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[54] **APPARATUS FOR FINISHING CELLULOSE-CONTAINING TEXTILE MATERIALS**

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[51] **Int. Cl.** **B05c 1/08**

[58] **Field of Search** ..... 68/15, 19, 19.1, 20, 175, 68/181 R, 202, 203; 118/6, 7, 8, 203, 246; 26/63

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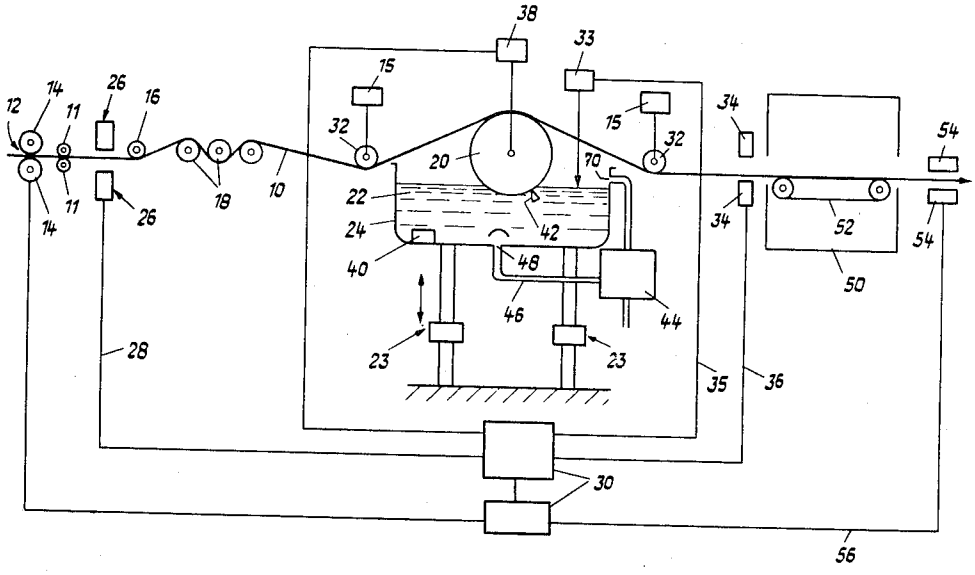
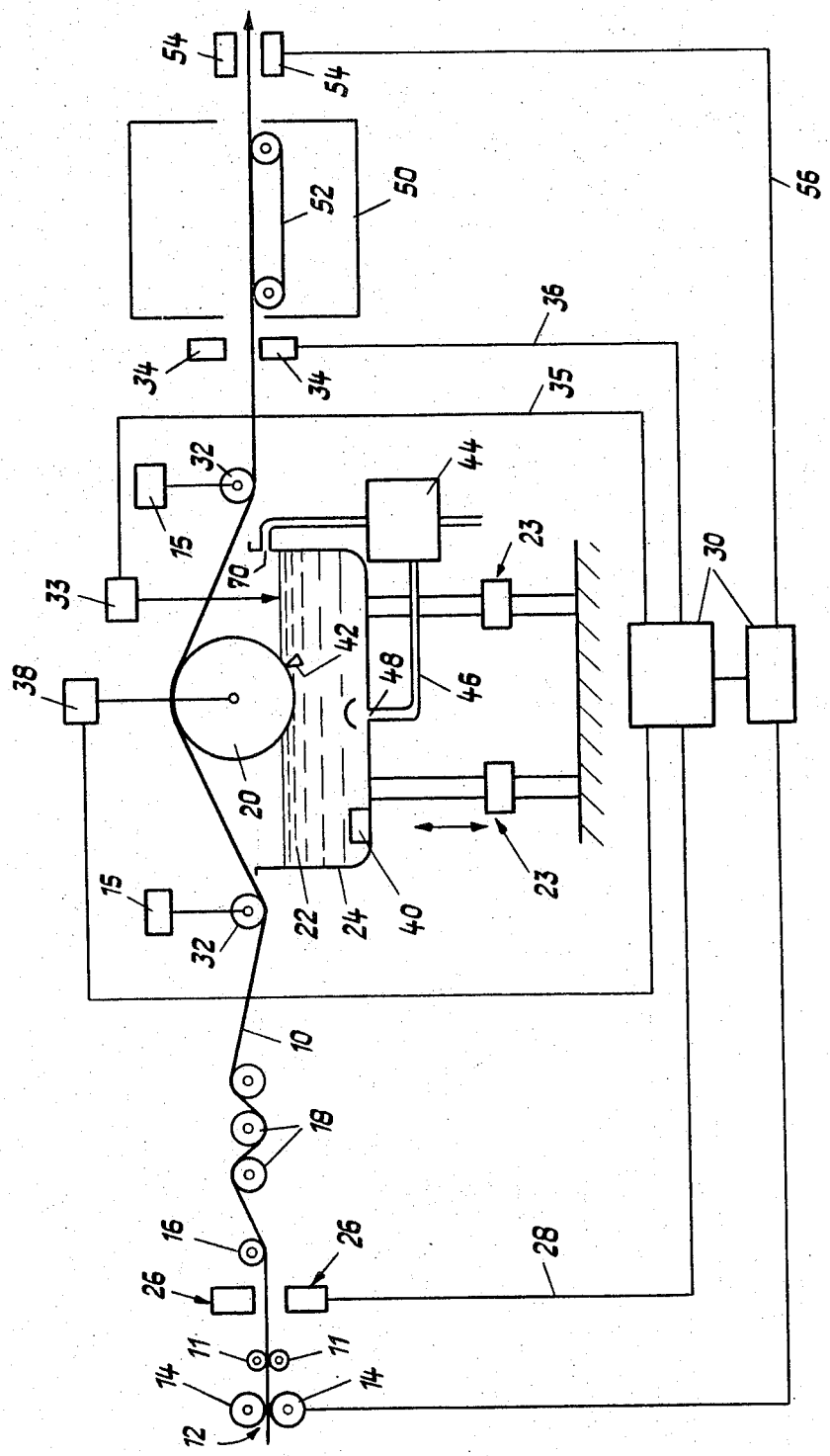
[57] **ABSTRACT**

An apparatus for finishing cellulose-containing textile materials comprising at least one applicator device which preferably is constituted by at least one applicator or kiss roll for applying the finishing bath, and control means for regulating the rotational speed of such kiss roll to precisely reguluate the amount of applied bath.

11 Claims, 1 Drawing Figure

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APPARATUS FOR FINISHING CELLULOSE-CONTAINING TEXTILE MATERIALS

CROSS-REFERENCE TO RELATED CASE

This application is a divisional application of our commonly assigned, copending U.S. application, Ser. No. 126.723, filed Mar. 22, 1971, and now U.S. Pat. No. 3.811,834.

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention broadly relates to the finishing cellulose-containing textile materials to impart improved use properties thereto. In its more specific aspects the invention concerns a new and improved method of finishing cellulose-containing textile materials, especially to render such shrinkage resistnt, crease resistant and to impart thereto permanent press properties, also to render such flameproof and hydrophobic, through the use of reactive finishing agents, drying of the textile material occurring following application of the finishing agent. The invention of this divisional application specifically deals with novel equipment for the performance of the inventive method and for producing textile products manufactured according to the inventive method aspects.

The finishing technique of this invention contemplates application of a bath containing the reactive finishing agent or agents, possibly also auxiliary agents such as catalysts, softeners and so forth, to the textile material in such manner that the textile material is imbued as uniformly as possible and at all locations thereof with the finishing bath. It is to be rocognized that this invention is not concerned with a method comtemplating application of the finishing agent to only one side of the textile material wherein such applied finishing agent is intended to remain as extensively as possible at the surface of such textile material.

