May 23, 1961 C. KRONSBEIN ET AL 2,985,502

METHOD OF DYEING KNITTED TEXTILE PRODUCTS

Filed April 1, 1959

Fig. 1.

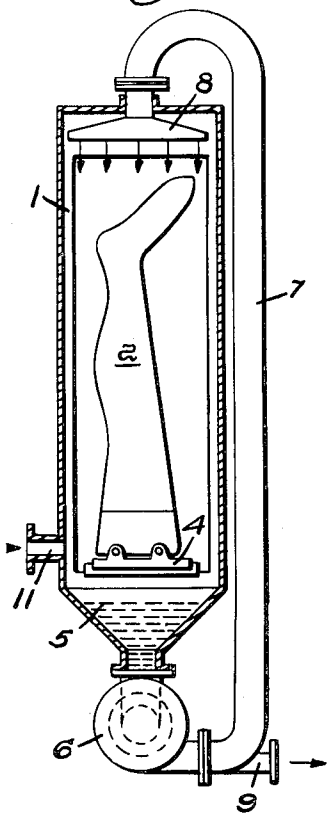


Fig. 2.

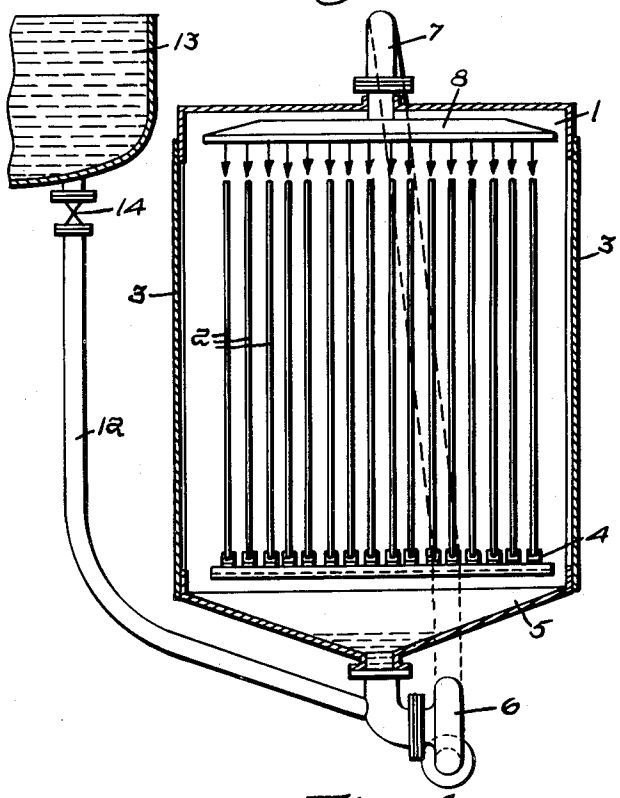


Fig. 3.

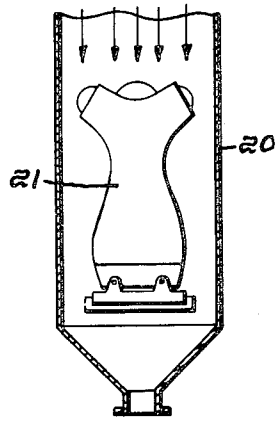
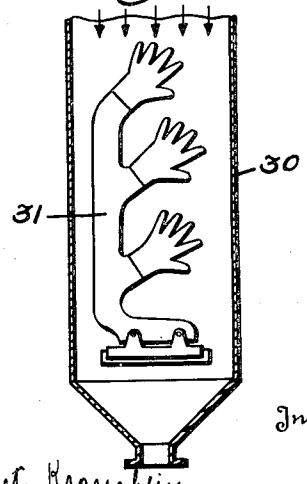


Fig. 4.



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METHOD OF DYEING KNITTED TEXTILE PRODUCTS

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4 Claims. (Cl. 8—150)

This is a continuation-in-part of our co-pending patent application Ser. No. 628,203, filed December 13, 1956, for Textile Dyeing Processes, now abandoned.

