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(54) METHOD FOR BOBBIN CLASSIFICATION ACCORDING TO THE STIFFNESS OF A YARN PACKAGE AND AN APPARATUS FOR DETECTING YARN PACKAGE PERMEABILITY

(57) The invention relates to a method for bobbin classification according to the stiffness of a yarn package (41) arranged on a tube (42) for dyeing, whereby bobbins (4) are sorted into groups according to the permeability of the package (41).

The invention also relates to an apparatus for detecting the permeability of the yarn package (41), which is arranged on a tube provided with a plurality of radial through holes (421), whereby the ends (43, 44) of the tube (42) are closed and the inner space of the tube (42) is interconnected to a source (1) of compressed air, whereby a flow meter (2) is arranged in the supply piping leading into the inner space of the tube (42) and a pressure gauge (3) is connected to the outlet piping of the source (1) of compressed air.

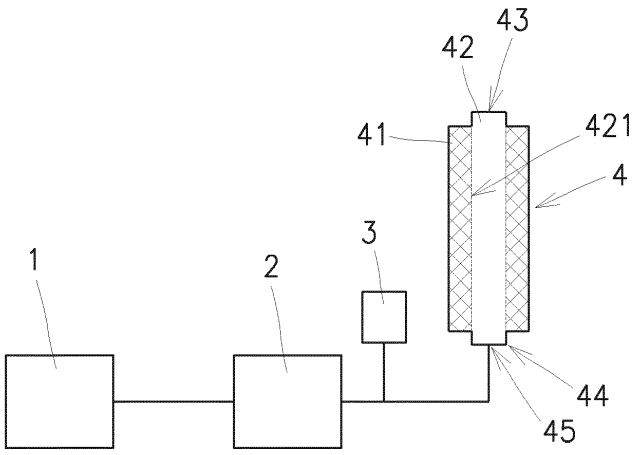

Fig. 1

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Description

Technical field

[0001] A method for bobbin classification according to the stiffness of the yarn package arranged on a tube for dyeing.

[0002] An apparatus for detecting the permeability of a yarn package which is arranged on a tube provided with a plurality of radial through holes.

Background art

[0003] Dyeing yarns and similar linear textile formations is generally carried out on a wound bobbin by forcing dye liquor through a layer of yarn.

[0004] A dyeing apparatus comprises a vessel connected to the supply of dye liquor from a storage reservoir and for discharging the dye back to the reservoir. Wound bobbins in the vessel are mounted on shanks which are composed of perforated pipes and are closed at one end, whereby the inlets to these perforated pipes are connected to the dye supply. The tubes of the bobbins are also perforated and so the dye supplied under pressure enters through the cylindrical surface of the tube into the volume of the yarn package and, having passed through the package, it returns to the storage reservoir. Such an apparatus is known, for example, from the document US 5351351.

[0005] The aim of the dyeing process of the yarn package is achieving uniform colour shade of all the wound yarn for all the bobbins of the entire dyed batch. Owing to the fact that the stiffness of individual yarn packages may vary, which may be caused, for example, by the yarn being unevenly tightened during winding, the yarn may be dyed unevenly. Naturally, this also unfavourably influences the appearance of the textile product, for example a knitted textile, a fabric and others, which are produced from such yarn.

[0006] There are several methods known from the background art that are used for detecting the stiffness of the yarn package. The known solutions are based, for example, on measuring the resistance to the deformation of the package. This is performed by measuring the resistance forces acting during the penetration of a needle into a layer of the package, or during turning a flat needle in a layer of the package. Other solutions derive benefit from measuring the reflection of testing weight falling on the package surface.

[0007] However, such measurements do not evaluate the package as a whole. The package is only assessed at certain points and, therefore, the outcome of the evaluation is not only influenced by an objective error of the measuring device caused by manufacturing tolerances and wear of the device, but also by subjective errors resulting from the measurement method, which is limited by the capabilities of the device used. The accuracy of the measurement is determined by the number of point measurements made at a particular package. A prerequisite for the applicability of the results is a relatively long time needed for the measurements and for the statistical evaluation, since it is known that there are significant variances in the obtained set of measured values.

[0008] The goal of the invention is to shorten the time which is necessary for determining the stiffness of the yarn package and increase considerably the objectivity of the evaluation of the measured data.