The term "reactive finishing agent or agents," as used in the context of this application, is intended to designate finishing agents which tend to react with the OH-groups of the cellulose molecules, possiblly while cross-linking the fibres. Typically examples of such reactive finishing aggents have been given throughout this disclosure and are well known in the textile finishing art.

The use of reactive finishing agents with cellulose-containing textile materials can occur fundamentally in accordance with two different basic techniques. Firstly, in accordance with the so-called dry curing or cross-linking technique, which in its broadest sense also can encompass the modified technique of moist curing or cross-linking, and secondly, in accordance with the wet curing or cross-linking technique. When employing the first technique class noted above there is undertaken a complete or partial drying of the impregnated textile material after applicatin of at least the cross-linking chemicals. On the other hand the second technique class contemplates occurrence of the cross-linking reactions of the system, composed of cross-linking chemicals and the cellulose, after application of the chemicals while still in wet condition and without intermediate drying of the textile material; to which end, as to general rule, rather long dwell or residence times are necessary.

With the foregoing in mind it is here to be noted that the present invention has for one of its primary objectives to improve the techniques of the first-mentioned method classification discussed above.

A further and more specific objective is to provide an improved finishing apparatus for textile materials which enjoy the notable advantage of using less finishing agent, in fact also even less auxiliary agents, yet still obtaining at least comparable if not better finishing effects than obtained with prior art finishing equipment requiring the use of considerably greater quantities of finishing agents and auxiliary agents.

In keeping with the last-mentioned ojective it is still a further important object of the instant invention to provide improved economies in the art of textile finishing and thus lower costs for textile products produced thereby.

Another equally significant object of the present invention is concerned with a textile finishing apparatus by means of which an essentially dry cellulose-containing textile material has applied thereto at least one finishing agent which is reactive for cellulose, application of the quantitative amount of applied finishing agent being controlled, with drying and curing following the application of the finishing agent to the textile material.

A further noteworthy object of the present invention is the economical production of finished textile products by means of the new and improved apparatus of the invention.

Now in order to implement these and still further objects of the invention, which will become more readily apparent as the description proceeds, the invention is directed to finishing cellulose-containing textile materials through continuous application of individual bath components or a single total bath, containing at least one reactive finishing agent for cellulose, to the essentially dry textile material followed by subsequent partial or complete drying of such textile material, and contemplates that the partial baths or total bath are applied in such quantities to the textile material that the percentual total of the applied bath material together with the moisture contained in the textile material, based upon the weight of the dry textile material, at most amounts to $((W^2/150) + 40)$, wherein W represents in percent the water retention capacity of the textile material determined in accordance with ASTM-D2402-65T. It might thus be stated, the amount of applied finishing bath is controlled such that the thus treated textile material is essentially without any squeezable excess thereof, this applied amount of finishing bath generally being about 10 to 40 weight percent less than the amount of finishing bath applied by conventional techniques, and the applied amount of finishing agent being about 10 to 60 percent less than the amount of finishing agent applied by conventional techniques.

The apparatus of the invention for finishing cellulose-containing textile materials comprises at least one applicator device for the bath containing the finishing agent, and possibly the catalyst and auxiliary agents, and which includes at least one applicator or kiss roll. A control mechanism serves to control the rotational speed of such applicator roll to thereby also control the applied quantity of finishing bath. The roll is located in a vat at the lower region of which there is supplied through one or more openings the finishing bath. Detectors at the input and output regions of the vat cooperate to determine the applied quantity of bath, and

thus can serve to regulate via the control mechanism the surface or rotational speed of the applicator roll. A heater unit operably associated with the vat ensures that a desired viscosity of the bath is maintained. As the textile material leaves the vat is passes, preferably following a certain dwell time, into a conventional dryer. A detector mechanism associated with the dryer determines the residual moisture content of the textile material, using the determined value to control through-put speed of such textile material. Specific details of the equipment will of course be given hereinafter in conjunction with the explanation of the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

Therefore, the invention will be better understood and objects other than those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawing wherein the single FIGURE schematically illustrates an exemplary embodiment of equipment useful in the practice of the method of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before dealing specifically with concrete facets of the present invention it is believed that by initially considering the prior art techniques and procedures a more meaningful presentation and understanding of the particular aspects of this invention can be realized.

Hence, at the outset it should be appreciated that a vast number of textile finishing processes have become part of the state-of-the-art which resort to impregnation of textile materials, which may contain or consist of natural of regenerated cellulose, with reactive finishing agents, such as N-hydroxymethyl- or N-alkoxymethyl compounds of alkylene urea materials and acidic or potentially acidic catalysts in an aqueous bath. Thereafter, the textile material is completely or partially dried, and the reaction between the reactive finishing agent and the cellulose occurs during drying, or during a subsequent heat treatment or during a dwell period.

Impregnation of the textile material to be finished typically occurs in the prior art techniques through immersion or imbuing thereof in a bath containing the finishing agent, catalysts and, if desired, further additives such as softeners and/or dyes and/or wetting agents. A portion of the absorbed bath is then mechanically removed from the textile material, for instance by suction, squeezing-off or centrifuging, whereupon drying is initiated. The take-up of bath by the textile material occurs automatically since during immersion of the material an uncontrolled bath excess is taken-up. During subsequent mechanical treatment of the textile material a portion of the bath is removed. Consequently, an uncontrolled quantity of bath remains at the textile material, or, at the very best, a quantity of bath which is obviously very difficult to control. On the one hand, this quantitative amount of bath is dependent upon the type of textile material processed and its pretreatment as well as upon its formation during the spinning and weaving operations, and, on the other hand, upon the physical properties of the bath itself as well as upon the effectiveness of the employed mechanical bath removal hardware. In the case of standard pretreated, prepared cotton fabrics the take-up of treatment bath is typically in the order of magnitude between 60 percent and 70 percent based upon the weight of the dry textile material when utilizing conventional operating techniques wherein impregnation occurs through complete imbuing of the textile material in the bath by immersion, followed by squeezing-off excess bath one or more times by passing the textile material through appropriate squeeze rolls. It should be recognized this value is considerably above the value of the water retention capacity of the textile material as determined by the centrifugal test method according to ASTM-D2402-65T, wherein the water retention capacity will be simply referred to hereinafter as W (percent). Apart from the impregnation technique generally known as padding, a number of prior art patents teach the technique of spraying-on of the impregnation liquid or the roll application thereof, possibly with subsequent removal of excess bath, yet without presenting any particular guidelines or recommendations concerning the desired measures to be employed with respect to the strived for applied quantity of treatment liquid so as to qualify such as equivalent impregnation techniques.

In this regard it is important to emphasize that those skilled in the art considered it to be an absolute requirement for achieving reproducible results that there was always applied a relatively large quantity of treatment bath and, if necessary, followed by mechanical removal of a portion thereof, until there was obtained an equilibrium condition between the textile material and the remaining quantity of bath.

