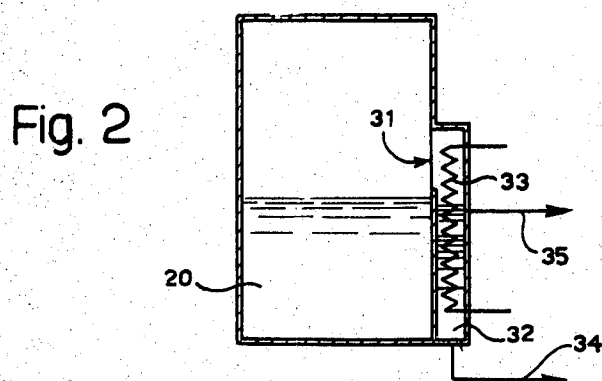
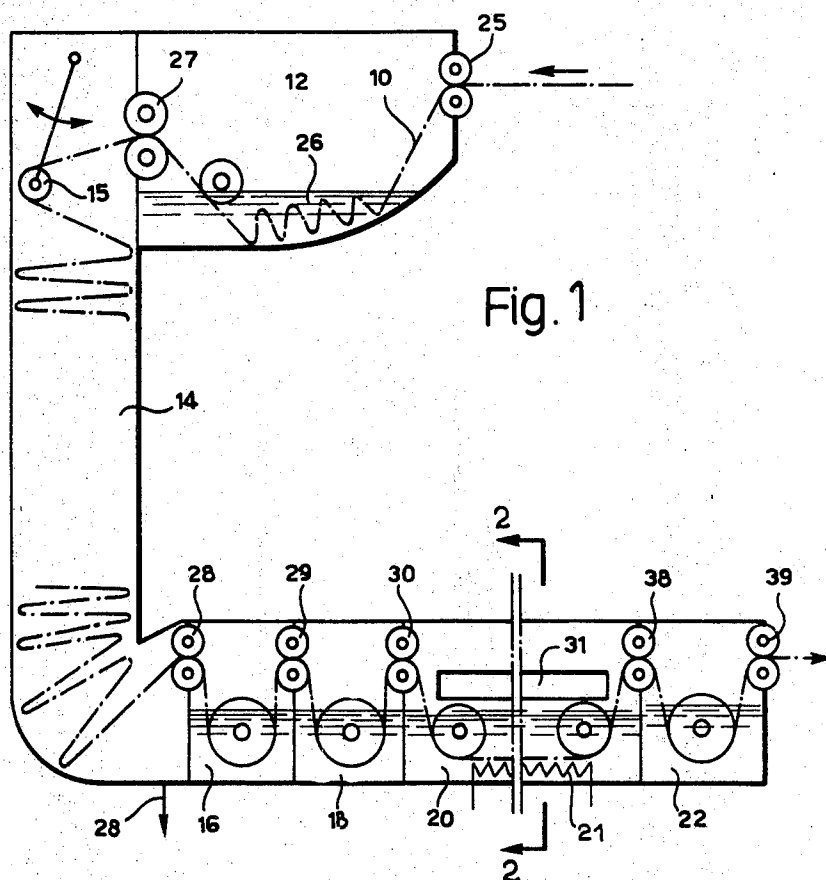


Jan. 26, 1971

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PREVENTION OF FELTING AND SHRINKING OF
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Filed Feb. 16, 1968

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PREVENTION OF FELTING AND SHRINKING OF WOOL-CONTAINING TEXTILE MATERIAL

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Filed Feb. 16, 1968, Ser. No. 705,981

Claims priority, application Italy, Feb. 25, 1967, 794,088

Int. Cl. D06I 1/00

U.S. Cl. 8—142

12 Claims

ABSTRACT OF THE DISCLOSURE

Wool-containing textile material is treated for prevention of shrinkage and felting by soaking in a solution of sulphoryl chloride in a volatile organic solvent, normally immiscible with water, for a short time to cause impregnation, wringing the material to remove excess solution, and, after temporary storing to allow the shrinkage prevention reaction to occur, removing the solution, preferably by washing with hot water.

The invention relates to the treatment of textile materials made of or containing wool fibers in order to reduce the natural tendency of such fibers to felt and shrink.

More particularly, the invention concerns the treatment of the such materials by means of sulphoryl chloride dissolved in a volatile organic solvent which is normally immiscible with water, such treatment being described, for example, in Italian patent specification No. 351,823 and British patent specification No. 464,503.

