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(54) **Method for continuous mercerising, and apparatus that employs such method.**

(57) Method and apparatus for continuous mercerising which are suitable to carry out mercerising treatment of a plurality of yarns being unwound continuously and parallel to one another from one (12) or more (112-212) feeder beams, the plurality of yarns (11) undergoing in succession the following operational steps:

- a pre-wash by immersion in at least one vessel (14), but preferably in three vessels (14), containing a bath consisting of hot water with an addition of surface active agents,
- impregnation in caustic soda by immersion in at least one vessel (14), but preferably in two vessels (14), containing a bath of heated caustic soda,
- stabilisation with a control of shrinkage of the yarns (11) in a stabilisation and tensioning chamber (23), in which the yarns (11) are placed partly in contact with a caustic soda bath,
- tensioning and drawing in the stabilisation and tensioning chamber (23), in which the yarns (11) are again placed partly in contact with a caustic soda bath,
- neutralisation by a hot wash, the neutralisation comprising: a first stage of washing by immersion in at least one vessel (14), but preferably

in two groups each of two vessels (14), containing a bath of hot water; a second stage of actual neutralisation by immersion in at least one one vessel (14), but preferably in two vessels (14), containing an acid bath; and a third stage of rinsing by immersion in at least one vessel (14), but preferably in three vessels (14), containing a bath of hot water, and

- drying in an oven (30) by a circulation of hot air,

the yarns (11) leaving the drying process being wound on one or preferably on a plurality of take-up beams (33).

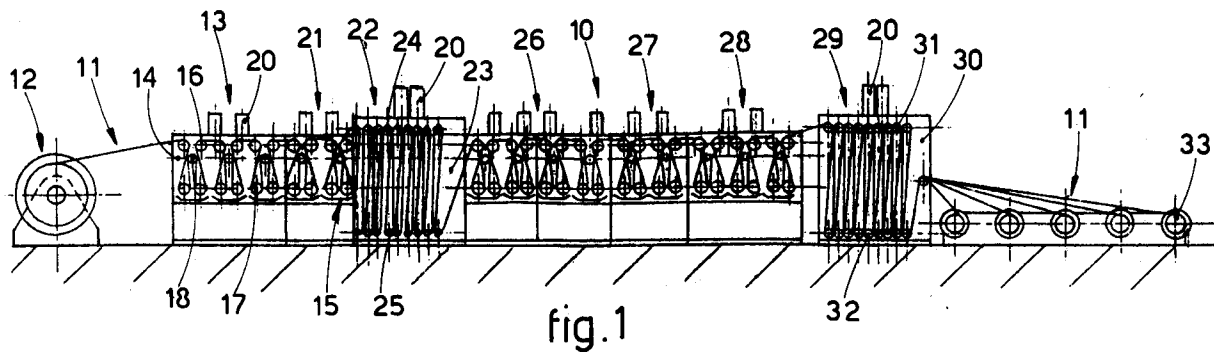
Continuous mercerising apparatus which is suitable to carry out mercerising treatment of a plurality of yarns being unwound continuously and parallel to each other from one (12) or more (112-212) feeder beams, the apparatus carrying out the above method and comprising the following operational assemblies positioned in succession:

- a pre-wash assembly (13) consisting of at least one pre-wash vessel (14), but preferably of three equal vessels (14) positioned one after another,
- an impregnation assembly (21) consisting of at least one impregnation vessel (14), but preferably of two equal vessels (14) positioned one

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- after another,
- a stabilisation and tensioning assembly (22) consisting of a stabilisation and tensioning chamber (23) comprising assemblies of upper rolls (24) and lower rolls (25) to control shrinkage and drawing of the yarns (11),
- a wash assembly (26) consisting of at least one wash vessel (14), but preferably of two groups each consisting of two equal vessels (14) positioned one after another,
- a neutralisation assembly (27) consisting of at least one neutralisation vessel (14), but prefer-

- ably of two equal vessels (14) positioned one after another,
- a rinse assembly (28) consisting of at least one rinse vessel (14), but preferably of three equal vessels (14) positioned one after another,
- a drier assembly (29) consisting of an oven (30) employing hot air, and
- a yarn (11) take-up assembly consisting preferably of a plurality of beams (33) containing aliquot parts of the number of yarns contained in the feed (12-112-212) to the apparatus (10).