Notwithstanding these preconceptions in the art, it has new been most surprisingly found that a considerable better utilization of the finishing agent can be realized if the finishing bath is applied in a limited amount to the essentially or substantially dry textile material (the expression "essentially or substantially dry textile material" as used in this application denotes a textile material dried to contain a residual moisture content normally less than 10 percent based upon dry fabric weight), and specifically in a much lesser amount than the heretofore usual quantity, which textile material is thereafter dried, if desired following a dwell period. The method of the invention for finishing cellulose-containing textile material by continuous application of partial baths or a single total bath, containing at least one reactive finishing agent for cellulose, to the textile material which is essentially dry and following such application contemplates partial or complete drying of the textile material, is more specifically manifested by the features that the partial baths or total bath are applied in such quantities to the textile material that the total percentual application of bath together with the moisture contained in the textile material, as related to the weight of the dry textile material, at most amounts to ((W/150) + 40), wherein W represents in percent the water retention capacity of the textile material determined according to ASTM-D2402-65T.

The just-mentioned upper limit of the applied amount of bath corresponds to an applied quantity of bath which must be below by about 10 to 40 percent by weight of that quantity which remains in the textile material during conventional application techniques and with subsequent squeezing between squeeze rolls, such as the standard padding by squeeze rolls, known as dip-nip technique.

The inventive technique apart from providing extremely favourable conditions for carrying out the drying process more economically than with conventional padding techniques, further affords the important advantage of considerably improved utilization of the finishing agent and which could not be anticipated or expected in any way whatsoever by those versed in the art. In contrast to the standard operating techniques this improvement manifests itself in the form of a very marked increase in the desired finishing effect with the the same expenditure of finishing agent related to the weight of the textile material. This totally new and unexpected result can also be taken advantage of in terms that, in comparison with conventional finishing techniques, a lesser quantity of finishing agent need be applied for a given quantity of textile material in order to obtain a desired finishing effect.

Apart from this valuable economical aspect of the present invention it was also possible to determine in certain instances during a number of tests that the inventive method may result in a more favourable finishing effect-strength relationship than in comparison with conventional impregnation techniques.

During simultaneous finishing and dyeing, for instance while using pigment dyes, the inventive method reduces the tendency of migration of the dyes during drying. Therefore it is possible to get by with the use of smaller quantities of adjuvants of products tending to mitigate against dye migration or, in fact, to completely dispense with the use of such adjuvants. This affords much improved conditions for obtaining much softer textile products. In contrast to conventional bath application techniques the inventive method additionally can improve the effect of softening agents, for instance increase of the wear resistance of cross-linked cellulose. In fact, the invention affords the possibility of being able to obtain at least the same effect but importantly with the use of lesser amounts of auxiliary finishing agents such as wetting agents, antifoaming agents, softeners, lubricants, hand modifiers, optical whiteners, dyestuffs, binders for dyestuff-pigments, flameproofing agents, water repellents, soil and oil release agents, just to mention a few. These auxiliary agents are not limiting features of the invention and are well known in the textile finishing art and any of the conventional employed agents may be used in the practice of this invention.

Now, the Table given hereinafter serves to elucidate the equation $((W^2/150) + 40)$ which constitutes one of the characterizing aspects of the invention. An inspection of the Table will reveal that the total amount of applied bath, as contemplated by the invention, can be adjusted to a considerably lower value than automatically occurs with conventional impregnation techniques. In this connection it is to be understood that the equation $((W^2/150) + 40)$ only represents the upper limit for the applied quantity of bath according to the invention, the preferred range however being lower, namely between about 10 to 40 percent, including the moisture contained in the textile material. However, working with bath quantities greater than 40 percent can be necessary if the concentration of functional or effective substances in the employed finishing agents is very low, or if there are present solubility problems for individual additives.

Now, at this juncture it is indicated that British Pat. No. 1,157,061, has already proposed application of small quantities of baths containing cross-linking agents to fabrics and thereafter drying such, yet under the absolute precondition that the treated textile material contain a water content of at least 40 percent in order to achieve a uniform finishing effect. With this wet/wet technique there can be obtained comparable, however, not improved finishing results, over those achieved with conventional techniques in which the concentration of the relevant cross-linking bath at the fabric is achieved by application of the bath containing the cross-linking agent according to conventional impregnation techniques upon dry fabrics, followed by squeezing-off of excess bath.

A different concept involving slight application of finish or size containing-cross-linking agents and with subsequent drying and heating, has become known to the art from U.S. Pat. No. 3,445,277. There, markedly viscous baths are applied to one face of the textile material so as to imbue one face thereof. With this process improved wear resistance should result. However, the working with viscous baths containing cross-linking agents is not desired under normal conditions. Additionally, the improvement of the material at one face of its crease recovery oftentimes results in a technologically unsatisfactory compromise. The same is also true for techniques in which cross-linking agent-containing preparations, rendered printable by the addition of thickeners, have been printed upon the textile material to obtain pattern effects.

Other different proposals relate to processes where baths containing cross-linking agents and catalysts, sometimes with the addition of non-aqueous liquids, are applied in small quantities to the textile material where, however, thereafter cross-linking occurs in a dwell stage without previous or simultaneous drying. Therefore, these techniques are not suitable for contin-

Textile Material	Water-retention capacity (W) determined according to ASTM-D2402-65 T (%)	Upper limit of applied quantity of bath +) according to invention $(W^2/150 + 40)$ (%)	Bath take-up for conventional impregnation techniques (dip-nip technique) (%)
Imitation Broadcloth 100 % cotton, bleached, mercerised	48	55	68
Batiste 50 %/50 % Polyester/Cotton bleached	30	46	63
Cambric 100 % regenerated cellulose bleached	90	94	110

+) Moisture content included in the textile material

uous operation. Additionally, these techniques require a very intensive afterwashing in contrast to the conventional dry curing or cross-linking technique. This is the case not only for removing non-bound finishing agents, rather under certain circumstances also for the purpose of eliminating the catalysts which might disturb the following drying operations.

It is to be understood that the teachings of the invention have a wide range of utility and specifically the inventive method is applicable to textile materials in almost every form, such as yarn, yarn strands, fabric, knitted goods, felt, and so forth, preferably in the form of flat textile structures, such as fabrics or knitted fabrics which consists entirely or partially of native, regenerated or modified cellulose.

Now in order to put into practice the teachings of the invention it is possible to use every reactive finishing agent having a tendency of reacting with the hydroxyl groups. Finishing agents of this type are well known in large numbers in the textile finishing art. It has in fact been determined that it is possible to increase the finishing effect in accordance with the inventive method by using finishing agents of the most different make-up or composition. Hence, the selection of the finishing agent is not critical to the invention and, thus, can be undertaken on the basis of typically observed criteria, such as permanence, chlorine resistance, affecting or influencing the color fastness of dyeing, hydrolysis resistance, costs and so forth. In particular, there come into consideration reactive N-methylol compounds containing nitrogen-bound methylol groups or alkoxymethylol groups, especially derivatives of urea and thiourea and their derivatives, of cyclic urea derivatives in the form of heterocyclic **5**- and **6**-rings and their hydroxy- or oxo-derivatives of bicyclic heterocompounds, further, derivatives of dicyandiamide, guanidine, carbamates, triazane derivatives and mixtures of such compounds. There can be also used nitrogen-free formaldehyde cross-linking products, especially formed from the reaction with low molecular alcohols, alone or in mixture with one or more of the mentioned N-methylols. Apart from formaldehyde there also come into consideration cross-linking agents formed on the basis of higher saturated or unsaturated aldehydes and their derivatives. Also useful are products possessing reactive epoxy-, isocyanate-, vinylsulphone-, halogen-, hydrine- or carboxylic acid-groups. It is also possible to utilize in accordance with the inventive method so-called ambivalent cross-linking agents of the type N-methylolacrylamide, catalyzed in a first step to be acidic and in a second step to be alkaline. As a general rule, it might hereby be stated that the cross-linking agents are those typically used in conventional processing methods found in the textile finishing industry for the production of wash-wear and permanent press cellulosic fabrics and are also well known as creaseproofing agents for cellulose. Further typical examples are dimethylol urea, dimethylol ethylene urea, dimethylol propylene urea and methylolated derivatives of propylene urea, N, N'-dimethylol -4, 5-dihydroxy ethylene urea, dimethylol hydroxy ethyl carbamate, bis-methoxymethyl-ethyl carbamate, tris- (1-aziridinyl) phosphine oxide, vinyl cyclohexene diepoxide, formaldehyde, methylol and methylolated triazine derivatives, acetals and the like, and alkylated derivatives of such compounds and mixtures thereof. It is again indicated that the nature of the cross-linking agent is in no way a limiting feature of the invention.

