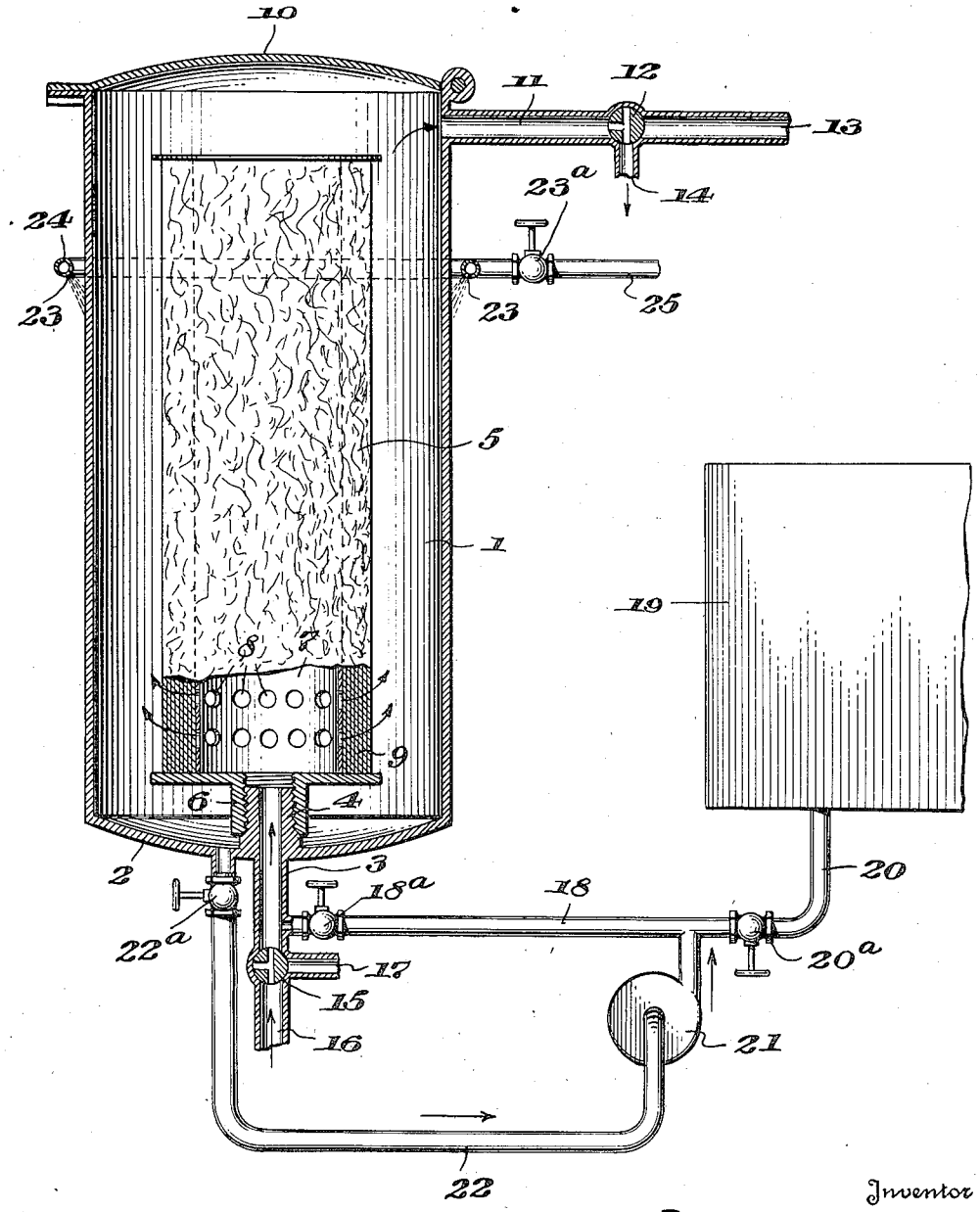
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STEAM PROCESS FOR FIXING COLORING MATERIAL IN TEXTILE GOODS