Principle of the invention

[0009] The aim of the invention has been achieved by a method for classification of bobbins according to the stiffness of a yarn package arranged on a tube for dyeing, whose principle consists in that the bobbins are sorted into groups according to the permeability of the package. This criterion is very close to the actual process of dyeing packages.

[0010] The permeability is determined by measuring the hydraulic gradient on a layer of a package at a specific constant air flow rate, or the permeability is determined by measuring air flow rate through a layer of the package at a specified constant hydraulic gradient on the layer of the package. From the point of view of the results of testing, both methods are virtually equal and selecting one method depends on the availability of the testing means and/or possible unique features of the packages being dyed, the type of dye or the testing frequency.

[0011] In order to determine the hydraulic gradient on a layer of a package, the overpressure of the air supplied into the inner space of the tube with close ends in comparison with the ambient atmospheric pressure is measured. Thus it is possible to obtain also the direction of the hydraulic gradient which corresponds to the passage of the dye through the package during the process of dyeing.

[0012] The goal of the invention has also been achieved by an apparatus for detecting the permeability of a yarn package, which is arranged on a tube provided with a plurality of radial through holes, whose principle consists in that the ends of the tube are closed and the inner space is interconnected with a source of compressed air, whereby a flow meter is arranged in the inlet piping leading into the inner space and a pressure gauge is connected to the outlet piping of compressed air.

[0013] The advantage of the solution according to the invention is relative simplicity of its implementation, obtaining reproducible and reliable results, availability of the means which constitute the testing apparatus, as well as the fact that it is possible to store the measured values so that they can be retrieved for the purpose of finding the reason of altered stiffness of the package or its colouring.

Description of drawings

[0014] The apparatus for measuring the stiffness of a

yarn package according to the invention is schematically represented in the drawing, where Fig.1 shows a flow chart of a pneumatic circuit, Fig. 2 shows the course of mutual dependence of the air flow (Q) through the package (axis y) and the hydraulic gradient (P) of the air in the package being measured (axis x) and Fig. 3 shows the development of the flow lines in the longitudinal section of the package volume.

Specific description

[0015] The apparatus for detecting the permeability of the yarn package according to the invention is based on a principle which physically corresponds to a method of dyeing yarn carried out during its production.

[0016] The permeability of the package is determined by its stiffness resulting from the tightening of separate **turns** during winding the bobbin. During dyeing the dyeing liquor is forced through a layer of the package so as to achieve uniform colour shade of the yarn. Measuring the package stiffness and, accordingly, its permeability is therefore carried out by forcing the liquor through analogically with the actual process of dyeing. For practical reasons, which particularly include the price of the device, the elaborateness of measurements and the necessity to maintain the yarn package in a dry state, the testing medium is gas, preferably air.

[0017] A permeable package **41** of yarn puts up a resistance to the passage of the air which is characterized by hydraulic gradient **P**, i.e. by the difference between the pressure before the entry of the air into the layer of the package **41** and the pressure of the air behind the layer of the package **41**. The hydraulic gradient **P** grows with the stiffness of the package **41** and the flow rate **Q** of the air being forced through. For the same dimensions of the package **41** of yarn, namely its length, its outer diameter and the outer diameter of the tube **42**, the package **41** permeability is a fundamental parameter which defines the stiffness of the package **41**. The reason why a gas medium is used is the fact that this measurement allows to compare only relative stiffness, that is the total mean permeability of separate packages **41** being tested, not the absolute value of permeability, and the material is not anyhow damaged by it.

[0018] An example of embodiment of the apparatus according to the invention is illustrated in Fig. 1. For detecting the permeability by the air a source **1** of compressed air is used with a flow meter **2** preferably arranged in the outlet branch pipe of the source **1** of compressed air. Behind the flow meter **2**, to this branch pipe is connected a flow meter **3** measuring the pressure P_0 of the air before the bobbin **4** with the package **41** of yarn being measured, which constitutes in principle overpressure in relation to the ambient atmospheric pressure. The package **41** is arranged on a tube **42**, which is for the purpose of dyeing yarn provided along its length by a plurality of regularly divided radial through holes **421**. At one end **43** the tube **42** is closed for the measurement purpose. At the other end **44** an inlet orifice **45** of the compressed air supply is arranged for the measurement purpose.