The concentration of the finishing agent or agents in the employed bath is dependent upon the degree of the desired finishing effect. A particularly surprising advantage of the inventive method resides in the fact that, from the standpoint of weight, considerably less finishing agent, based upon the textile material, is required for achieving a certain degree of finishing. It has been found in order to obtain numerically the same functional effect, for instance dry crease angle, wash-wear rating (MONSANTO, AATCC Tentative Test Method 88A- 1964T) and so forth, generally when practising the inventive method there is only required about 40 percent to 90 percent by weight of the quantity of finishing agent heretofore required for achieving the corresponding momentary effect, particularly only 50–75 percent. Consequently, there is achieved considerable savings in cost apart from the more rapid carrying out of the method. Also, as already mentioned when using the same quantities of finishing agent as heretofore there is obtained a considerably better finishing effect.

As previously indicated the cross-linking agent is treated with a suitable catalyst to activate such agent. Catalysts useful in the practice of the invention are any of those known in the textile field and commonly used with cross-linking agents of the type enumerated above. Hence, useful catalysts which come under consideration are the known acidic or potentially acidic compounds typically used for the reaction of reactive finishing agents with cellulose. Thus, for instance, there can be employed salts of stronger acids and weaker bases, such as magnesium chloride, zinc chloride, zinc nitrate, aluminum chloride, calcium chloride, acid reacting ammonium- and amine salts, additionally inorganic or organic acids alone or in mixture with one or more of the mentioned salts. Further examples of suitable curing catalysts are zinc fluoroborate, ammonium chloride, ammonium phosphate, sodium fluoroborate, isopropanolamide hydrochloride, benzyldimethylamine oxalate, or mixtures thereof and with organic acids. The concentration of the catalysts is chosen so as to be in a range suitable for the particular momentarily employed system. The amount of catalyst applied to the fabric is not narrowly critical and can range from about 2 weight percent to about 55 weight percent of the cross-linking agent in the fabric.

Generally, finishing aent and catalyst are applied to the textile material from the same bath. Under certain circumstances, in consideration of the bath stability, or also for reasons of economy, or other reasons it can, however, be advantageous to apply the finishing agent and catalyst from two different baths. But in any case the total quantity of applied bath including the still present or separately applied water must be below the recited maximum value $((W^2/150) + 40)$, based upon the weight of the dry textile material. It is also possible to apply a portion of the liquid required for the total bath application prior to and/or after the application of finishing agent and catalyst to the textile material.

In the event there is required an accelerator for the reaction between the reactive finishing agent and the cellulose, the catalyst also can be applied in gaseous or liquid from after drying.

As already considered there can be further added to the finishing bath auxiliary agents, such as, for example, conventional hydrophobic-, softening-, levelling, and wetting agents and antifoaming agents or polymer additives such as starch and starch derivatives or plastic

dispersions, just to mention a few. In this regard it can be also advantageous to separately apply certain components. Also possible are combinations containing dyes as well as products for achieving oil and/or soil release or flame resistance properties or for obtaining biostatic or biocide effects (fungicide- or hygienic finishing).

With the view of obtaining uniform application of the bath it has been found advantageous to maintain at the employed temperature the viscosity of the bath beneath 7 centipoise, preferably beneath 3 cp. Furthermore, the specific surface tension at the employed temperature is advantageously adjusted to possess a value beneath 50 dyne/cm. If the viscosity of the bath is too high the danger exists that the textile material is only finished at one face or generally irregularly. The same is also true for baths having too great surface tension. In order to reduce surface tension there are available suitable surfactants or surface active agents or additives such as, for instance, organic solvents.

Serving as the basis for the bath there can be preferably used water. However, the inventive effect also occurs even if the bath consists partially or predominently of non-aqueous liquids. it is important to mention in contrast to the already known techneques achievement of the additional effect is not dependent upon maintaining a certain maximum water content of the bath.

Application of the finishing bath or the partial bath is undertaken according to the invention, for instance, by spraying, roll kissing, brushing, imprinting, or transferring the bath through imbued fabrics or other absorbent materials.

It is here particulary mentioned that the heretofore utilized vats combined with rubberized squeezing rollers for the removal of the bath excess which can be squeezed-off, previously conventionally and almost exclusively employed during manufacture and serving for the continuous application of finish baths, are not suitable for carrying out the inventive method. As already indicated, these conventional devices, commonly known as padding machines, apply the bath in amounts greatly exceeding the upper boundary value of $((W^2/150) + 40)$.

Of the different apparatuses known from other finishing operations for the precise controllable limited application of the finishing both the applicator or kiss roll technique when using one or a number of kiss rolls has been found to be particularly suitable. These rolls or rollers are of the type which are partially immersed in the treatment bath to be applied and owing to rotation thereof are continuously covered with a thin both film. The textile material undergoing treatment is guide over these rolls, contacting the surface of such rolls over the entire width thereof and, in the direction of travel of the material, contacting such rolls along a path extending over a number of centimeters, approximately over one-quarter of the roller periphery. The speed of travel of the textile web is greater than the peripheral velocity or surface speed of the applicator or kiss rolls, so that the liquid film present at the zone of the contact surface is continuously wiped away from the kiss roll or rolls by the textile web or material.

At this juncture it is thought advisable to specifically consider in conjunction with the accompanying drawing a preferred embodiment of inventive apparatus useful for the practice of the inventive method. Here the textile material which is treated has been shown conveniently in the form of a textile web or fabric, although it should be understood that, as explained above, other forms of textile structures can be equally well treated.

When undergoing treatment the textile material can be introduced into the depicted treatment equipment through the agency of a suitable speed-controlled infeed mechanism **12**, here shown as incorporating the infeed or delivery rolls **14**. Rolls **14** can be conveniently driven at variable desired rotational speeds in any suitable manner. Downstream of the infeed mechanism **12**, in the direction of web travel, there are successively arranged a pair of selvedge guide rolls **11**, followed by a detector mechanism **26** to be considered shortly, a linear guide roll **16**, and curved expander roll means **18**, here shown as three curved rolls, between which travels the textile web, as shown. The curved expander rolls **18** serve to deliver the textile material over the kiss or applicator roll **20** in a condition as free as possible of creases or folds resulting in uniform application of the treatment bath **22** located within the vat or vessel **24**. After the three curved expander rolls **18** there are arranged to opposite sides of the vat **24** guide rolls embodying a first and second linear expander roll **32**, as shown, each such linear roll **32** possessing a helical surface with helical grooves starting at the center thereof and extending towards both ends or terminal portions thereof, and each being rotatably driven in desired rotational sense by the separate drive means **15** as well as being vertically adjustable to control contact of the fabric or web **10** with the applicator roll **20**. Here it might also be remarked that mechanism **23** of any suitable construction serves to lower the vat to control the immersion depth of the application roll **20** therein and for cleaning purposes.