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STEAM PROCESS FOR FIXING COLORING MATERIAL IN TEXTILE GOODS

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According to the methods used heretofore for dyeing and printing fabrics, in the former case the principle adopted was to charge the fabrics to be dyed with more or less dissolved colouring matter, by gradual steps, until the desired color was obtained. In order to accelerate this method the process is usually carried out under fairly high temperatures, according to the colouring material used. All processes of this type require a comparatively long treatment and, therefore, the heat consumed is considerable. In the case of normal printing methods, the colours are applied in a more or less intensive manner and, in one case, they are subsequently exposed to the action of steam, in order to effect a fixing of the dye on the fibre. However, by such means a deep penetration of the colouring material into the fibres cannot be obtained and, for this reason, uniform colouring of the fibres is not possible, generally speaking, particularly in the case of compact tissues.

The problem of colouring material penetrating as deeply as possible into the fibres, either applied by a dyeing or by a printing step has not heretofore been solved in a technically satisfactory manner. It was ascertained with some surprise that, when dyeing or printing textile goods of every description, for instance, yarns, tissues, knitted and woven textile materials or webs, of natural or of artificial fibres, a far deeper penetration of the colouring material into the fibre and, thereby, a better fixation of the colouring matters was obtained, if the textile goods to be dyed or printed, which had been treated beforehand with colouring material in the well known manner, was exposed to a treatment by wet steam in a container by means of alternate low and high pressure, and then subjected to further treatment in the usual way. The change of pressure is advantageously effected in rapid succession. Thereby, it is possible to produce a deep impregnation effect within a relatively short space of time. If the low pressure lies in the vacuum range, the vacuum pressure can be produced by condensation of the steam from the higher pressure. When dyeing or impregnating, the dyer's bath or impregnating solution can be let in the container at vacuum pressure, and the liquor may be subsequently circulated in vacuum condition. After removal of the liquor, the container is filled with the steam under higher pressure. This treatment can be repeated. Subsequent to the treatment of the liquor, the amount, pressure and temperature respectively of the steam supply

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can be influenced and regulated by simultaneous continuation of the process by condensation.

The change of the low pressure into the vacuum region is carried out under an automatic ventilation of the tissue. The single fibres of the material first swell, when they are under treatment by steam, whereby at least a part of the air in the fibres is removed. In the following vacuum stage, the remaining air contained in the fibre is removed and, due to the pressure treatment then immediately following, the single particles of the colouring material, or of the impregnating material, are forced into the hollow spaces of the fibres, which are now devoid of air. Then, during the alternate pressure and vacuum treatments, the dye is pumped into the fibres in an increasingly stronger manner. If the low pressure is changed into the region of pressures above the atmospheric pressure, this method can be rendered more economical, inasmuch as an important saving of steam can be attained. Condensation of steam is reduced, and the consumption of steam is, therefore, also considerably reduced. As compared with the constant pressure damping process so far known, a pronounced saving of time is attained. It is of advantage, when starting the steam treatment, to remove the air from the tissue by means of an intensive current of steam through the material to be treated. It is appropriate to lead steam to the material to be treated, either from the interior to the exterior, or vice versa, or, in a given case, alternately.

By way of example, the following is an illustration of the method described according to the present invention:

First example.—A compact piece of textile material with cellular wool in the warp and artificial silk in the woof was subjected to a preliminary treatment and dried in the usual manner. Subsequently, it was padded on a Foulard-machine at 90° C. with benzo fast copper red colour (1 mol. 4-4-diaminodiphenyl-3-3'-dioxyacetic acid diazotized and coupled with 2 mol. 1-phenyl-3-methyl-5-aminopyrazol) and an addition of wetting means. The intermediately dried or wet tissue was then transferred to a pressure-container, and the latter was filled with wet steam of low pressure, for instance, 0.2 at. above the atmospheric pressure. Subsequently, a vacuum was produced, for instance, up to 80%, and then an immediate increase of pressure was applied, for instance, up to 1 at. above the atmospheric pressure, and for a period of 20 minutes. These steps were repeated three times. Then the tissue was fixed in the

usual manner for 30 minutes at about 80° C., by means of acetic acid and sulphate of copper, washed out and dried.

The tissue treated in this manner is of absolutely uniform composition, the woof-threads and the warp-threads being completely impregnated by the colouring matters.

Second example.—A tissue treated in the same way as described in the first example, was treated on one side by means of vat-dyes. After drying, it was subjected to the same alternate wet-steam-treatment in a pressure-container, such alternate steps taking place for 8–20 minutes and, subsequently, it was treated in the usual manner.

The tissue showed far more intense colours and much stronger impregnation as compared with tissues treated during the same period of time, with the same amount of colouring material, and subjected to the steam-treatment, which had been in use up to the present.

Third example. A heavy twilled tissue consisting of cellular wool and cottonised hemp in the warp, and cellular wool in the woof, was subjected to a preliminary treatment in the ordinary way and then dried. Subsequently, it was treated during passage through a Foulard-machine at 90° C., by means of colouring matters and an addition of wetting means. The intermediately dried or wet tissue was then transferred to a container, and the latter filled with steam of, for instance, 1 at. above the atmospheric pressure. Subsequently, the mixture of steam-air was blown out, by means of a strong current, until the steam-pressure had been reduced to about 0.4 at. above the atmospheric pressure. Following these steps, the steam-pressure was subjected to rapid changes between 0.4 and 0.8 at. above the atmospheric pressure, approximately eight times within 6 minutes. The entire treatment was effected by steam in saturated condition. The tissue was then further treated in the usual manner. The material treated in this way showed uniform and completely impregnated woof-threads and warp-threads of far more intense colouring shades than the colours developed on the jigger.

By the process according to the present invention, a considerable shortening of the time required for dyeing is attained and, thereby, also a considerable saving of heat energy and of colouring materials, apart from the intense impregnation of the fibre by the colouring materials. then damping impressions according to the present invention, effects can be accomplished, which are surprising and could not be attained heretofore by applying the same amount of colouring materials.

The same effect can also be attained if an impregnation of the textile goods is carried out in the manner described, either independently, or simultaneously with the dyeing- or impregnating-procedure.

In the drawing, a section through an apparatus is illustrated by way of example, in which the inventive method can be carried out.

A sealed container 1 has a bottom 2 into which a centrally located pipe 3 extends. Said pipe has a threaded upper end 4 inside of said container 1. A reel or spool 5 can be removably mounted on said threaded portion 4 by means of its correspondingly threaded lower end or hub 6. The reel or spool 5 has a cylinder 7 provided with a number of openings 8. The cylinder 7 may be conveniently made of perforated sheet metal. A piece or web 9 of the textile material to be treated can be spirally wound on said cylinder 7.

The top of the container 1 is closed by a hermetically sealing cover or lid 10 which can be readily opened when the reel or spool 5 is introduced into the container or removed therefrom. A pipe 11 ends in the upper part of the wall of the container 1, said pipe 11 having a three-way cock 12, through which the pipe can be selectively connected either with a live steam feed conduit 13 or an exhaust steam conduit 14.

The central pipe 3 can be selectively connected with a live steam feed conduit 16 or an exhaust steam conduit 17 through a three-way cock 15. A feed pipe 18 and a pipe 20 connect the central pipe 3 with a vessel or tank 19 containing the dyer's bath. Said vessel or tank 19 is connected with pipe 22 ending in the bottom 2 of the container 1 through pipe 20 and a circulating pump 21. In each of the pipes 18, 20 and 22 stop cocks 18*a*, 20*a* and 22*a* respectively are inserted.

Before the apparatus is operated, the reel or spool 5, on which a web of textile material 9 is wound, is introduced through the open top of the container 1 and the hub 6 of said reel or spool 5 is firmly screwed on the upper end 4 of the pipe 3. The container 1 is then hermetically closed by the cover 10. The three-way cocks 15 and 12 are turned to the positions shown in the drawing. Live steam is now streaming through the conduit 16, the three-way cock 15, the pipe 3, interior of the reel or spool 5, openings 8 of cylinder 7, textile material 9 into container 1 and escapes from there through the pipe 11, three-way cock 12 to the exhaust pipe 14. The steam is passed through the textile material 9 until the air is entirely removed therefrom. Thereafter, the three-way cocks 15 and 12 are turned to positions in which they shut off the container 1 completely. To accomplish this, three-way cock 15 has to be turned 90° counterclockwise, while the cock 12 has to be turned 180°. During this operation, the steam feed conduits 16 and 13 are shut off by separate valves, not shown in the drawings.

A cold water feed pipe 25 supplies water to an annular tube 24 surrounding the container 1, a shut-off valve 23*a* being inserted in said feed pipe 25. The annular tube 24 is provided with a number of nozzles 23 which are directed against the wall of the container 1 in such a manner that when the shut-off valve 23*a* is opened, said container 1 is sprayed with cold water and thereby cooled so that the steam in the interior of the container 1 is condensed. As a result of this, a vacuum is created inside of the container 1 opening the most inner pores or interstices of the fibres of the textile material 9. Thereafter, the stop cocks 18*a* and 20*a* are opened so that the dyer's bath in the vessel or tank 19 which is under atmospheric pressure is sucked through the pipes 20, 18 and 3 into the interior of the reel or spool 5 under the action of the vacuum and streams through the openings 8, and the textile material 9 into the container 1, filling the latter completely. The stop cock 20*a* is now closed and the stop cock 22*a* opened. Thereafter, the pump 21 is put into operation, circulating the dyer's bath in the direction of the arrow (in pipe 22) through the pipes 22, 18, 3, the reel or spool 5, the openings 8, the textile goods 9, the container 1, and back to the pipe 22, whereby the dyer's bath is repeatedly passed through the textile material 9 until a sufficient impregnation or dyeing is obtained. Thereafter, the stop cock 18*a* is shut off and the three-way cock 12 is returned to the

position shown in the drawing. The stop cock 20*a* is now opened and the pump 21 pumps the dyer's bath back to the vessel or tank 19 through the pipes 22, 20 and the stop cock 20*a*. After return of the dyer's bath, the stop cocks 20*a* and 22*a* are again closed.

The textile material 9 is now impregnated or dyed with the coloring substance, which has to be fixed in the fibres. To accomplish this, the three-way cock 15 is returned to the position shown in the drawing. Wet steam is now fed to the container 1 through the pipe 16, the three-way cock 15, the pipe 3, the interior of the reel or spool 5, the openings 8, the textile material 9 and is passed from there through the pipe 11, the three-way cock 12 to the exhaust pipe 14, the direction of the steam being indicated by arrows. After the textile material 9 has been intensively treated by the wet steam passing therethrough in this manner, the two three-way cocks 12 and 15 are turned to positions in which they completely shut off the container 1. By opening the valve 23*a*, cooling water is passed through the nozzles 23 so that the outside of the container 1 is sprayed with cold water with the result that the steam inside the container 1 is condensed and a pressure drop obtained within said container 1. Immediately thereafter, the valve 23*a* is closed and the three-way cock 15 is opened, so that again wet steam enters the container 1 through the pipe 16, three-way cock 15, pipe 3, reel or spool 5 and textile material 9, whereby the original pressure in the interior of the container 1 is obtained. When this has taken place, the three-way cock 15 is turned to closing position shutting off the container 1. The cool water valve 23*a* is now opened so that the cooling water sprays through the nozzles 23 on the container 1 resulting in a pressure drop within said container. The pressure change or variation steps can be repeated any number of times, whereby care has to be taken that the steam in the interior of the container 1 remains markedly wet during the whole fixation step, because the fixation effect of the high quality of the inventive process can only be obtained if steam remaining wet during the whole treatment is acted upon the textile goods under repeated pressure change or variation.