The reaction between wool and sulphoryl chloride takes place through the hydrolysis of the latter in the presence of normal moisture in the wool, the hydrolysis products comprising hydrochloric acid and sulphuric acid. The concentration by volume of the sulphoryl chloride in the solvent usually amounts to about 2% and does not generally exceed about 4%. The known treatment consists essentially in soaking the textile material in the organic solution of sulphoryl chloride at room temperature (15–30° C.) for a period of time suitable for obtaining the desired effect. This period of time depends upon the concentration and temperature of the sulphoryl chloride solution, but generally the period is rather long, of the order of one hour with a 2% sulphoryl chloride solution at room temperature. In order to treat material continuously and at a reasonable speed under these conditions, fairly large treatment vats would be required, adapted to contain lengths of material of the order of 350–400 metres and a correspondingly high quantity of continuously renewed treating solution. Using such a process, it would be difficult to prevent a thorough scouring of the wool by the solvent circulating through the vat, which in turn facilitates penetration of the sulphoryl-chloride into the individual wool fibers. This is quite undesirable as it adversely affects the properties of the fibers. As distinct from chlorine treatment in an aqueous solution, chlorine treatments in an organic solvent are intended to act on the appendicular portions only of the textile scales, that is, on the portions which are directly responsible for felting of the fibers, without attacking and damaging the fiber cores.

Moreover, after soaking the material in the solvent for a period of the order of one hour, removal of the solvent from the depth of the fibers becomes difficult and cannot be completed satisfactorily unless the material is maintained at length in an oven with a vigorous circulation of hot air, which in turn adversely affects the quality of the material and, furthermore, cannot be carried out easily without leakage of solvent to the external atmosphere occurring.

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A main object of the present invention is to improve the process of treatment of wool-containing textile material with a view to avoiding the abovementioned drawbacks, and more particularly with a view to enabling the process to be carried out continuously.

The invention accordingly provides a process for preventing felting and shrinking of wool-containing textile material by treatment with an impregnating solution of sulphoryl chloride in a volatile organic solvent which is normally immiscible with water, characterised by the steps of soaking the material in the said solution for a period of time just sufficient for impregnation of the material; removing excess solution from the material while leaving therein a quantity of solution not exceeding the weight of the material; temporarily storing the thus treated material for a period of time sufficient to cause the desired degree of felting or shrinking prevention, and then removing the solution from the material.

The removal of the solution from the material is advantageously effected by washing with an aqueous liquid or by steam.

In order to safeguard the material as far as possible against deterioration during the solution removing step the volatile organic solvent is advantageously such that it forms with water a minimum boiling point azeotrope. Also, the solution is preferably removed from the material by washing with hot water at a temperature exceeding the boiling point of the said azeotrope so as to remove the solution still contained in the material by azeotropic distillation.

The treatment with the solution of sulphoryl chloride entails hydrolysis of the latter to hydrochloric and sulphuric acids. Therefore, the process according to the invention advantageously includes the step of neutralising these acids before the azeotropic distillation washing step. The neutralising step is advantageously preceded by washing with water at room temperature, which removes from the material most of the acids and water soluble salts as well as a certain portion of the solvent, the latter being subsequently recoverable by decantation.

The organic solvent employed should, of course, be chemically inert toward the sulphoryl chloride. Chlorinated solvents may usefully be employed, such as, for example, trichloroethylene, perchloroethylene and carbon tetrachloride, the azeotropic data of which are given below in Table 1:

TABLE 1

Name	Solvent	Azeotrope with water		
		Boiling point, ° C.	Concentration of solvent, percent by weight	Boiling point, ° C.
Trichloroethylene	-----	87	93	73
Perchloroethylene	-----	121	84.2	87.7
Carbon tetrachloride	-----	76	95.9	66

Considering the boiling point of water (100° C.), the above table shows that the azeotropes are of the minimum boiling point type. The preferred solvent is trichloroethylene having regard to the low boiling point of its azeotrope; carbon tetrachloride, the azeotrope of which boils at a still lower temperature, is unfortunately toxic.

The present invention also provides an apparatus for use in carrying out the said process, the apparatus comprising a consecutive arrangement of an impregnating vat containing an impregnating solution, a temporary storage tank, a first washing vat containing an aqueous liquid, means for conveying the material successively through impregnating vat, the said tank and the washing vat being in a tightly sealed condition with respect to the external atmosphere, and means for adjustably wringing the material being transferred from the impregnating vat to the tank to remove excess solution from the material.

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The invention will be further understood from the following description, given by way of example, with reference to the accompanying drawing, in which:

FIG. 1 is a longitudinal diagrammatical sectional view of an apparatus according to one embodiment of the invention; and

FIG. 2 is a cross sectional view on line 2—2 of FIG. 1, showing a recovery vat in the said apparatus.