The present invention is concerned with treating textile products with hot liquids, and more particularly with hot dyes.

It is one object of this invention to provide improved systems for treating textile products with liquids at elevated temperatures, and more particularly with dyes at elevated temperatures.

Another object of this invention is to provide improved methods of treating textile products with liquids at elevated temperatures, and more particularly with dyes at elevated temperatures.

Another object of this invention is to provide means which make it possible to minimize the quantity of dye or other treating liquid used in the process, to minimize the time involved in the dyeing or other liquid treating process and to minimize the heat needed to raise to a required level the temperature of the dye, or other treating liquid, used in the process.

The methods used heretofore for dyeing knitted textile products such as, for instance, hosiery, gloves, sweaters, etc. require relatively large amounts of dye. This results in relatively high dyeing cost for such products.

It is, therefore, another object of the invention to provide dyeing methods for knitted textile products requiring relatively small quantities of dye, and involving considerably smaller cost than the batch dyeing methods which were used heretofore for dyeing such products.

Another object of the invention is to provide dyeing methods for so called dry textile goods which methods lend themselves well to be combined with other finishing operations such as, for instance, fixation, cleaning, or sizing of the goods.

Another object of the invention is to provide generally improved methods for treating knitted textile goods made of synthetic fibers.

Another object of the invention is to provide improved spray dyeing systems for hosiery made of synthetic fibers requiring smaller quantities of dye and less heat and working more efficiently than comparable prior art spray dyeing systems for hosiery.

Other objects and advantages of the invention will, in part, be obvious and in part appear hereinafter.

For a more complete understanding of the invention reference may be had to the following detailed description thereof taken in connection with the accompanying drawing, in which:

Fig. 1 is substantially a vertical section across a tank adapted to practicing the invention, and associated apparatus;

Fig. 2 is a substantially vertical section across the tank and associated apparatus shown in Fig. 1 taken along a plane at right angles to the plane of Fig. 1;

Fig. 3 is a more diagrammatic illustration of an arrangement for treating such goods as sweaters, pullovers, or knitted underwear; and

Fig. 4 is a relatively diagrammatic illustration of an arrangement for treating knitted gloves made of synthetic fibers.

Figs. 1 and 2 refer to an arrangement for treating stockings made of a material known in the trade as Perlon-nylon 6 (a polymer of caprolactam). Reference numeral 1 has been applied to indicate a substantially steam-tight tank or treating tank provided with substantially steam-tight doors 3 for admitting textile products to be dyed into tank 1 and for removing dyed textile products from tank 1. The goods to be dyed are mounted on separate supports, e.g. each stocking to be dyed is mounted on a separate supporting frame indicated by reference numeral 2. The size of tank 1 is relatively small or, to be more specific, the size of tank 1 is adapted to receive sixteen stockings, each mounted on a separate supporting frame 2. Each supporting frame 2 is mounted on a stand 4, and stands 4 are stacked and inserted into guiding means as, for instance, a U-shaped rail, to facilitate moving of stands 4 into, and out of, tank 1. Tank 1 is made to withstand an internal pressure of at least 45 lbs. per square inch but is preferably considerably stronger. The upper part of tank 1 is provided with spray nozzle means 8 adapted to produce a spray, or a large number of relatively fine jets, of liquid. The lower part 5 of tank 1 is substantially in the shape of an inverted pyramid or cone and decreases in cross-section toward the lowest point of the tank. The intake of suction pump 6 is connected to the lowest point of tank 1. The outlet of suction pump 6 is connected to a fluid circulating pipe 7 which, in turn, is directly connected to the spray nozzle means 8 adjacent the top of tank 1. The outlet of suction pump 6 is provided with a dumping pipe 9 for removing, or dumping, dyes upon completion of the dyeing process. Tank 1 is further provided with an intake pipe 11 intended to admit steam derived from an auxiliary steam source into tank 1. Pipe 11 is arranged in the lower portion of tank 1 but above part 5 thereof. Reference numeral 12 has been applied to indicate a dye supply pipe connected to dye storage tank 13. Measuring valve 14 is interposed between dye storage tank 13 and pipe 12. The object of valve 14 is to admit a pre-measured volume of dye to the bottom of tank 1 and to circulating pump 6. In the embodiment of the invention shown which is intended to dye simultaneously sixteen stockings about two gallons of dye are admitted at one time from dye storage tank 13 to tank 1 and pump 6. Pump 6 operates continually and circulates the dye through pipe 7 directly to spray nozzle 8. The stockings in tank 1 are subjected to relatively finely divided jets of hot dye, generally directed from the top region of tank 1 to the bottom region 5 thereof. The excess of dye not absorbed by the stockings on supports 2 is being collected on the bottom region 5 of tank 1 and circulated and recirculated by the action of pump 6. The dye re-admitted to spray nozzle 8 is used for re-subjecting the stockings in tank 1 to finely divided jets of dye generally directed from the top region of tank 1 to the bottom region thereof. At the same time at which dye is admitted through pipe 12 to tank 1 and pump 6 steam is admitted into tank 1 through the steam intake pipe 11. The initial pressure of the steam derived from an auxiliary source of steam is in the order of 80–180 lbs. per square inch. The steam is caused to flow through an automatic reducing valve (not shown) adapted to maintain steam admitted to tank 1 at a constant pressure. The constant pressure to be maintained depends upon the temperature required for the particular dyeing process in hand. The pres-