The fixing action can be still more intensified by operating the three-way cocks 15 and 12 alternately, rather than the three-way cock 15 alone to restore the pressure, whereby at each operation the three-way cock previously used is turned to a position shutting off the container 1. As a result of this alternate operation of the two three-way cocks, the wet steam is passed alternately through the textile material 9 in the one and in the other direction, i. e., from the interior of the reel or spool 5 outwardly through the openings 8 and the textile material 9 in the direction of the arrows and then in the opposite direction. If the steam shall be solely passed in the opposite direction of the arrows, i. e., from the container 1 inwardly towards the interior of the reel or spool 5, only the three-way cock 12 has to be operated.

After the color has been sufficiently fixed, the steam supply is shut off, the cover 10 opened, the reel or spool 5 unscrewed from the threaded upper end 4 of pipe 3 and removed from the container 1. After a new reel or spool 5 wound with untreated textile material has been introduced into the container 1, the process can be repeated as described.

If a spool carrying textile goods previously loaded with coloring substances, for example, by padding or printing, is introduced into the container 1, the dyeing step is omitted and only the fixing step is carried out, whereby the steam will be passed through the textile material either in the one or the other direction, or alternately in both directions as described. In this case, it is very important that the steam used for the fixing step is and remains markedly wet throughout this operation, because the coloring substances previously applied to the textile goods adhere to the fibres more or less superficially and the textile goods are ordinarily dried after the color loading step. Consequently, it is essential that markedly wet steam is employed to fix the coloring substances in the fibres and that the wet condition of the steam is constantly checked during the operation, as the textile goods practically do not contain any moisture.

What I claim is:

1. A process for fixing coloring materials in textile goods comprising passing steam through the textile goods carrying the unfixed coloring materials until the air is entirely removed from said goods, shutting off the steam supply, evacuating the textile goods, passing wet steam through the textile goods, and varying the steam pressure alternately several times between higher and lower ranges.

2. A process for fixing coloring materials in textile goods comprising passing steam through the textile goods carrying the unfixed coloring materials until the air is entirely removed from said goods, shutting off the steam supply, evacuating the textile goods, passing wet steam through the textile goods, and varying the steam pressure alternately several times between higher and lower ranges, the differences between said ranges being at least .4 atmosphere.

3. A process for dyeing textile goods, comprising treating said goods with steam, subjecting them to a vacuum produced by condensing the steam, introducing coloring liquor into said goods by the suction action of the vacuum and thereby dyeing them, removing the coloring liquor from the treated goods, fixing the coloring substances retained in the goods by the previous dyeing step by passing wet steam through the goods and varying the steam pressure alternately several times between higher and lower ranges.

4. A process for dyeing textile goods comprising treating said goods with steam, subjecting them to a vacuum produced by condensing the steam, introducing coloring liquor into said goods by the suction action of the vacuum and thereby dyeing them, removing the coloring liquor from the treated goods, fixing the coloring substances retained in the goods by the previous dyeing step by passing wet steam through the goods, and varying the steam pressure alternately several times between higher and lower ranges, the differences between said ranges being at least .4 atmosphere.

5. A process according to claim 1, in which the lower pressure is produced by condensation of the steam while the steam supply is shut off.

6. A process according to claim 1, in which the lower pressure is above atmospheric pressure.

7. A process according to claim 1, in which the pressure variations between higher and lower ranges are effected at the rate of approximately 8 times within 6 minutes.

8. A process according to claim 2, in which the pressure of the wet steam is varied between

vacuum and one atmosphere above atmospheric pressure.

9. A process according to claim 1 in which the steam is passed through the textile goods in one direction.

10. A process according to claim 1, in which the steam is passed through the textile goods alternately in the one and the other direction.

11. A process according to claim 1, in which the pressure of the wet steam is rapidly varied between .4 atmosphere above the atmospheric pressure and .8 atmosphere above the atmospheric pressure.

12. A process according to claim 3, in which the coloring liquor is circulated during the vacuum step.

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