The material being treated is denoted by 10. This material may be in the form of a wool or wool-containing fabric, or worsted fiber slivers, or spun fibers of any other form capable of being fed in a continuous length, such as hanks or skeins bound to one another in chain form and opened as widely as possible. The apparatus shown in FIG. 1 comprises, in sequence, an impregnating vat 12, vertically extending temporary storage tank or so-called J-box 14 equipped at its upper end with a folding apparatus 15, smoothing vat 16, a neutralising vat 18, a recovery vat 20 and a softening vat 22. All the vats and the J-box 14 are air-tightly sealed with respect to the external atmosphere. Although one particular arrangement has been shown, it will be appreciated that any arrangement suitable for carrying out the sequence of operations described hereinafter may be used.

The material 10 is fed to the impregnating vat 12 by a pair of rollers 25 and travels down into a bath 26 contained in the vat. The bath 26 comprises an impregnating solution of sulphuryl chloride in any of the above mentioned solvents, such as, for example, trichloroethylene. The impregnation of the material 10 takes place in a few seconds, the impregnated material being then transferred from the vat 12 to the J-box 14 by a pair of adjustable-pressure entraining rollers 27. The pressure of the rollers 27 should be adjusted to wring from the material 10 any excess solution from the bath 26, leaving in the material a quantity of the solution which substantially equals in weight the material 10, or a quantity of solution of less weight than the material, so as to avoid any appreciable separation of liquid from the material as the latter is folded in the J-box 14. Any separated liquid may be removed through a bottom drain 28 in the J-box 14 and recovered.

The J-box 14 is elongated in a vertical direction and of such a capacity that the material travelling through the J-box 14 in the form of descending folds remains therein for a sufficient, predetermined period of time according to the nature of the material. As the material travels down the J-box 14 the reaction of the sulphuryl chloride with the material, that is, the hydrolysis of the sulphuryl chloride by the moisture contained in the fibers of the material, and the digestion of the appendicular portions of the scales of wool fiber takes place. More particularly, having regard to the absence of an actual bath of sulphuryl chloride solution, the said reaction in the J-box 14 requires (at room temperature) a total time of one hour approximately. This means that, for example, with a rate of feed material of 6–7 metres per minute, 360–420 linear metres of material 10 should be accommodated in the J-box 14 in a folded condition.

Generally, both the J-box 14 and impregnating vat 12 operate at room temperature (15–20° C.); however, it will be understood that means (not shown) can be provided for adjusting the operating temperature in a given selected operating range.

The material reaching the base of the J-box 14 is withdrawn by a pair of rollers 28 and undergoes a first wash in the smoothing vat 16 with water at room temperature. This preliminary washing step largely removes the organic liquid and salts impregnating the material, whereafter a further pair of rollers 29 transfers the material to the neutralising vat 18. The wash water continuously flowing out of the smoothing vat 16 is advantageously conveyed to a separator (not shown) from which the heavy organic phase is recovered for re-use and the light aqueous phase is discarded.

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The material reaching the neutralising vat 18 is strongly acid (of pH about 2–3). The vat 18 should therefore act as a buffer for this excess acidity by raising the pH of the material substantially to the iso-electric point of wool (pH 4.5–5.0). The vat 18 is therefore fed with an aqueous solution of sodium acetate or other suitable salt, still preferably at room temperature.

The neutralised material is continuously transferred by a pair of rollers 30 to the recovery vat 20 which contains hot water at a temperature exceeding the boiling point of the solvent/water azeotrope; for example, with trichloroethylene as the solvent it is sufficient and advantageous to use hot water at about 80–82° C. With other solvents, steam may be used. The desired temperature of the aqueous bath in the vat 20 may be maintained by heating means, shown diagrammatically at 21, governed by a thermostatic control. Under these conditions, the solvent still impregnating the material is mixed with water to form the azeotrope, which readily evaporates; this establishes a high concentration gradient between the solvent in the material and the solvent in the azeotrope, which greatly accelerates removal of the solvent, even though the temperature of the washing medium is substantially below the boiling point of water. Using trichloroethylene solvent, substantially complete removal of the solvent from the fibers is effected without a temperature of about 85° C. being exceeded, the removal being preferably carried out as stated above, at around 80–82° C.

The azeotrope vapours evolved in the recovery vat 20 are relatively heavy, and therefore tend to accumulate immediately above the liquid level in the vat 20. A wide horizontal aperture 31 is therefore formed in one at least of the sidewalls of the vat 20 just above the said liquid level. As shown in FIG. 2, the aperture 31 communicates with a pocket 32 attached to the vat wall. A cooling coil 33, denoted diagrammatically by 33, is arranged in the pocket 32 and is effective to condense the vapours, which separate into separate liquid phases. The heavy organic phase, which collects on the bottom of the pocket 32, is evacuated through a conduit 34 and recovered for the re-use in the impregnating vat 12. The light aqueous phase is discharged through a conduit 35 and is preferably conveyed to the same separator as that associated with the smoothing vat 16, from which residual solvent is recovered for re-use.