[0019] Owing to the fact that the outer surface of the package is in contact with the ambient atmosphere, the value of the hydraulic gradient **P** on the package **41** layer is virtually identical to the inlet pressure P_0 of the supplied air.

[0020] In the first alternative of the apparatus according to the invention, the source **1** of compressed air is provided with a means of adjusting the amount of the flow **Q** of the supplied air. The source **1** of compressed air can be also a low-pressure blower, or the outlet of an unillustrated central distribution system of compressed air provided with a means for flow rate regulation. If a separate source **1** of compressed air is used, the flow meter can be arranged in its suction system. This, however, has a negative influence on the conditions in the suction of the source **1** of compressed air.

[0021] In the second alternative, the source **1** of compressed air delivers a constant amount of the air, or the source **1** of compressed air is coupled to a sufficiently precise known regulator of the pressure (not shown).

[0022] Fig. 2 shows a diagram of mutual dependence of the air flow **Q** in m^3/h through the layer of the package **41** and the hydraulic gradient **P** in kPa.

[0023] In the first variant, the detecting of the stiffness of yarn packages **41** is carried out by measuring the flow rate **Q** of the air by a flow meter **2** at a constant pre-set hydraulic gradient P_1 on a layer of the package measured by a pressure gauge **3**. In one bobbin **4** a specified hydraulic gradient P_1 is obtained after adjusting the source **1** to flow rate Q_1, in another bobbin **4** the same hydraulic gradient P_1 is obtained after adjusting the source **1** to flow rate Q_2. A soft package **41** is characterized by a higher flow rate Q_1, whereas a stiff package **41** is characterized by a lower flow rate Q_2.

[0024] In the second variant, detecting the stiffness of yarn packages **41** is carried out by measuring the hydraulic gradient **P** by the pressure gauge **3** at a constant pre-set flow rate Q_1 of the air controlled by the flow meter **2**. A stiff package **41** is characterized by a higher hydraulic gradient P_2, whereas a soft package **41** is characterized by a lower hydraulic gradient P_1.

[0025] On the basis of the values of the hydraulic gradient **P** measured for different amounts of flow rate **Q** it is possible to construct the entire curve of mutual dependence of the hydraulic gradient **P** and the flow rate **Q** for laboratory use. The curve **K2**, which is situated lower, defines a stiffer package **4** than the curve **K2**, situated above.

[0026] Handling bobbins, closing the tubes **42** by means of a sealing stopper at the end **43** and a stopper with the supply of compressed air at the end **44**, can be easily automated. By means of appropriate converters it is also possible to store the measured values of the hydraulic gradient **P** and the flow amount **Q** of the air so as to retrieve the causes of altered stiffness of the package

or the colouring.

[0027] Apparently, in the usual arrangement of the package on the bobbin, it is not possible to presume a uniform field of flow lines of the flowing fluid. Especially in areas situated on a small diameter of both ends of the package **411** short-circuit flowing from the tube towards the side annulus of the package occurs.

[0028] For the purpose of research and development, it is possible to determine the uniformity of the flow through a layer of the package **41** by means of numerical simulation, to detect the places of short-circuit flow of the air and according to need to propose adjustments leading to a reduction of unevenness of the flow through the package.

[0029] On the basis of the confrontation of the results obtained by a method of numerical simulation with the known operational process it is possible to propose using a covering plate to cover the ends of individual packages. In this manner, the dye flow from the radial holes **421** directly to the side of the package **411** is restricted, especially the flow through the portion adjacent immediately to the surface of the tube **42**, the flow of the dye towards the area of "the corners", i.e. the transition area **422** from the side of the package **411** to the cylindrical surface is strengthened. Similarly, even a short distance between the sides of the neighbouring bobbins, which are in the dyeing apparatus arranged practically one on top of another in the axis direction, has a positive effect on the uniformity of the colouring of these portions of the package.

[0030] The outcome of the numeric simulation is also the fact that even bobbins having identical average permeability detected by the method described above have a different intensity of air flow rate in different sections of the package volume, that is in the side, along the circumference, or in the area transition from the side to the circumference and, therefore, theoretically they also have a different degree of local colouring. During the dyeing process, this drawback can be effectively reduced by diversifying directions of the dye liquor flowing to the mass of the package and vice versa. It is apparent that so as to achieve proper colouring of the entire volume, it is also necessary to maintain a certain minimum period of dyeing so that all the sections in the package could be saturated with dye. If bobbins of one colour batch are sorted into groups according to a particular range of permeability, the period of the dyeing of stiffer bobbins will be longer than that of softer bobbins.