This invention concerns a method for the continuous mercerising of cotton yarns and other suitable yarns. To be more exact, the invention concerns a method suitable to carry out mercerising treatment of a plurality of yarns being unwound continuously from at least one feeder beam.

The invention concerns also an apparatus which employs the above method.

The state of the art covers a plurality of methods and apparatuses for mercerising fabrics and yarns, especially cotton fabrics and yarns.

It is known that mercerising is a treatment employing caustic soda, which is applied to yarns for instance, and we shall refer to yarns in the description that follows, the yarns being subjected to a suitable tension to cause them to obtain a lustre like that of silk.

In general, the mercerising process is applied above all to yarns intended for knitting by hand or machine, yarns for shirts and embroidery and sewing threads.

The principle on which mercerising is based has been known for a long time; the action of the caustic soda causes a great shrinkage of cotton, which when restored to its original length possesses a silky lustre.

The same result is achieved by hindering the shrinkage of the cotton by applying a suitable tension.

The reason why the lustre increases can be ascribed to the fact that by means of the mercerising treatment the fibre becomes smooth instead of being curled and its cross section becomes rounded, thus giving rise to a greater and more uniform reflection of the light by the fibre.

Mercerising increases also the strength of cotton yarns at the expense of their properties of resilience.

Moreover, given the use of the same dye, a mercerised cotton can be dyed much more intensely than a non-mercerised cotton, thus entailing a smaller consumption of dyestuffs in the dyehouse.

The known mercerising methods and apparatuses are of two types, namely discontinuous and continuous.

In practice the discontinuous treatment is employed everywhere nowadays and is carried out in successive steps on yarns generally wound in hanks. These steps arrange that the yarn is impregnated with the mercerising liquid, is then drawn, freed of caustic soda, rinsed and lastly neutralized.

Some patents and patent applications relating to the continuous mercerising treatment are known. Amongst them is US 3,549,310 which discloses a continuous mercerising method and device for core yarns undergoing a constant tension; this docu-

ment concerns the treatment of a single yarn being unwound from a feed package.

US 3,789,469 and its equivalent FR 2.213.997 disclose in particular a system suitable to unwind a plurality of yarns from a beam positioned to feed a continuous mercerising plant. The method provides for the plurality of yarns to be divided into groups by being tied with a lease yarn. This system enables the plurality of yarns to be guided and kept in the right position while being unwound from the beam and undergoing the mercerising treatment.

GB 1,218,260 discloses a continuous mercerising device consisting substantially of a pair of tapered rolls on which the yarn to be mercerised is wound. The taper of the rolls causes tensioning of the yarn, which undergoes the mercerising action while being wound on the rolls. This device is suitable to treat one single yarn coming from a yarn package.

GB 2,051,156 discloses a continuous mercerising device used especially for filament yarns and consisting of a vessel which contains assemblies of rolls that can be positioned in relation to each other so as to be able to vary the path of the textile material.

DE 1.610.882 discloses a mercerising process comprising in particular a bath to bleach the textile material, which is passed through this bath after the mercerising and washing steps.

JP 76022559 and JP 76014638 disclose continuous mercerising processes whereby the textile material is immersed in succession in a plurality of caustic soda solutions so as to obtain its final strength value gradually.

The present applicant has the purpose of obtaining a continuous mercerising method and apparatus which are suitable for achieving a process which can be employed on an industrial scale at modest costs with high-quality technological results.

The invention is set forth in the main claim, while the dependent claims describe various features of the invention.

The method according to the invention provides for the continuous treatment of a plurality of yarns being unwound parallel to each other from at least one feeder beam. This plurality of yarns undergoes substantially six mercerising treatment steps:

- a pre-wash with water and surface active agents;
- impregnation in caustic soda;
- stabilisation with a control of the shrinkage of the yarns;
- tensioning and drawing;
- neutralisation by a hot wash;
- drying in an oven.

Downstream of the drying step the yarns are

taken up advantageously in separate groups on a plurality of beams having smaller dimensions than the feeder beam or beams.

The above mercerising steps are carried out in a plurality of vessels which can be made movable so as to enable the yarns to be readily passed through, and inserted into, the operational assemblies arranged within such vessels. This becomes necessary upon each change of the lots being processed or owing to maintenance work or the like.

Each vessel or each group of vessels is equipped advantageously with its own motor and control means governed by a central processor unit which sets the various working parameters from time to time.

The apparatus of the invention may be equipped also with a system to monitor all the physical values entailed in the treatment so as to optimise every operational step, particularly from a technological or energy-consumption point of view.

The yarns may be tied crosswise to their direction of feed in the apparatus at pre-set intervals so as to ensure the advance of each yarn along the whole path of the treatment, even in the event of any breakages. These lease ties may be removed before the yarns are wound onto their take-up beams.

These and other special features of the invention will be made clearer in the description that follows.

The attached figures, which are given as a non-restrictive example, show the following:

Fig.1 is a diagram of a side view of a mercerising apparatus according to the invention;

Fig.2 is a plan view of the diagram of Fig.1;

Fig.3 gives a side view of a preferred embodiment of a type of vessel according to the invention.

Figs.1 and 2 give a diagram of the embodiment of a mercerising apparatus 10 according to the invention. The apparatus 10 is fed with a plurality of yarns 11 being unwound from at least one beam 12 packaged on a warping machine.

In the example of the embodiment shown the feed consists of two beams 112 and 212 to feed separately two sides having an identical configuration 110-210 into which the mercerising apparatus 10 can be divided.

If there is only one feeder beam 12, the apparatus 10 may not be divided in this way.

In the description that follows we shall refer to a treatment path for the yarns 11 in which they may be unwound equally well from one single beam 12 or from a plurality of beams 112-212.

The present applicant has found that with an embodiment such as that of Figs.1 and 2 the

speed of unwinding of the yarns 11 from the beam 12, this speed being that of the whole mercerising process, can reach 60 metres per minute or more and will ensure at the same time the required level of quality of the product thus treated.

The yarns 11 unwound from the beam 12 are fed to a pre-wash assembly 13 consisting in this example of three equal vessels 14, through which the yarns 11 are passed in succession.

A plurality of vessels 14 comprised also in assemblies located downstream of the pre-wash assembly 13 is employed in the mercerising apparatus 10.

When we speak of vessels employed in other assemblies that treat the yarns 11 in the following description, we means the same type of vessel 14 as those used in the pre-wash assembly 13. This type of vessel 14 is shown in Fig.3.

In this example this vessel 14 comprises a container 15 for treatment liquid, a pair of upper transverse rolls 16 at the entry and exit of the vessel 14, a pair of lower transverse rolls 17 positioned at the bottom of the vessel 14 and an intermediate transverse transmission roll 18.

Thrust means 19 to press on the yarns 11 in correspondence at least with the upper rolls 16 may also be included.

Actuation means 20 to drive the rolls are positioned above the vessel 14 and may cooperate with one single vessel 14 or with groups of vessels 14.

The intermediate transmission roll 18 is equipped advantageously with its own motor, which can move the roll 18 crosswise to the direction of feed of the yarns 11; the purpose of this is to be able to ensure correct positioning of the plurality of yarns 11 during their movement of feed through the apparatus 10; the position of the yarns 11 is monitored by control means, such as photoelectric cells cooperating with the motor of the intermediate transmission roll 18.

Each vessel 14 can displace its container 15 within the apparatus 10 so as to free the upper, lower and intermediate rolls 16-17-18 for the purpose of enabling an easy insertion and passage of the yarns 11 during operations for changes of lots or other operational requirements.

The containers 15 can be lowered to the position shown with lines of dashes in Fig.3.

Water heated to about 90°C and containing suitable surface active agents is employed in the pre-wash step in the pre-wash assembly 13.

The quantity and temperature of the water and its content of surface active agents may be checked advantageously by means of suitable sensors in the vessels 14; these sensors will be linked to centralised control systems for automatic management of the operations. This feature is included also in any other operational assembly which will

be described hereinafter.

Water to top up the vessels 14 of the pre-wash assembly 13 can be prepared in a separate tank and heated by means of heat exchangers, independently or with the water coming from the recovery of caustic soda, as we shall detail later.

For indicational purposes, with a mercerising speed of about 60 metres per minute the yarns 11 in the embodiment shown take about 10 to 11 seconds to pass through the pre-wash assembly 13 fully according to experiments conducted by the present applicant.

The yarns 11 pass from the pre-wash assembly 13 to an assembly 21 which performs impregnation with caustic soda and in this example consists of two vessels 14.

The temperature of the bath is kept at about 40° C, while the metering and heating of the caustic soda can be carried out and checked in a supplementary container.

In the conditions cited above the stay time of the yarns 11 immersed in the bath is about seven seconds.

The yarns 11 pass from the impregnation assembly 21 to a stabilization and tensioning assembly 22 consisting of a stabilization and tensioning chamber 23 equipped with a plurality of upper rolls 24 and coordinated lower rolls 25.

In a first phase in this chamber 23 the yarns 11 undergo a series of passes about the upper rolls and lower rolls 24-25 which hinder the shrinkage of the yarns 11. This shrinkage can also be suitably regulated by controlling the tension of the yarns 11.

The stabilization phase in the above conditions lasts for a period of about 36 to 38 seconds.

In a second phase, after being wrung with an adjustable pressure, the yarns 11, still within the chamber 23, undergo a further series of passes about the upper rolls and lower rolls 24-25. In this second phase the yarns 11 are drawn by tensioning, for instance by a length equal to 4% of the initial length, during a period of about 3 to 4 seconds.

All the lower rolls 25 in the chamber 23 are advantageously partly immersed in caustic soda to prevent possible oxidation of the yarns 11.

The step of neutralization of the yarns 11 consists of a first washing stage, a second actual neutralization stage and a third rinsing stage.

The washing stage is performed by a wash assembly 26 consisting of two groups each formed of two vessels 14, each vessel 14 containing water at a temperature of about 80° C.

The actual neutralization stage is carried out by a neutralization assembly 27 consisting of two vessels 14 containing an acid bath to neutralize the pH.

The rinsing stage is performed by a rinsing

assembly 28 consisting of three vessels 14 containing water at a temperature of about 40° C.

The vessels 14 in the wash assembly 26 and rinse assembly 28 are equipped with an inlet and outlet for the water, which is fed continuously so as to flow in the opposite direction to the feed of the yarns 11 to be treated. The water passes advantageously from one vessel 14 to the next within each of the above assemblies 26-28 by an overflow system.

The water collected at the outlets of the wash assembly 26 and rinse assembly 28 can be processed to recover caustic soda by evaporation of the water.

The thermal energy made available during the processing can be employed to heat the water used in the upstream steps.

The yarns 11 pass from the rinse assembly 28 to a drier assembly 29 consisting of an oven 30 in which the yarns 11 undergo a series of passes about upper rolls 31 and lower rolls 32.

The oven 30 may advantageously be of a type with a circulation of a forced draught of air heated by a submerged combustion system, as described in IT-A-83487 A/89 in the name of the present applicant.

It is obvious that the system to heat the air by submerged combustion may be replaced by other known heating systems.

During the drying step the yarns 11 undergo firstly a water removal process that brings the value of relative humidity down to about 70%; thereafter they are passed through the oven 30 in contact with air heated to a temperature between 90° and 120° C and then leave the oven 30 with a relative humidity of about 7 to 8%.

The yarns 11 leaving the drier assembly 29 are taken up on a beam or advantageously a plurality of small beams 33, each of which will hold an aliquot part of the yarns 11 held on the feeder beam 12 or feeder beams 112-212. These small take-up beams 33 will be used to feed a suitable unwinding-winding machines thereafter.

Claims

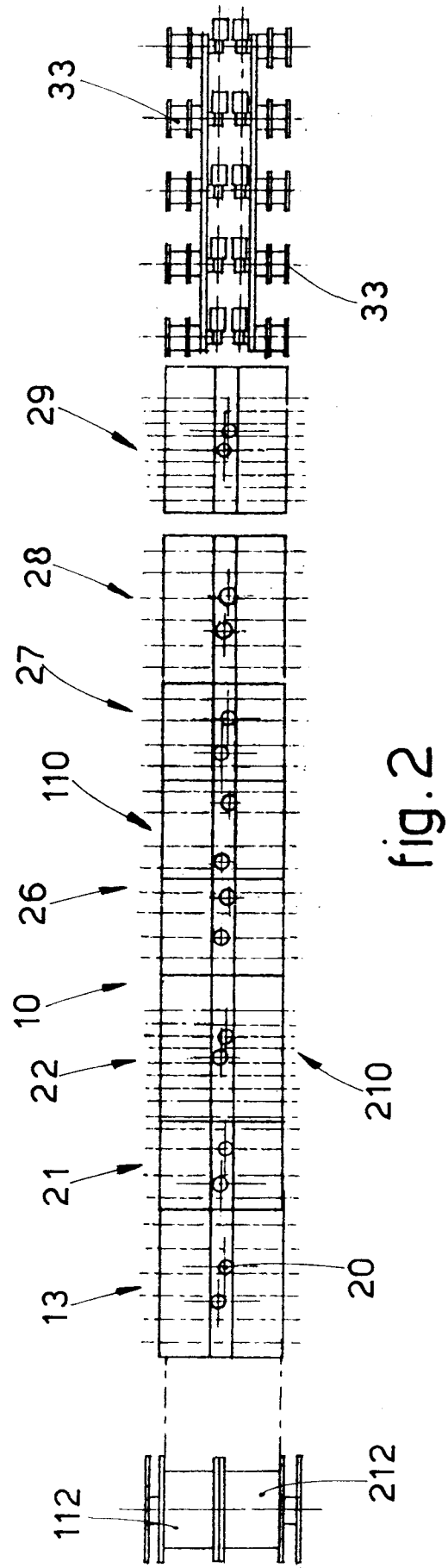
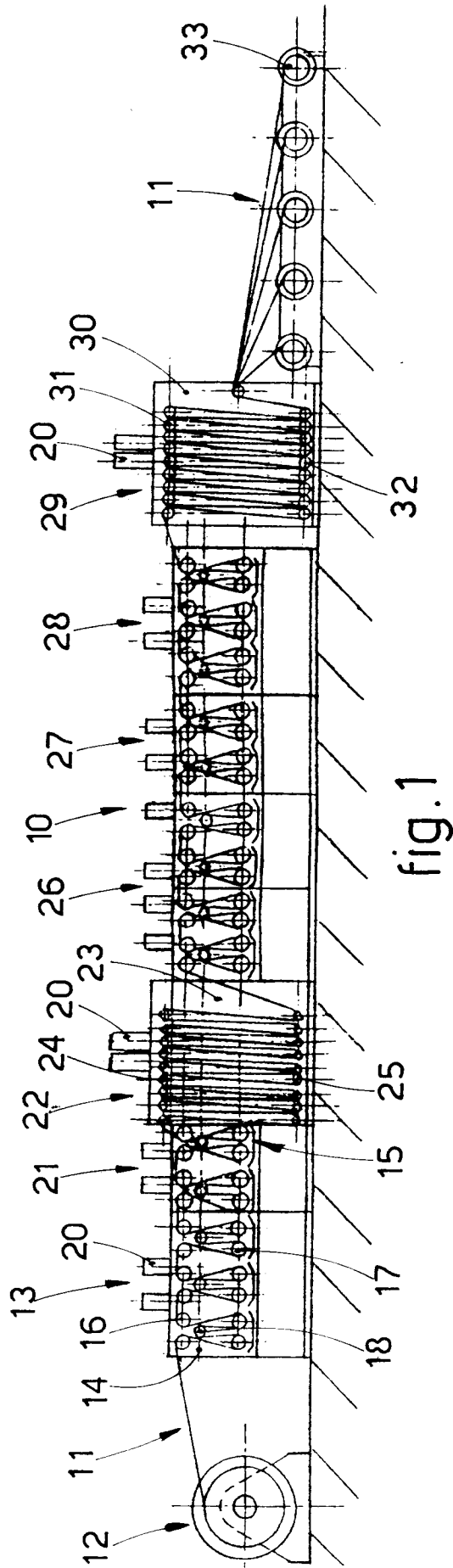
1. Method for continuous mercerising which is suitable to carry out mercerising treatment of a plurality of yarns being unwound continuously and parallel to one another from one (12) or more (112-212) feeder beams, the method being characterized in that the plurality of yarns (11) undergoes in succession the following operational steps:

- a pre-wash by immersion in at least one vessel (14), but preferably in three vessels (14), containing a bath consisting of hot water with an addition of surface ac-

- tive agents,
- impregnation in caustic soda by immersion in at least one vessel (14), but preferably in two vessels (14), containing a bath of heated caustic soda,
 - stabilisation with a control of shrinkage of the yarns (11) in a stabilisation and tensioning chamber (23), in which the yarns (11) are placed partly in contact with a caustic soda bath,
 - tensioning and drawing in the stabilisation and tensioning chamber (23), in which the yarns (11) are again placed partly in contact with a caustic soda bath,
 - neutralisation by a hot wash, the neutralisation comprising: a first stage of washing by immersion in at least one one vessel (14), but preferably in two groups each of two vessels (14), containing a bath of hot water; a second stage of actual neutralisation by immersion in at least one one vessel (14), but preferably in two vessels (14), containing an acid bath; and a third stage of rinsing by immersion in at least one vessel (14), but preferably in three vessels (14), containing a bath of hot water, and
 - drying in an oven (30) by a circulation of hot air,
- the yarns (11) leaving the drying process being wound on one or preferably on a plurality of take-up beams (33).
2. Method as claimed in Claim 1, in which the temperature of the bath in the pre-wash step is about 90° C.
 3. Method as claimed in Claim 1 or 2, in which the temperature of the bath in the step of impregnation in caustic soda is about 40° C.
 4. Method as claimed in any claim hereinbefore, in which the tension of the yarns (11) in the stabilisation step can be regulated.
 5. Method as claimed in any claim hereinbefore, in which the yarns (11) are wrung immediately downstream of the stabilisation step and such wringing can be performed with a variable pressure.
 6. Method as claimed in any claim hereinbefore, in which the value of the drawing of the yarns (11) in the tensioning and drawing step is about 4% of the initial length of the yarns (11).
 7. Method as claimed in any claim hereinbefore, in which the temperature of the bath in the first
- washing stage of the neutralisation step is about 80° C.
 8. Method as claimed in any claim hereinbefore, in which the temperature of the bath in the third rinsing stage of the neutralisation step is about 40° C.
 9. Method as claimed in any claim hereinbefore, in which the yarns (11) are washed and rinsed in water running in the opposite direction to their movement of feed in the washing and rinsing stages of the neutralisation step.
 10. Method as claimed in any claim hereinbefore, in which the washing and rinsing water of the neutralisation step is treated to recover caustic soda.
 11. Method as claimed in any claim hereinbefore, in which the thermal energy made available in the recovery of the caustic soda is employed in one or more steps of the method itself.
 12. Method as claimed in any claim hereinbefore, in which the temperature in the drying step is kept within a range of 90° to 120° C.
 13. Method as claimed in any claim hereinbefore, in which the yarns (11) leaving the drying step have a relative humidity of about 7 to 8%.
 14. Method as claimed in any claim hereinbefore, in which the speed of mercerising may be 60 metres per minute or more.
 15. Method as claimed in any claim hereinbefore, in which the yarns (11) being unwound from the feeder beam (12) or beams (112-212) are tied in a crosswise direction at pre-set intervals.
 16. Method as claimed in any claim hereinbefore, in which each step of the mercerising method is governed by a central processing unit which controls and regulates the working parameters.
 17. Method as claimed in any claim hereinbefore, which includes a monitoring system to check all the physical values of the treatment.
 18. Continuous mercerising apparatus which is suitable to carry out mercerising treatment of a plurality of yarns being unwound continuously and parallel to each other from one (12) or more (112-212) feeder beams, the apparatus carrying out the method of the claims hereinbefore and being characterized in that it comprises the following operational assemblies po-

sitioned in succession:

- a pre-wash assembly (13) consisting of at least one prewash vessel (14), but preferably of three equal vessels (14) positioned one after another, 5
 - an impregnation assembly (21) consisting of at least one impregnation vessel (14), but preferably of two equal vessels (14) positioned one after another, 10
 - a stabilisation and tensioning assembly (22) consisting of a stabilisation and tensioning chamber (23) comprising assemblies of upper rolls (24) and lower rolls (25) to control shrinkage and drawing of the yarns (11), 15
 - a wash assembly (26) consisting of at least one wash vessel (14), but preferably of two groups each consisting of two equal vessels (14) positioned one after another, 20
 - a neutralisation assembly (27) consisting of at least one neutralisation vessel (14), but preferably of two equal vessels (14) positioned one after another, 25
 - a rinse assembly (28) consisting of at least one rinse vessel (14), but preferably Of three equal vessels (14) positioned one after another, 30
 - a drier assembly (29) consisting of an oven (30) employing hot air, and 35
 - a yarn (11) take-up assembly consisting preferably of a plurality of beams (33) containing aliquot parts of the number of yarns contained in the feed (12-112-212) to the apparatus (10). 40
- 19.** Apparatus (10) as claimed in Claim 18, which comprises two equal working sides (110-210). 45
- 20.** Apparatus (10) as claimed in Claim 18 or 19, in which the vessels (14) consist of a container (15) for the bath, a pair of upper transverse rolls (16), a pair of lower transverse rolls (17) and an intermediate transverse transmission roll (18). 50
- 21.** Apparatus (10) as claimed in any of Claims 18 to 20 inclusive, in which thrust means (19) to press on the yarns (11) cooperate with the upper rolls (16) of the vessels (14). 55
- 22.** Apparatus (10) as claimed in any of Claims 18 to 21 inclusive, in which each vessel (14) comprises its own actuation means (20). 60
- 23.** Apparatus (10) as claimed in any of Claims 18 to 21 inclusive, in which the actuation means (20) cooperate with groups of vessels (14). 65
- 24.** Apparatus (10) as claimed in any of Claims 18 to 23 inclusive, in which the intermediate transverse roll (18) is equipped with its own means to actuate transverse movement. 70
- 25.** Apparatus (10) as claimed in any of Claims 18 to 24 inclusive, in which the intermediate transverse roll (18) cooperates with means that monitor the position of the yarns (11) during the lengthwise forward movement of the same (11). 75
- 26.** Apparatus (10) as claimed in any of Claims 18 to 25 inclusive, in which the container (15) can be displaced to free the rolls (16-17-18). 80
- 27.** Apparatus (10) as claimed in any of Claims 18 to 26 inclusive, in which the vessels (14) are equipped with sensors to monitor the working parameters. 85
- 28.** Apparatus (10) as claimed in any of Claims 18 to 27 inclusive, in which the pre-wash assembly (13) is connected to a supplementary device that heats topping-up water. 90
- 29.** Apparatus (10) as claimed in any of Claims 18 to 28 inclusive, in which the impregnating assembly (21) is connected to a supplementary device that heats the caustic soda. 95
- 30.** Apparatus (10) as claimed in any of Claims 18 to 29 inclusive, in which the lower rolls (25) of the stabilisation and tensioning chamber (23), are partly immersed in a vessel containing caustic soda. 100
- 31.** Apparatus (10) as claimed in any of Claims 18 to 30 inclusive, which is connected to a central data processing system. 105





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EUROPEAN SEARCH REPORT

Application Number

EP 90 12 3294

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	FR-A-2 217 467 (HEBERLEIN) * the whole document *	1,3,6,18	D06B7/04
X	FR-A-2 024 796 (VEPA) * the whole document *	1,18	
X,D	DE-A-1 610 882 (VEPA) * the whole document *	1,18	
A	DE-A-3 021 783 (IVANOVSKIJ NAUCNO- ISLEDOVATEL 'SKIJ INSTITUT CHLOPCATOBUMAZNOJ ...)		
A	EP-A-144 818 (BABCOCK TEXTILMASCHINEN)		
A	FR-A-1 350 199 (HERMANN WINDEL)		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D06B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11 JULY 1991	Examiner PETIT J. P.
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