sure at which steam is being introduced into tank 1 ought to be at least as high as the pressure of saturated steam at a temperature of, or exceeding, 100 deg. C. When dyeing Perlon-nylon 6 stockings satisfactory results may be obtained by admitting steam at a pressure of about 15 lbs. per square inch. That pressure ought to be maintained constant during the entire dyeing process.

The dye stored in storage tank 13 may comprise additional ingredients whereby the dyeing process may be combined with other finishing processes as, for instance, washing, or sizing. The dye in storage tank 13 may include a metal complex dye, a dispersing agent, a cleaning agent or detergent, a sizing agent, etc.

The time required to start the dyeing process subsequent to opening of measuring valve 14 is about 20 seconds, and the time required to dye and steam treat the sixteen stockings in tank 1 is in the order of six minutes. The temperature at which the dyeing process is being performed is in the order of 120 deg. centigrade. At the end of the aforementioned dyeing period of six minutes admission of steam through passage 11 is discontinued and pipe 9 is opened by a valve (not shown) to dump the used or exhausted dye from the dyeing system. The dyed stockings are removed from tank 1 when the pressure prevailing therein is subsided, i.e. is equal to ambient pressure.

The above described dyeing process lends itself well to semi-complete or to complete automation.

The apparatus diagrammatically shown in Figs. 3 and 4 is supposed to be substantially identical with the apparatus shown in Figs. 1 and 2. According to Fig. 3 tank 20 houses supports 21—of which only one can be seen—for such knitted textile products as underwear, sweaters, pullovers, etc. The products may be made of a mixture of equal parts of such synthetic fibers as those known by the name of viscose fibers and polyester fibers, e.g. Dacron fibers. The dyeing fluid used for this particular mixture of fibers comprises 3% substantive dyes, 2.5% dispersing dyes, 1.5% acetic acid, a dispersing medium 1 gram per quart, and some additional ingredients in the nature of finishing or sizing agents. The temperature is maintained at about 110 degrees centigrade and the pressure within the tank is maintained at about 8 lbs. per square inch. The polyester component of the fibers is being fixed during the steam treatment accompanying the dyeing process proper, i.e. a condition is imparted to the polyester fibers precluding subsequent changes of the shape thereof. The total treatment time for knitted underwear and sweaters made from the aforementioned mixture of synthetic fibers is in the order of six minutes. The sequence of steps involved in the treatment diagrammatically indicated in Fig. 3 is the same as that described in connection with Figs. 1 and 2.