The material treated in the vat 20 is withdrawn by a pair of rollers 38 and fed to the softening vat 22 in which it is treated with any of the conventional wool softening agents in order to make up, if necessary, for a small loss of softness due to the action of the solvent on the wool fibers. Finally a pair of rollers 39 withdraws the treated material from the softening vat 22 and delivers it to a drier (not shown).

EXAMPLE

An apparatus as shown in the drawing was fed from a creel carrying 24 spools of worsted wool silver weighing 25 g. per linear metre. The vat 12 contained 200 litres of a 2% sulphuryl chloride solution in trichloroethylene at room temperature. The slivers were entrained by the rollers 25 at a rate of 6 linear metres per minute, the imbibition period in the bath 26 being 5 seconds. The rollers 27 wrung the slivers at an overall pressure of 4,000 kg. to thereby leave in each sliver substantially 25 g. of solution per linear metre of the sliver. The level of the bath 26 in the vat 12 was kept constant by an automatic regulator (not shown on the drawing) through which the vat 12 was supplied with about 216 kg./hour (144 litres/hour) fresh impregnating solution.

The impregnated wrung slivers were folded in the J-box 14 at room temperature, the dwelling time in the J-box 14 being one hour. The smoothing vat 16 contained about 100 litres of water at room temperature and was supplied with further water at a rate of 200 litres per hour, the effluent from the vat 16 flowing to the solvent

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recovery separator (not shown). An aqueous solution of sodium acetate was circulated through the neutralising vat 18 and brought the pH of the slivers to 4.5-5.0. The washing in the recovery vat 20 was carried out with water at a temperature of 80-82° C. Finally, the slivers softened in the softening vat 22 were passed through a drier of conventional type for the tops.

The sliver-conveying roller pairs 29, 30, 38 and 39 each exerted a pressure of about 4,000 kg. on the sliver so as to wring excess liquid from the sliver each time the latter was entrained thereby.

A substantially similar process in accordance with the invention may be adopted for treating fabrics made wholly or partly of wool. An apparatus similar to the apparatus shown in the drawing may further be employed for treating wool yarn or thread in hanks or skeins, the latter being bound to one another in an endless chain.

In order to treat wool in tuft form by the process according to the invention the various components of the apparatus as shown should be conveniently modified in accordance with the known criteria in treatments of this kind of material (such as by employing vats equipped with harrows) and substituting for the folding apparatus 15 a tuft distributing device. Of course, in this case also the various components of the apparatus are interconnected in an air-tight manner with respect to the external atmosphere, as shown in the drawing.

What is claimed is:

1. A process for preventing felting and shrinking of wool-containing textile material comprising the steps of: soaking the material in an impregnating solution containing at least an amount of sulphoryl chloride which is effective to prevent felting and shrinking of the wool-containing textile material and up to about 4% by volume of sulphoryl chloride in a volatile organic solvent which is chemically inert towards the sulphoryl chloride, which is capable of forming with water a minimum boiling point azeotrope and which is normally immiscible with water, for a period of time just sufficient for impregnation of the material;

removing excess solution from the material while leaving therein a quantity of solution not exceeding the weight of the material;

temporarily storing the thus treated material for a

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period of time sufficient to cause the desired degree of felting or shrinking prevention; and finally removing the solution from the material.

2. The process as claimed in claim 1 wherein the final step of removing the solution from the material is effected by washing with an aqueous liquid.

3. The process as claimed in claim 1 wherein the organic solvent consists essentially of trichloroethylene.

4. The process as claimed in claim 1 wherein the process is continuous and the textile material is fed continuously through the successive steps of the process.

5. A wool-containing textile material which has been treated by the process according to claim 1.

6. The process of claim 1 wherein the concentration of the sulphoryl chloride is about 2% by volume.

7. The process as claimed in claim 2 wherein the solution is removed from the material by washing with hot water at a temperature exceeding the boiling point of the azeotrope so as to remove the solution still contained in the material by azeotropic distillation.

8. The process as claimed in claim 2 wherein the vapours evolved during the azeotropic distillation step are condensed in part, the condensate is decanted, the organic phase separated from the aqueous phase, and the separated organic phase is reutilized in the impregnating solution.

9. The process as claimed in claim 7 wherein the azeotropic distillation step is effected by washing with water at a temperature of 80-82° C.

10. The process as claimed in claim 7 in which the azeotropic distillation washing step is preceded by a neutralizing step.

11. The process as claimed in claim 10 in which the neutralizing step is preceded by washing with water at room temperature.

12. The process as claimed in claim 3 wherein the azeotropic distillation step is effected by washing with water at a temperature of 80-82° C.

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MAYER WEINBLATT, Primary Examiner

U.S. Cl. X.R.

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