At this point it is to be mentioned that the detector mechanism **26** constitutes a standard reference detector unit embodying two conventional measuring or detector heads which measure the fabric weight per unit area and the moisture content of the fabric, respectively to determine the correct weight of the dry fabric or web, measurement occurring prior to entry of the web into the finishing bath **22**. Detector **26** delivers the measured information in the form of suitable electrical signals via conductor **28** to suitable control unit **30**.

Upon leaving the zone of the first linear expander roll **32** the fabric contacts the surface of the applicator or kiss roll **20** continuously rotating within bath vat **24**, the rotational axis of roll **20** preferably being located above the normal bath level. The pair of linear expander rolls **32** to each side of the rotational axis of the applicator roll **20** urge the web or fabric **10** into proper wiping contact with the surface of such applicator roll, preferably along about one quarter of its peripheral surface, thus picking-up the thin film of bath continuously present on the applicator roll surface, a part of which is always immersed in the bath. In this way a controlled quantity of bath is uniformly applied over the full width of the textile material in controlled manner due to the action of the applicator roll likewise extending over the full width of the textile material undergoing treatment.

After the required amount of finishing bath has been applied to the textile material **10** it moves into the operable zone of a second detector mechanism **34**, serving to measure the applied amount of finishing agent as well as the fabric weight per unit area. Detector mechanism **34** then likewise delivers a measurement signal via conductor **36** to the control unit **30**. At the control unit **30** the respective signals received from the first detec-

tor **26** and the second detector **34** are compared with one another and processed and control unit **30** then delivers an appropriate control signal to drive mechanism **38,** for instance a suitable reversible drive motor, serving to selectively drive the applicator roll **20** in both directions at controlled variable peripheral or surface speeds. Thus, for instance, if this control unit **30** has determined via the detectors **26, 34** that the textile web **10** leaving the zone of the kiss or applicator roll **20** has applied thereto insufficient quantities of finishing bath, then, the drive unit **38** receives an appropriate signal which, in turn, causes the kiss roll **20** to rotate at an increased rotational speed, thereby applying more finishing bath to the textile material. In this way there can be achieved a precisely controlled application of finishing bath in the reqauired amount to the textile material. Also, as previously indicated heretofore the finishing agent is applied in such amount to the textile material or web **10** that after leaving the applicator roll **20** essentially no squeezable excess of finishing agent is present at such textile material.

For the purpose of controlling the viscosity of the finishing bath **22** there may be advantageously provided a suitable heater unit **40.** Also at the lower region of the application or kiss roll **20** and beneath the surface of the bath **22** there can be arranged a doctor blade **42** which counteracts the formation of air bubbles and the presence of undesirable particles such as fiber waste. This doctor blade **42** contacts the surface of the applicator roll **20.** There is also advantageously provided a separate supply tank **44** for the bath, which may be equipped with a suitable pump, and serves to introduce, via the line or conduit **46,** the bath from below to the lower region of the vat **24** through the agency of one or more screened or hood-covered inlet openings, generally referenced at **48,** these openings extending in spaced relation across the width of vat **24,** in other words in the direction of the longitudinal axis of rotation of the kiss or applicator roll **20.** By virtue of this measure foaming of the bath is suppressed, and there is simultaneously achieved good mixing and agitation of the bath. Proper mixing and agitation of the bath can be further enhanced if the bath **22** within the vat **24** is permitted to continuously overflow via the overflow **70** into the supply container **44** where it is then recirculated as described above back into the lower region of the vat **24,** if desired following filtering of any foreign contaminants from the treatment bath.

After the continuously moving textile material or web **10** has passed the detector mechanism **34** located at the outfeed side of the vat **24** it automatically arrives at the region of the schematically depicted dryer mechanism **50** which, as will be explained more fully hereinafter can constitute any of the conventionally used types of drying hardware found in the textile finishing art, such as tenter frames, jet dryers, loop dryers, infrared dryers, cylinder dryers and the like. The dryer mechanism **50** is advantageously equipped with a chain-type fabric take-up mechanism **52** which operates at a lower speed than the infeed mechanism **12** so as to relax the fabric. If desired, the textile web **10** can pass into the dryer mechanism **50** after having been exposed to a certain dwell time which can be achieved, for instance, by passing the fabric or textile web **10** over a suitable number of non-illustrated deflecting rollers, or by temporarily winding-up the fabric or web.

At the dryer mechanism **50** the textile web **10,** now imbued with the controlled quantity of applied finishing bath, is partially or completely dried, thereafter leaves this dryer and arrives at the operable zone of a further detector mechanism **54** measuring residual moisture content of the textile web. If this residual moisture content is found, for instance to be too low then the measuring head of detector unit **54** delivers a suitable signal via the control line **56** to the fabric infeed mechanism **12** so that the throughput speed of the textile material **10** through the system and through the dryer **50** is accordingly increased. Due to this increased throughput speed and the corresponding shorter exposure time of the imbued textile web to the action of the dryer **50** the residual moisture content will then be accordingly increased. Of course, if the reverse situation is true the detector unit **54** will then deliver an appropriate signal which would slow down the throughpassage of the textile material through the system thus increasing the residual moisture content. Any deviations in the throughput speed of the textile material, of course, will be sensed by the detector units **26, 34** so that, if necessary, an appropriate adjustment will be made of the peripheral speed of the applicator roll **20** via the control unit **30** and the drive unit **38** to thereby attain application of the desired controlled amount of finishing bath to the textile web fabric **10.**

In the exemplary system there is shown a single kiss or applicator roll **20** in one bath vat. The bath **22** may be assumed to contain the complete cross-linking agent, and if necessary, the catalysts and auxiliary finishing agents. Of course, it would be possible to use a number of adjacently arranged speed-controlled kiss rolls **20** in the same vat for applying the bath. Also, in the event partial baths are used then there can be employed a number of vats each containing one or more speed-controlled kiss rolls as explained above. This modification of the system will be readily evident from what has been discussed above.

A particular advantage of the apparatus construction of the invention discussed above resides in the possibility of infinitely controlling the relationship of the speed of movement of the textile goods **10** to the peripheral speed of the applicator or kiss roll or rolls **20** so that application of the bath **22** can be adjusted quite exactly and in reproducible fashion to the desired value. Monitoring of the applied quantity can be also undertaken discontinuously, for instance by weighing or titration. However, it is highly desirable to use continuously operating detector systems, such as the detectors discussed above, which are for example radiation responsive and operating for instance on the basis of radiation absorption or reflection. As described above the measurement signals can be advantageously directly employed for controlling the speed of rotation of applicator or kiss rolls for application of a desired reference quantity of bath. This control posssibility is especially preferred.

Additionally, application of the bath can be controlled as a function of bath consumption. Here, the quantity of bath to be used and previously precalculated is continuously dosed to the kiss roll and the rotational speed of such kiss roll is continuously varied via a level sensor or feeler control **33** arranged at the kiss roll vat **24,** or possibly at the communicating liquid container **44,** connected via conductor **35** with the control unit **30,** and operation occurring in such a manner that this liquid level remains constant and the application of the bath therefore automatically corresponds exactly to the infeed of bath. Any undesired deviations

in the bath level cause the level sensor **33** to adjust the speed or rotation of the applicator or kiss roll **20** via the control unit **30** and drive unit **38** until the bath level is again constant.

Now to achieve uniform application of the bath to the textile material guiding of such textile material over the kiss roll so as to be as free as possible of creases or folds is considered to be an important prerequisite. Therefore, as considered above, it is desirable to deliver the textile material via one or more of the curved expander or spreader rolls **18** serving to stretch the material. Moreover, experience has shown that a particularly advantageous arrangement is afforded if a linear guide roll is placed between the expander rolls and the bath applying path.

The bath applied-textile material is delivered, over a shorter or longer dwell path, directly to the drying unit. In this connection it is advantageous in a number of incidences to work with as low as possible tension in the lengthwise direction of the textile material, for instance by adjusting the speed of the textile removal equipment **52** so as to be lower in comparison to the textile infeed mechanism **12,** as discussed above.

It is to be remembered that if a bath is applied which consists of a number of partial baths then a special applicator or kiss roll can be provided for each such bath. The possibility thus exists of applying the different partial baths to the same face of the textile web, or however, for instance when working with two partial baths to apply each respective partial bath to a respective face of such textile web. Equipment for such opposite face application of two baths to textile material has been disclosed in U.S. Pat. No. 3,443,322, granted May 13, 1969.

A particularly advantageous feature of the described applicator device resides in the fact that in comparison to conventional immersion/impregnation techniques, here it is practically impossible for any exchange effect to occur between the bath supply and the textile material, thus considerably preventing a gradual change in the composition of the bath, for instance by reduction of the content of substantive components. Furthermore, maintaining of the temperature of the bath constant is here considerably simpler than in systems using immersion paths.

The temperature of the bath normally is around room temperature. It may be necessary to work with cooled baths if such contain easily volatized constituents. On the other hand, the composition of the bath may necessitate heating it up, as by the heater **40,** in order to reach the favorable viscosity range of below 7 cp and to thus afford for the bath the required penetration capability.

As explained above, the textile material containing the bath is then partially or completely dried following a shorter or longer dwell or residence time. This dwell interval can amount to a few seconds or even fractions of a second. In extremely unfavorable situations, for instance when working with extremely densely woven fabrics possessing a corresponding slower penetration time for the bath, for the purpose of enhancing uniform penetration of the textile material by the finishing bath it is advantageous to resort to the use of special measures, such as connecting-in air-or vapor-passages or temporarily winding-up the textile material. Also mechanical expedients, for instance tandemly arranged deflecting locations possessing small radii of curvature, squeezing arrangements, damming- or drawing arrangements, distributor units in the form of brushes or squeegees, and so forth can serve this purpose.

The textile material then is dried, the amount of residual moisture to be obtained depending upon the momentarily employed method technique: partial drying while observing a residual moisture content of 6 –15 percent by weight for the so-called moist curing and more intensified drying for dry curing. In the event the textile material is to only then be subjected to the curing operation after mechanical deformation or after having performed ready-to-wear manufacturing operations, then careful drying procedures are likewise required. When working with baths which only penetrate the textile material with difficulty it is advantageous to maintain as high as possible the vapor content of the drying air and thus the wet bulb temperature.

Suitable drying units are those known devices which work with convection-, condensation-, radiation-, or high frequency-thermal energy. The lower content of bath of the textile material promotes more rapid drying, with less energy requirements, therefore also enables the use of devices such as, for instance, those working with high-frequency-drying which, for reasons of economy, previously could not be used for textile materials containing the usual high treatment bath content. A further advantage of the inventive method is present in the case of aqueous baths in terms of reduced shrinkage of the textile material by swelling, which under circumstances when working with fabrics enables carrying-out drying without special expander or stretching devices, for instance at cyliners instead of tenter frames.

After drying, and if desired also following mechanical deformation by friction, embossing, stretching or damming-up, or after completion of the ready-to-wear manufacturing operations, the reaction of the finishing agent with the cellulose is carried-out in an additional heating step (condensation), in the event that such has not already occurred as in the case of moist curing during drying or in a dwell period following drying. Carrying out of the curing operation occurs in conventional equipment while using heat of convection, condensation, radiation or high frequency energy. However, it is also possible to work with high-energy radiation.

In the case of two-stage cross-linking processes, for instance during ambivalent cross-linking or with the combination of dry cross-linking followed by acidic basic wet cross-linking with a second cross-linking agent the procedures which are followed are conventional in the art.

The cured textile material can then be subjected to conventional wet treatment processes, such as afterwashing, top-finishing or dimensional stabilization.

The invention will be further elucidated in conjunction with a number of Examples hereinafter, each Example being divided into sub-examples referring to respective comparison and inventive Examples:

EXAMPLE 1

Two-bath processes

A 100 percent cotton imitation broadcloth (yarn count, metric warp: 70, weft: 55; number of threads per centimeter warp: 49, weft: 24; weight per square meter: 120 gms.) is pre-treated in conventional manner by singeing, desizing, boiling, bleaching and mercerizing.

Variant Example 1.1 (Comparison)

A bath containing 100 gms/lites of a 50 percent by weight dimethyloldihydroxyethylene urea solution is applied in a padding machine by immersion and squeezing (dip-nip technique) until it retains a quantity of bath corresponding to 70 percent of the weight of the dry fabric.

Variant Example 1.2 (Inventive)

The cross-linking bath contains 233 gms/liter of the same pre-condensate solution, yet it is applied while using an applicator device (kiss roll mechanism), with the ratio of the fabric- to kiss or applicator roll-speed being controlled such that a takeup of bath of 30 percent of the weight of the dry fabric results. Both application techniques (Examples 1.1 and 1.2 above) produce at the fabric a content of 3.5 percent by weight of 100 percent pre-condensate.

The fabric is now dryed at the tenter frame. Thereafter there is applied to the fabric a catalyst bath containing 7.5 percent hydrochloric acid in an applied quantity amounting to 7.0 percent based upon the weight of the dried fabric. The acid-containing fabric is smoothly wound-up, and allowed to dwell for 20 hours at room temperature. Thereafter, the fabric is washed-out, neutralized with an aqueous solution containing 2.5 gms/liter sodium carbonate, rinsed and dryed.

The technological test after three boiling washes or washes at a boil resulted in the following values:

	(Variant Example 1.1) cross-linking agent padded-on (dip-nip) (comparison)	(Variant Example 1.2) cross-linking agent kiss-roll applied (inventive)
Wash-and wear rating (MONSANTO, AATCC Tentative Test Method, 88A-1964T)	3.5	4.0
Dry crease recovery angle (°) (MONSANTO ASTM-D1295-67 warp & weft)	220	240
Wet crease recovery angle (°) (MONSANTO, ASTM-D1295-67 warp & weft)	270	280
Tensile strength (kg) grab, weft, Grab-test ASTM-D1682-64	18	17

Examples 2–6 and 8 describe the mode of operation utilizing only one finishing bath.

EXAMPLE 2

The cotton fabric used in Example 1 is creasefree finished by dry cross-linking with dimethylolpropylene urea.

Addition Example 2.1 (For comparison purposes) aqueous solution:

150 gms/liter dimethylolpropylene urea solution 50 percent aqueous

18 gms/liter magnesium chloride hexahydrate

Addition Example 2.2 (For inventive process) aqueous solution:

175 gms/liter dimethylolpropylene urea solution 50 percent aqueous

22 gms/liter magnesium chloride

The solution of Addition Example 2.1 is applied in conventional manner by immersion and squeezing at the padding machine. The solution of Addition Example 2.2 is uniformly sprayed-on by nozzles. Thereafter, dried at 120°C and during 5 minutes condensated at 150°C. The technological examination took place after three boiling washes with a complete washing agent in a household washing machine, resulting in the following values:

	finished with Addition Example 2.1 (Comparison)	finished with Addition Example 2.2 (Inventive)	ready for sizing
applied bath +)	69%	30%	–
applied quantity of 100% cross-linking agent +)	5.2%	2.6%	–
Dry crease recovery angle MONSANTO ASTM-D1295-67 (warp & weft)	(°) 235	225	150
Wet crease recovery angle MONSANTO ASTM-D1295-67 (warp & weft)	(°) 235	260	200
Tensile strength, weft direction (kg), grab Grab-test ASTM-D1682-64	22	20	30

+) based upon dry fabric weight

Although in Addition Example 2.2 only half of the cross-linking agent was used it was possible to obtain at least an equally good if not even greater crease recovery effect.

EXAMPLE 3

The cotton fabric used in Example 1 is provided with an approximately 50 percent aqueous solution of dimethyloldihydroxyethylene urea, wherein in each instance two different concentrations are applied, namely conventionally (padding by dip-nip) and according to the present invention (kiss roll). Drying takes place at the tenter frame at 130°C until reaching a residual moisture content of 3 –4 percent, the curing taking place at 150°C for 5 minutes. As catalyst there is employed magnesium chloride hexahydrate which is introduced into the finishing bath, and specifically 13.5 percent of the momentarily employed quantity of the commercially available cross-linking agent.

The experimental variations and the technological test results determined after three boiling washes are set forth in the following table.

Embodiment	3.1	3.2	3.3	3.4
Method of Application	padding [3]	kiss roll [4]	padding [3]	kiss roll [4]
Applied Amount [1] Concentration of 50% Cross-linking agent	70%	30%	70%	30%
— in the bath	75 g/l	175 g/l	150 g/l	350 g/l
— on the fabric [2]	5.2%	5.2%	10.5%	10.5%
Wash/Wear rating (MONSANTO, AATCC Tentative Test Method 88A-1964 T)	3.0	3.6	3.7	4.0
Dry crease recovery angle (°) (MONSANTO ASTM-D1295-67 warp & weft)	210	245	250	285
Wet crease recovery angle (°) (MONSANTO ASTM-D1295-67 warp & weft)	235	255	250	270
Tensile strength (kg) grab, weft.	26	20	21	16

[1] Finishing bath, based upon dry fabric weight.
[2] Based upon dry fabric weight.
[3] Comparison.
[4] Inventive.

From the results it will be clearly recognised that the inventive mode of operation provides a considerable effect increase.

EXAMPLE 4

The cotton fabric characterized in Example 1 is cured in moist condition with dimethyloldihydroxyethylene urea while using 40 percent of a commercially available catalyst solution for the moist curing based upon the employed quantity by weight of 50 percent cross-linking agent. In both variants application was undertaken by a horizontal double-roller padding machine, the treatment bath being located between the rotating rollers equipped with a lateral cover plates. According to the conventional embodiment variant (4.1) the fabric travelled from above through the treatment bath and thereafter through the squeeze nip, the fabric thus receiving an applied amount of bath of 68 percent based upon the weight of the dry fabric. On the other hand, according to the embodiment variant 4.2 application of the treatment bath to the fabric was undertaken in a manner where the fabric was only guided over both rolls, the rolls being driven such that they rotated in contra direction with respect to one another out of the bath and thus delivered the treatment bath to the fabric. Both rollers travelled at a lower surface speed or peripheral velocity in relation to the speed of movement of the fabric, so that the fabric wiped away the bath film located at the rollers. The system was adjusted so as to apply a quantity of treatment bath of 30 percent, based upon the weight of the dry fabric. After application of the bath, and in both embodiments here under consideration, the fabric was dried so as to possess 6 – 8 percent residual moisture and thereafter was allowed to dwell at room temperature at a wind-up roll tightly sealed with a polyethylene foil. Thereafter, under cold conditions or temperature the acidic catalyst was removed by an alkali treatment and the fabric thoroughly washed. After three boiling washes the following values were ascertained:

Embodiment	4.1 (Comparison)	4.2 (Inventive)
Applied quantity [1] Concentration of 50% cross-linking agent	68 %	30 %
— in the bath [1]	150 gms/liter	340 gms/liter
— at the fabric [2]	10.4 %	10.4 %
Wash/Wear-rating (MONSANTO, AATCC Tentative Test Method 88A-1964 T)	3.2	3.7
Dry crease recovery angle (°) (MONSANTO ASTM-D1295-67 warp & weft)	215	240

Embodiment	4.1 (Comparison)	4.2 (Inventive)
Wet crease recovery angle (°) (MONSANTO ASTM-D1295-67 warp & weft)	270	285
Tensile strength (kg) (grab, weft) Grab-test ASTM-D1682-64	23	20

[1]Finishing bath, based upon weight of dry fabric.
[2]Based upon weight of dry fabric.

EXAMPLE 5

The cotton fabric used in Example 1 is finished so as not to need ironing, in accordance with the teachings of Swiss Pat. No. 466,206 while using a gaseous catalyst.

Finishing bath for comparison (Embodiment **5.1**) and Inventive method (Embodiment **5.2**)

Aqueous solution containing

100 gms/liter dimethyloldihydroxyethylene urea 50 percent solution

40 gms/liter polyethylene emulsion, 25 percent solution

0.5 gms/liter non-ionic wetting agent

In the comparison embodiment Example 5.1 the fabric is immersed in the finishing bath, squeezed at a two roller padding machine so as to have taken-up a quantity of bath amounting to 66 percent, based upon the weight of the dry goods and then dried at a tenter frame at 130°C to a residual moisture content of 5 percent and cooled at rollers to a temperature of 35°C.

In the embodiment Example 5.2 of the invention the finishing bath is applied as in Example 1 while using a kiss or applicator roll, the ratio of the speed of movement of the fabric to the kiss roll speed being adjusted such that there is obtained take-up of bath of 35 percent based upon the weight of the dry goods. Drying and subsequent cooling then occurs as in the manner of the comparison embodiment Example 5.1.

Both embodiments have the textile material thereof guided over the unit described in Swiss Pat. No. 466,206 which contains boiling azeotropic hydrochloric acid, specifically at a speed of movement of the textile material of 60 meters/min., there resulting via the 20 mm. wide vapor outlet-slot a contact time of approximately 0.02 seconds. The fabrics of both embodiments thus take-up about 0.8 percent hydrochloric acid and 0.4 percent water based upon their dry weight.

The fabric gasified in this manner is then directly delivered to a full-width washing machine, neutrally washed and finally manufactured in the usual way.

After three boiling washes the following technological data could be ascertained:

	Comparison Embodiment 5.1	Inventive Embodiment 5.2
Wash/Wear-rating (MONSANTO, AATCC Tentative Test Method 88A-1964 T)	4.1	3.9
Dry crease recovery angle (°) (MONSANTO ASTM-D1295-67 warp & weft)	238	245
Wet crease recovery angle (°) (MONSANTO ASTM-D1295-67 warp & weft)	275	282
Tensile strength (kg) grab in weft direction Grab-test ASTM-D1682-64	18	17

Although this inventive embodiment contained approximately one-half the amount of finishing agent, nontheless it was possible to practically obtain equal results as for the conparison embodiment.

EXAMPLE 6

Trouser material formed of blended yarn 70/30 polyester/rayon staple with a weight-per-square meter of 215 grams is pretreated, dyed and dried in conventional manner.

A finishing operation is undertaken for the purpose of achieving permanent press characteristics while using the following finishing bath:

Aqueous solution containing

100 gms/liter dimethyloldihydroxyethylene urea, 50 percent solution

25 gms/liter "PRIMENIT" VS (wash resistant, hydrophobic softening agent of the well known German concern Farbwerke Hoechst)

20 gms/liter magnesium chloride hexahydrate.

The finishing bath for the embodiment Example 6.1 (comparison Example) is applied by immersion and squeezing at the padding machine with a sqeezing effect of 51 – 53 percent based upon the weight of the dry goods. In the inventive embodiment Example 6.2 the same finishing bath is applied by padding and in an amount of 28 to 30 percent.

Drying occurs in both embodiments in six zone-tenter frame at 110°C to 120°C to a residual moisture content of 6 – 8 percent. In the case of the embodiment Example 6.1 the speed amounted to 20 meters/min., and for the embodiment Example 6.2 to 35 meters/min. The thus finished fabric worked into leisure pants which after pressing are baked in a furnace or oven at 150°–160°C for 12 minutes.

Test pants produced according to the embodiment Examples 6.1 and 6.2 exhibit after washing and drying on a line equivalent permanent press properties, even though the inventive embodiment, in contrast to the comparison embodiment, contains only about 56 percent of the quantity of finishing agent.

EXAMPLE 7

A patterned, yarn colored sport shirt material consisting of 10 percent rayon staple with 135 gms/m², after conventional pretreatment, is finished in accordance with the invention while using two partial baths so as to be easy to care.

At a first kiss roll 30 percent of an aqueous bath is applied to the front side or face of the fabric. This bath contains 400 gms/liter of a dimethylol urea solution, 50 Percent Solution, and 30 gms/liter "PRIMENIT" VS (cf. Example 6), and 0.5 gms/liter "RAPIDNETZER" RBD (wetting agent of the well known German concern Badische Anilin- & Sodafabrik AG(BASF) formed on the basis of sulphonamide). After this first roll pass the goods travel towards an air passage of 6

meters via a second kiss roll, and thus at the rear face of the fabric are coated with an aqueous solution of 60 gms/liter "KNITTEX" catalyst F 53 (Trademark product of Fabrik Pfersee) in such a manner that the total amount of applied bath, based upon the weight of the dry fabric, now amounted to 45 percent. Thereafter, the fabric passes in succession through a rapid steamer and a tenter frame. In the same pass the fabric is dried and condensed at a six zonetenter frame at 140°C during 40 seconds.

There is obtained a fabric possessing good dimensional stability and good properties as concerns ease of care. The use of both partial baths in higher bath stability in contrast to conventional single bath techniques, which already after a few hours results in the presence of precipitations with the above employed finishing components.

EXAMPLE 8

A fabric pre-treated and dyed in conventional manner and intended for rainwear, an imitation poplin, consisting of 100 percent cotton with 180 gms/m^2, is rendered hydrophobic while using a reactive water repellant agent in an organic solvent.

There is used a solution of 20 gms/liter "PHOBOTEX" FTN (reactive water repellent agent of the well known Swiss concern CIBA-GEIGY AG formed on the basis of fatty acid substituted melamine precondensate) in trichloroethylene.

In the variant embodiment of Example 8.1 (comparison example) the finishing solution is continuously sprayed by means of nozzles, the fabric being charged with approximately 100 percent by weight of finishing solution. In the embodiment Example 8.2 (inventive) limited application is undertaken by kiss roll-operation to achieve a weight take-up of 45 percent.

In both embodiments drying is undertaken at 130°C in an installation suitable for reclaiming the solvent, and at the same time condensation occurs.

The rain test (Bundesmann) in both embodiments, after 10 minutes rain duration, resulted in a water take-up of 10 percent.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims. ACCORDINGLY,

What is claimed is:

1. In an apparatus for continuously impregnating a sheet-like expandible porous textile web by applying thereto a controlled amount of a treatment bath which completely penetrates through the textile web and substantially drying the impregnated textile web, comprising textile web infeed means for controlling the infeed of the textile web to be impregnated and dried and continuously moving in a predetermined direction of travel, at least one applicator device arranged downstream of the infeed means in the direction of travel of the textile web for applying a low-viscosity treatment bath having a viscosity below about 7 centipoise to the textile web at one face thereof for the substantially complete and uniform penetration of the applied treatment bath throughout said textile web, means located intermediate said web infeed means and said applicator device for engaging said material web and transversely expanding the same so as to deliver the material web essentially without creases and folds to said applicator device, said applicator device comprising at least one rotatable kiss roll having an axis of rotation, a vat for the treatment bath within which there is rotatably mounted said kiss roll with a portion of the surface of the kiss roll located above the level of the treatment bath in said vat, a doctor blade disposed to engage the surface of said kiss roll beneath the level of said treatment bath at a location counteracting the formation of air bubbles and the accumulation of fiber material at the surface of the kiss roll, means for selectively rotating said kiss roll in either of both rotational directions at a controllable rotational speed as a function of the speed of travel of the textile web in order to control the amount of treatment bath applied to the textile web, at least one pair of guide rolls for guiding said textile web over said kiss roll with a predetermined and controllable looping angle externally of the level of the treatment bath, each guide roll being arranged to one respective side of the axis of rotation of said kiss roll, at least one detector device for determining the weight per unit area including the liquid content of said textile web, control means operatively connected with said detector device and said kiss roll for regulating the rotational speed of the kiss roll as a function of the detected weight per unit area including the liquid content of said textile web ascertained by said detector device in order to ensure that the kiss roll applies a substantially constant amount of a non-squeezable excess of treatment bath to said textile web, dryer means arranged downstream of the kiss roll with respect to the direction of travel of the textile web for adjusting the damp textile web following contact with the kiss roll to a drying action sufficient to substantially dry the textile material to an extent so as to contain a residual moisture content which is less than 10 percent based upon the dry fabric weight.

2. The apparatus as defined in claim **1**, wherein said detector device is arranged at a location downstream of the kiss roll where it cooperates with the impregnated textile web while the latter is still in a damp condition following application of the treatment bath by the kiss roll.

3. The apparatus as defined in claim **1**, further including additional detector means arranged upstream of the kiss roll with respect to the direction of travel of the textile web for determining the weight per unit area of the textile web and the moisture content of the raw untreated textile web prior to application of treatment bath by the kiss roll.

4. The apparatus as defined in claim **1**, including a further detector device for determining the moisture content of the substantially dry textile web departing from said dryer means.

5. The apparatus as defined in claim **4**, wherein said control means incorporates means responsive to said further detector device for controlling the delivery speed of said textile web infeed means in order to ensure that said dryer means delivers the textile web with a predetermined moisture content.

6. The apparatus as defined in claim **5**, wherein said at least one detector device senses changes in the delivery speed of the textile web due to variations in the detected amount of the applied treated bath and acts upon said control means to initiate adjustment of the rotational speed of the kiss roll as a function of the detected delivery speed of the textile web.

7. The apparatus as defined in claim 1, wherein said expanding means includes expander rolls disposed between said textile web infeed means and said kiss roll.

8. The apparatus as defined in claim 1, further including means for controlling the temperature of the treatment bath in order to control the viscosity thereof.

9. The apparatus as defined in claim 1, further including an overflow means provided for said vat for the overflow of the treatment liquid contained therein.

10. The apparatus as defined in claim 1, wherein said detector device operates continuously and without contact with said textile material.

11. The apparatus as defined in claim 10, wherein said detector device is a radiation responsive detector device.

* * * * *