List of references

[0031]

1	source of compressed air
2	flow meter
3	pressure gauge
4	bobbin (with yarn package)
41	yarn package
411	side of package
42	tube
421	through holes in the tube
422	transition (from the side of the package to the cylindrical surface of the package - "corner")
43	tube end (closed)
431	flow line (in the area of the closed end of the tube)
44	the tube end (with air supply)
441	flow line (in the area of the tube end with air supply)
45	inlet orifice of air supply
K1	curve of the dependence of the pressure on the flow of less stiff package
K2	curve of the dependence of the pressure on the flow of stiffer package
P	hydraulic gradient on a layer of the yarn package
P_0	overpressure of the air before the inlet tube area (in comparison with ambient atmospheric pressure)
P_1	hydraulic gradient of the air (= pressure of the air in the inlet tube area - specific - of softer package)
P_2	hydraulic gradient of the air (= pressure of the air in the inlet tube area - (specific - of stiffer package)
Q	air flow
Q_1	air flow (specific - of softer package)
Q_2	air flow (specific - of stiffer package)

Claims

1. A method for classification of bobbins (4) according to the stiffness of a yarn package (41) arranged on a tube (42) for dyeing, **characterized in that** the bobbins (4) are sorted into groups according to the permeability of the package (41).

2. The method according to Claim 1, **characterized in that** the permeability is determined by measuring the hydraulic gradient (P) on a layer of the package (41) at a specified constant flow rate (Q) of the air.

3. The method according to Claim 1, **characterized in that** the permeability is determined by measuring the flow (Q) of the air through a layer of the package (41) at a specified constant hydraulic gradient (P) of the air on a layer of the package.

4. The method according to Claim 2 or 3, **characterized in that** in order to determine the hydraulic gradient (P) on a layer of the package (41), overpressure (P_0) of the air supplied into the inner space of the tube (42) with closed ends (43, 44) in comparison with the ambient atmospheric pressure is measured.

5. An apparatus for detecting the permeability of a yarn package (41) of yarn, which is arranged on a tube (42) provided with a plurality of radial through holes (421), **characterized in that** the ends (43, 44) of the

tube (42) are closed and the inner space of the tube (42) is interconnected with a source (1) of compressed air, whereby a flow meter (2) is arranged in the supply piping leading into the inner space of the tube (42) and a pressure gauge (3) is connected to the outlet piping of the source (1) of compressed air (3).