Fig. 4 refers to dyeing of gloves made from synthetic fibers known in the trade as Orlon 81 (polyacrylonitrile). The gloves to be dyed are arranged inside of tank 30, and mounted on substantially hand-shaped separate supports integrated into a unitary supporting structure 31. The dyeing fluid comprises 2% of a suitable detergent and 1 gram per quart of a suitable finishing agent. The total treatment time is in the order of eight minutes, the treatment temperature in the order of 125 deg. centigrade, and the treatment pressure in the order of 23.5 lbs. per square inch. The sequence of steps involved in the treatment of gloves diagrammatically indicated in Fig. 4 is the same as that described in considerable detail in connection with Figs. 1 and 2.

It is apparent from a consideration of the process described above and illustrated in Figs. 1 to 4 that the goods to be dyed are not immersed in a dye bath, as is the case in conventional dyeing, but are repeatedly subjected to directed sprays of dye which is being circulated, and recirculated. This enables to dye textile materials with a minimum of dyes, and imparts a high degree of flexibility to the dyeing process.

Best results can be achieved only if the pressure in the tank or treatment chamber is at least as high as the pressure of saturated steam at the preferred dyeing temperature. The dyeing temperature should be at least 100 deg. centigrade. Supplying steam to tank 1 from an auxiliary source enables to reach the preferred, or required, pressure range almost instantly, i.e. at the very outset of the dyeing process. The admission of steam derived from an auxiliary source of steam to the dyeing chamber may be started prior to the admission of dye from tank 13 into the dyeing chamber, simultaneously with the admission of dye from tank 13 into the dyeing chamber, or shortly after the admission of dye from tank 13 to the dyeing chamber has been completed.

It will be apparent from the foregoing that we have provided a system for treating textile products with hot dyes or other hot liquids wherein the liquid storage means are segregated from the closed spray treating system. Liquid is admitted from the former to the latter in critically small quantities. The conduit means 7 is adapted to have a minimal dye storage capacity and is directly connected to the nozzle means 8, i.e. no storage vessel or tank is interposed between the upper end of conduit means 7 and nozzle means 8 and no storage vessel or tank is needed at this point since the dye is stored in the separate storage vessel or tank 13. The quantity of dye or other treating liquid admitted from storage tank 13 to dyeing tank 1 is substantially equal to the aggregate storage capacity of pump 6 and conduit 7. This is less than required to form a head of dye or other liquid in the bottom portion 5 of dyeing tank 1 when pump 6 is operating. A low head of liquid may form in the lower portion 5 of tank 1 as long as pump 6 is not operating. This has been indicated in Figs. 1 and 2. As soon as pump 6 starts to operate this small head of dye or other liquid disappears into the circulating system. Because of the very small quantity of dye or other liquid involved in the process relatively little heat is required to raise the liquid to the required treating temperature. The superheated steam admitted through admission means 11 forms an upwardly directed counterflow to the downward flow of dye in spray-form. By establishing counterflows of steam and dye the area of heat exchange between the heating medium and the heated medium is maximized and consequently the heating time minimized.

When dyeing hosiery made of synthetic fibers the aforementioned critically small quantity of dye admitted at any time from tank 13 to tank 1 is in the order of 28–34 litres per 60 pairs of hosiery, or about .46 to .56 litre per stocking. More generally speaking, the ratio of the weight of the dye, or dyeing liquor, to the weight of the goods to be dyed should be in the order of 15:1. This limited quantity of dye is continuously circulated and recirculated by pump 6, except the portion thereof absorbed by the products to be dyed. The rate at which dye is being directly recirculated from pump 6 to spray nozzles 8 is substantially equal to the rate at which dye is sprayed from nozzles 8 per unit of time.

