but it will be understood that the concentration may be kept constant if desired, as may be the case in some instances, and one or more of the other factors of temperature, pressure and period of contact may be varied.

I have found that at the high temperatures used in my process I am able to pass a strip of cloth through the closed chamber 11 at a rate of more than twenty-five yards per minute, keeping the material in contact with the solution S for a total period of immersion of less than a minute and which may be on the order of from one-quarter to one-half of a minute. At this speed of travel of the material it is possible to dye a run of upwards of fifteen hundred yards in less than one hour, or three thousand yards or more in less than two hours.

Accordingly to my method there is no upper limit, that I know of, to the temperature which may be employed except the limit imposed by the limitations of the apparatus used for increasing the speed of travel of the material. With my present apparatus I have obtained good results using temperatures to and in excess of 295° F.

To obtain the full benefit of my process the highest practical temperature should be employed, and the period of contact of the material with the aqueous solution S in bath 10, should be fixed as the minimum period required to give the desired shade using the maximum dye concentration which is economical. The minimum period required to give the desired shade using a temperature within the range of from 220° F. to 295° F. will be from say five minutes to a quarter of one minute.

The lower limit of the temperature range is more difficult to fix, because, although higher temperatures are preferable it is possible to obtain a measureable acceleration in the rate of penetration and chemical bonding employing temperatures which while well above 212° F. are nevertheless lower than the optimum temperature range for the fiber to be dyed according to my method. Thus, for example, I have found that while the preferred lower limit of the range for treating lengths of woolen or worsted material or wool fibers, is approximately 240° F., improved useful practical results may be obtained with temperatures down to possibly 220° F. particularly if the wool material is pretreated by wetting it out with acid such as acetic acid, or if the period of contact between the material being dyed and the aqueous bath, in the presence of the selected dye, is prolonged, although this is undesirable because of the greater time, or the increased size of bath 10, or both, which is required.

For the union dyeing of wool I prefer to use temperatures having a range well above 212° F., preferably employing a temperature on the order of 260° F. in a range having 240° F. as its lower limit, but in some cases having 220° F. as its lower limit according to the percent of wool in the cloth being dyed.

As an illustration of the results obtained by the employment of the high temperatures of my method on cloth being continuously and rapidly moved through an aqueous bath 10, into which the dye was introduced separately from the cloth, I give the results tabulated below from operations in which there was used in each instance the same dark blue dye and the same pressure but different temperatures:

Operation	Temp. dye solution	Pressure	Shade imparted to cloth
No. 1.....	° F. 210-212	Pounds 42	A light blue.
No. 2.....	276-277	42	A very dark blue (deeper than navy blue).

In both of these operations the period of contact between solution S and the material at a given point was 0.36 minutes, and the concentration of the dye in solution S was 2.37 by volume. By the first operation a privative dyeing was obtained i. e. some dye had penetrated but the material had not absorbed anywhere near the amount of color required. The second operation produced full shade dyeing.

In the practice of my invention it is possible and practical to use higher dye concentration than can be used in a batch operation, thus further accelerating the dyeing operation; for example, I have obtained excellent results using dye solutions in which dye was from 2% to 4% of the solution by volume, according to the shade desired, at temperatures from 220° F.-290° F. but I do not wish to be limited to this range

which may be considerably widened according to the temperature used and the shade desired.

Generally speaking, in the performance of my method I may use all dyes. Some of the dye stuffs which I have used, introducing the dye separately from the cloth, with very satisfactory results, in concentrations ranging from 2% to 4% by volume at temperatures above 239° F., and for a period of contact with the material of one-half a minute or less, are the following: Pontacyl Fast Blue SB 209, Pontacyl Black RC (no number), Pontacyl Fast Carmine 6B, 57, Pontacyl Dark Green B 247, and Neutral Red MG (Calcocid Fast Red A, 176). I have also obtained good results using direct dyes, particularly in dyeing mixtures of wool and other fibers. Among the dyes I have found satisfactory for dyeing a mixture of wool and non-woolen fibers are the following:

Calcomine-----	Navy Blue R (no number)
Do-----	Black BTCW 401
Calcodur-----	Brown BRL (no number)
Calcomine-----	Red FC 419
Calcodur-----	Yellow NN 814
Do-----	Orange GL 653
Do-----	Green BL (no number)

In dyeing unwoven fibers, such, for example, as "top" or a mixture of fibers, a conveyor of any suitable construction, such, for example, as an endless conveyor, may be provided, to receive a sliver from the entrance die and support and conduct it down into and under the surface of the dye solution and upwardly to the exit die. Obviously various means may be provided for supporting the fibers in the dye bath and bringing them into contact with both the dye bath and the rinsing bath.

In carrying out my method I prefer to employ a closed chamber having transparent side walls or windows through which the operations within the chamber may be viewed. In order to resist clouding of the transparent side walls or windows by steam I prefer to maintain within the closed chamber a pressure sufficiently above the pressure of saturated steam at the temperature employed to resist the formation of steam and to maintain visibility. This may be readily accomplished by introducing compressed air into the closed chamber 11, as for example through branched conduit 45a and I have successfully maintained visibility within chamber 11 using a pressure of approximately 50 lbs. per square inch for temperatures from 240° to 280° F. If higher temperatures are used a corresponding increase in pressure is desirable to maintain visibility without clouding.

It will thus be seen that there has been provided by this invention a method in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As various possible embodiments might be made of the features of the above invention and as the art herein described might be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

What I claim is:

1. The method of dyeing material comprising nitrogenous textile material which comprises running a length of material in open width through an aqueous bath in the presence of a selected dye,

said bath being heated substantially above 212° F., under pressure, the dye being substantially completely fixed on the material during the period of contact of the material with the said bath, and no further ageing being necessary.

2. The method disclosed in claim 1 in which the period of contact between the said aqueous bath and the material is on the order of from 0.25 minutes to 5 minutes.

3. The method disclosed in claim 1 in which the said aqueous bath is heated within a range having a temperature on the order of 295° F. as its upper limit.

4. The method of dyeing material comprising nitrogenous textile material which comprises running a length of material in open width through an aqueous bath in the presence of a selected azo dye, said bath being heated substantially above 212° F., under pressure, and the dye being substantially completely fixed on the material during the period of contact of the material with the said bath, and no further ageing being necessary.

5. The method of dyeing material comprising nitrogenous textile material which comprises running a length of material in open width through an aqueous bath in the presence of a selected dye, said bath being heated to within a high temperature range having a temperature on the order of 220° F. as its lower limit, under pressure, and the dye being substantially completely fixed on the material during the period of contact of the material with the said bath, and no further ageing being necessary.

6. The method of dyeing material comprising nitrogenous textile material which comprises running a length of material in open width through an aqueous bath in the presence of a selected dye, said bath being heated to within a high temperature range having a temperature on the order of 240° F. as its lower limit, under pressure, and the dye being substantially completely fixed on the material during the period of contact of the material with the said bath, and no further ageing being necessary.

7. The method of dyeing woolen material and material comprising wool which comprises running a length of material in open width through an aqueous bath in the presence of a selected dye, said bath being heated substantially above 212° F., under pressure, and the dye being substantially completely fixed on the material during the period of contact of the material with the said bath, and no further ageing being necessary.

8. The method of dyeing nylon material and material comprising nylon which comprises running a length of material in open width through an aqueous bath in the presence of a selected dye, said bath being heated substantially above 212° F., under pressure, and the dye being substantially completely fixed on the material during the period of contact of the material with the said bath, and no further ageing being necessary.

9. The method of dyeing material comprising nitrogenous textile material which comprises padding a selected dye onto a length of material and running the length of material in open width through an aqueous bath heated substantially above 212° F., under pressure, the dye being substantially completely fixed on the material during the period of contact of the material with the said bath, and no further ageing being necessary.

10. The method of dyeing material comprising nitrogenous material which comprises run-

ning a length of the material in open width through an aqueous bath in the presence of a selected dye while maintaining said aqueous bath under pressure sufficiently greater than atmospheric pressure to permit said aqueous bath to be heated to a temperature substantially above 212° F. without substantial change from liquid to steam phase to substantially completely fix the dye on the material.

11. In a method of dyeing material comprising wool, nylon, silk, and other nitrogenous fibers the step which comprises running a length of the material in open width through an aqueous bath of dye solution heated substantially above 212° F. under pressure to substantially completely fix the dye on the material.

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