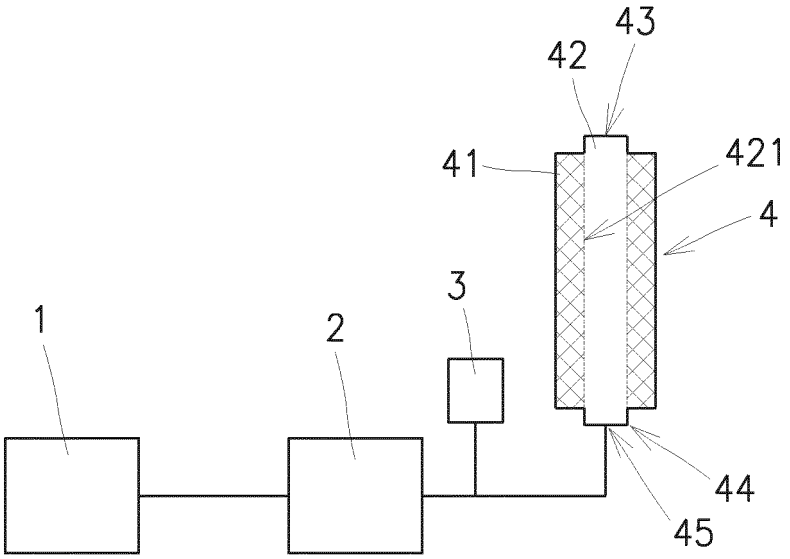
43
42
41
421
4
3
1
2
44
45

Fig. 1

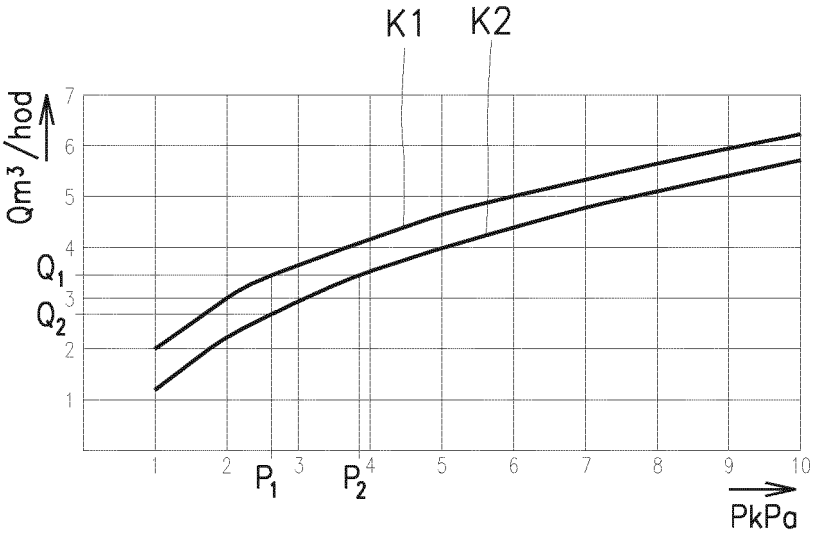
K1
K2
Qm³/hod
7
6
5
4
3
2
1
Q1
Q2
1
2
3
4
5
6
7
8
9
10
P1
P2
PkPa

Fig. 2

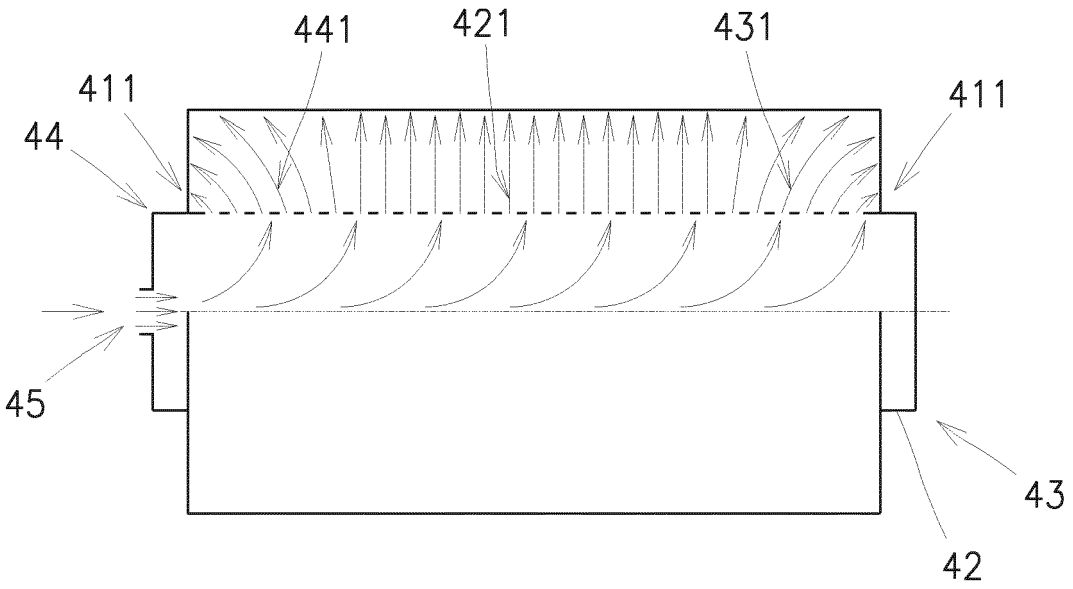

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 15 17 7641

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	US 5 351 351 A (ONO NOBUTAKA [JP]) 4 October 1994 (1994-10-04) * abstract; figures * -----	1-5	INV. B07C5/34

TECHNICAL FIELDS SEARCHED (IPC)

B07C
D06B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 January 2016	Wich, Roland

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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T : theory or principle underlying the invention
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22-01-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5351351 A	04-10-1994	JP H0778307 B2	23-08-1995
		JP H05339868 A	21-12-1993
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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