It will be understood that, although but a few embodiments of this invention have been shown and described in detail, the invention is not limited thereto and that the illustrated embodiments may be modified without departing from the spirit and scope of the invention as set forth in the accompanying claims.

It is claimed:

1. A method of dyeing textile products comprising the steps of admitting a predetermined limited quantity of dye to a closed dyeing system, said limited quantity being in the order of 15 times the weight of the textile products to be dyed, of spraying said dye from spray nozzles at a predetermined rate per unit of time upon the textile products to be dyed, of collecting the dye not absorbed by the products to be dyed at a point below the products

to be dyed, of continuously circulating and recirculating all of said limited quantity of dye except for the portion thereof absorbed by the products to be dyed substantially at said predetermined rate per unit of time from said point below the products to be dyed directly back to said spray nozzles, and of heating said dye by a counterflow of steam while being in the form of a spray emanating from said spray nozzles.

2. A method for dyeing hosiery comprising the steps of admitting a predetermined limited quantity of dye to a closed dyeing system, said limited quantity being in the order of 28–34 litres per 60 pairs of hosiery, of spraying said dye from spray nozzles at a predetermined rate per unit of time upon the hosiery to be dyed, of collecting dye not absorbed by the hosiery to be dyed at a point below the hosiery to be dyed, of continuously circulating and recirculating all of said limited quantity of dye except for the portion thereof absorbed by said hosiery to be dyed substantially at said predetermined rate per unit of time from said point below the hosiery to be dyed directly back to said spray nozzles, and of heating said dye by a counterflow of steam while being in the form of a spray emanating from said spray nozzles.

3. A method for dyeing hosiery in a dye circulating system, said dye circulating system comprising a dyeing tank, spray means adjacent the top of said dyeing tank, and pump and conduit means for directly supplying said spray means with dye derived from the bottom of said tank, said method comprising the steps of admitting a predetermined quantity of dye from a storage tank segregated from said dye circulating system to said dyeing tank thereof, said quantity of dye being substantially equal to the aggregrate dye storage capacity of said pump means and said conduit means and less than required to form a head of dye in the bottom portion of said dyeing tank when said pump means is operating, of admitting superheated steam to the lower portion of said dyeing tank while said pump means is circulating and recirculating said dye, and of maintaining a counterflow of steam to the spray of dye produced by said spray means until said dye reaches a predetermined dyeing temperature.

4. A method of dyeing hosiery in a system comprising a treating tank, steam admission means in the lower portion of said treating tank, a plurality of supports inside said treating tank for supporting hosiery to be treated with hot liquid, spray nozzle means inside said treating tank arranged above said supports for spraying liquid upon said hosiery on said supports, drain means to withdraw liquids from said treating tank upon completion of a treating cycle, liquid circulating means including a first conduit means directly connecting the bottom portion of said treating tank to said spray nozzle means and adapted to have a minimal liquid storage capacity, said circulating means further including pump means connected to said first conduit means, a liquid storage tank segregated from said liquid circulating means, a second conduit means connecting said storage tank to said treating tank, and valve means in said second conduit means for admitting predetermined quantities of liquid from said storage tank to said treating tank, said method comprising the steps of admitting a quantity of dye from said storage tank to said treating tank substantially equal to the aggregate dye storage capacity of said pump means and of said first conduit means and less than required to form a head of dye in said bottom portion of said treating tank when said pump means is operating, of admitting superheated steam to said steam admission means while said pump means is circulating and recirculating said dye, and of maintaining a counterflow of steam to a spray of dye produced by said spray nozzle means until said dye reaches a predetermined dyeing temperature.

References Cited in the file of this patent

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"Automatic Processing of Nylon Hose," p. 57, July 1955, "Man-Made Textiles."

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,985,502 May 23, 1961

Curt Kronsbein et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, between lines 8 and 9, insert -- Claims priority, application Germany Dec. 19, 1955 --; column 4, line 51, and column 5, line 12, for "pairs", each occurrence, read -- pieces --.

Signed and sealed this 31st day of July 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents