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(54) **TRANSFER DYEING DEVICE**

(57) The present invention provides a transfer dyeing apparatus including a dyeing box, a dyeing portion sleeve device, a permeation box, and a permeation device. The dyeing box is filled with an inerted gas. The dyeing portion sleeve device is arranged in the dyeing box and is configured to dye a surface of a fabric with a dye. The permeation box is arranged downstream of the dyeing box in a moving direction of the fabric and is filled with an inerted gas. The permeation device is arranged in the permeation box and is configured to enable the dye on the surface of the fabric to permeate into the fabric. The dyeing box and the permeation box are in communication with each other. The fabric sequentially passes through the dyeing box and the permeation box. Sealing devices are arranged at a fabric inlet of the dyeing box and a fabric outlet of the permeation box respectively, so that the dyeing box and the permeation box are hermetically sealed relative to an environment.

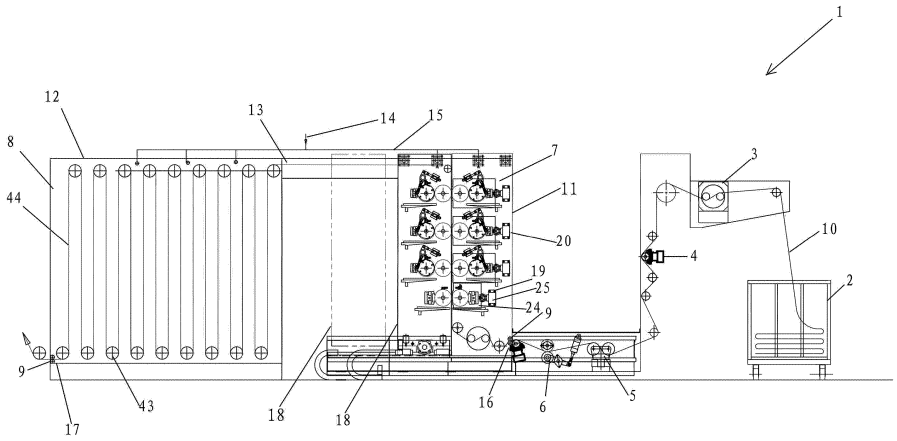

FIG. 1

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Description

BACKGROUND

Technical Field

[0001] The present invention relates to printing and dyeing machinery of the textile industry, and in particular, to a transfer dyeing apparatus.

Related Art

[0002] Denim, also known as denim cloth, is a relatively thick yarn-dyed warp-faced denim fabric, which has a darker color in warp, generally indigo color, and has a lighter color in weft, generally light gray or scoured raw white. Therefore, it is also known as indigo denim. There are two current production methods for denim. One of the production methods is to dye and weave warp yarn, and the traditional production process is as follows: white yarn —> dyeing —> yarn-dyed fabric (fabric treatment) → cutting → sewing → manual water washing finishing —> after-finishing —> packaging, where the warp yarn is dyed by coloring in the combination of pulp dyeing and a one-step dyeing process. The other production method is to dye gray cloth into denim, and the he traditional production process is as follows: gray cloth —> dyeing —> dyed gray fabric (fabric treatment) —> cutting —> sewing —> manual water washing finishing —> after-finishing → packaging, where the gray fabric is mostly dyed by a high-temperature and highpressure jet overflow dyeing machine. The dyeing machine is composed of a body circulating pump heater, a nozzle, a lifting device, a feeding cylinder, and other components. The fabric is repeatedly circulated in the dyeing machine in a rope-like relaxed form and is continuously impacted and impregnated by dye liquor to achieve dyeing.

[0003] The current production methods of denim will result in a large amount of inorganic salts and waste dyes in the water-washing wastewater, and thus increasing the COD of sewage. The CODcr of the sewage is as high as 2200-2800 mg/L, the concentration of suspended solid is 300-400 mg/L, the pH value is 11-13, and the chroma is 1500-1800 times. Therefore, the production process is very unfriendly to the environment. With the strictness of the environmental protection policy, the production cost will continue to increase.

[0004] In order to reduce the pollution caused by the traditional dyeing and finishing of denim, some processes for coloring the surface of denim have been developed in recent years, so as to reduce the consumption of dyes and reduce the pollution caused by after-finishing. At present, the denim fabric is dyed with paint or reactive dyes.

[0005] In practical applications, the applicant has found that, for example, indigo dyes and sulfur dyes, which are insoluble in water and have no affinity for fibers, cannot be used directly for dyeing, but need to be reduced under alkaline conditions by a strong reducing agent to a water-soluble leuco which is a slightly water-soluble light-colored substance and can therefore be used for dyeing. However, if the indigo dyes and the sulfur dyes are exposed to oxygen in the air over a large area, they cannot be reduced to a leuco for coloring. Therefore, for denim dyed with indigo dyes and sulfur dyes, at present, warp yarn is subjected to rope dyeing, sheet dyeing and hanging ring dyeing, or gray cloth is dip-dyed. This, as before, leads to the above-mentioned environmental pollution and cost increase.

[0006] Therefore, there is an urgent need to develop dyeing equipment that conforms to a leuco dyeing mechanism of indigo dyes and sulfur dyes and can provide an environment suitable for leuco dyeing of indigo dyes and sulfur dyes.

SUMMARY

[0007] Accordingly, the present invention aims to provide a transfer dyeing apparatus capable of proceeding a leuco dyeing mechanism of indigo dyes and sulfur dyes and providing an environment suitable for leuco dyeing of indigo dyes and sulfur dyes, thereby greatly reducing environmental pollution and production cost.

[0008] In order to solve the problems and defects in the prior art, the present invention provides a transfer dyeing apparatus as the technical solutions. The transfer dyeing apparatus includes a dyeing box, a dyeing portion sleeve device, a permeation box, and a permeation device. The dyeing box is filled with an inerted gas. The dyeing portion sleeve device is arranged in the dyeing box and is configured to dye a surface of a fabric with a dye. The permeation box is arranged downstream of the dyeing box in a moving direction of the fabric and is filled with an inerted gas. The permeation device is arranged in the permeation box and is configured to enable the dye on the surface of the fabric to permeate into the fabric. The dyeing box and the permeation box are in communication with each other. The fabric sequentially passes through the dyeing box and the permeation box. Sealing devices are arranged at a fabric inlet of the dyeing box and a fabric outlet of the permeation box respectively, so that the dyeing box and the permeation box are hermetically sealed relative to an environment.

[0009] Preferably, the dyeing box is in communication with the permeation box via a channel allowing the passing of the inerted gas and the fabric.

[0010] Preferably, the dyeing box and the permeation box are integrally formed with each other.

[0011] Preferably, the sealing device has a housing and an airbag pair in the housing, a side wall of the housing is provided with a cloth inlet and a cloth outlet allowing the passing of the fabric, and the airbag pair includes two airbags that are opposite to each other and the fabric can pass between the two airbags.

[0012] Preferably, the number of the airbag pair is at least two, and each of the airbag pairs is successively

arranged in the moving direction of the fabric.

[0013] Preferably, the two airbags of the airbag pair contact the fabric in a line-contact manner or a surface-contact manner.

[0014] Preferably, each of two ends of each of the airbags are provided with a fixing device, and the airbag is fixed on the side wall of the housing via the fixing devices.

[0015] Preferably, the sealing device has an inflation device provided for the airbags, the inflation device includes an air pump and a pipeline system connected between the air pump and the airbags, and the air pump is capable of inflating air into each of the airbags via the pipeline system.

[0016] Preferably, each of the airbags is provided with an air pressure indicator, and it can be determined whether an air pressure in each of the airbags has reached a predetermined threshold via the air pressure indicator.

[0017] Preferably, the airbag has a uniform circular cross-section over a substantially entire length of the airbag after being filled with air.

[0018] Preferably, a length of the airbag is greater than a width of the fabric, so that the fabric can be hermetically sealed and surrounded by the airbags circumferentially.

[0019] Preferably, a surface of the airbag is configured to allow the fabric to be capable of sliding between the two airbags that are opposite to each other while the inerted gas cannot pass between the airbags.

[0020] Preferably, the airbag is pressed laterally against either the side wall of the housing or an adjacent airbag, so that a hermetically sealed space is substantially formed between the two airbags that are opposite to each other.

[0021] Preferably, the sealing device has a return port penetrating through the side wall of the housing, and the inerted gas entering the housing can be recycled via the return port.

[0022] Preferably, the dyeing box and the permeation box are provided with a common inerted gas filling device capable of filling the dyeing box and the permeation box with the inerted gas via gas filling pipelines in parallel connection at the same time.

[0023] Preferably, the permeation device includes at least two rows of guide rollers, and each of the rows of the guide rollers is spaced apart from one another.

[0024] Preferably, each of the rows of the guide rollers includes a plurality of the guide rollers arranged successively, and the guide rollers in different rows are staggered and spaced apart from each other.

[0025] Preferably, the fabric entering the permeation box extends serpentinely in a plurality of fabric sections via the guide rollers and substantially longitudinally.

[0026] Preferably, adjacent fabric sections extend in parallel and movements of the adjacent fabric sections are in opposite directions.

[0027] Preferably, the dyeing portion sleeve device has a direct dyeing group pair and a transfer dyeing group pair successively arranged in the moving direction of the fabric, the direct dyeing group pair has two direct dyeing groups which are arranged symmetrically relative to the fabric and include anilox rollers, and the transfer dyeing group pair has two transfer dyeing groups which are arranged symmetrically relative to the fabric and include plate rollers and transfer rollers.

[0028] Preferably, the number of the transfer dyeing group pair is at least two.

[0029] Preferably, one of the direct dyeing groups of the direct dyeing group pair is arranged on a mounting block, and the mounting block is capable of being moved on a guide rail of the dyeing box in a transverse linear guide manner so as to drive one of the direct dyeing groups to move toward or away from the other direct dyeing group.

[0030] Preferably, one of the transfer dyeing groups of the transfer dyeing group pair is arranged on a mounting block, and the mounting block is capable of being moved on a guide rail of the dyeing box in a transverse linear guide manner so as to drive one of the transfer dyeing groups to move toward or away from the other transfer dyeing group.

[0031] Preferably, the transfer dyeing group includes a pressing assembly configured to adjustably provide a pressure of the plate roller against the transfer roller, and the pressing assembly is capable of making the plate roller selectively move between an abutment position and a stop position; at the abutment position, the plate roller abuts against the transfer roller so as to generate the pressure of the plate roller against the transfer roller; at the stop position, the plate roller does not abut against the transfer roller.

[0032] Preferably, the transfer dyeing group includes a plate changing device, and the plate roller can be changed via the plate changing device.

[0033] Preferably, the transfer dyeing group includes a slant plate pulling device, and a position and an angle of the transfer roller can be finely adjusted via the slant plate pulling device.

[0034] Preferably, the transfer dyeing group includes an axial plate pulling device provided for the plate roller so as to adjust an axial position of the plate roller.

[0035] Preferably, the dyeing box is provided with a sliding door movable between a hermetically sealed closed position and an open position, where at the open position of the sliding door, the interior of the dyeing box is accessible from the exterior of the dyeing box.

[0036] Preferably, the fabric is denim.

[0037] Preferably, the inerted gas is nitrogen.

[0038] Preferably, the permeation device includes at least two columns of guide rollers, and each of the columns of the guide rollers is spaced apart from one another.

[0039] Preferably, each of the columns of the guide rollers includes a plurality of the guide rollers arranged successively, and the guide rollers in different columns are staggered and spaced apart from each other.

[0040] Preferably, the fabric entering the permeation box extends serpentinely in a plurality of fabric sections

via the guide rollers and substantially transversely.

[0041] Other objectives, features, and details of the present invention are more comprehensively understood with reference to the following detailed description of the exemplary embodiments in combination with the accompanying drawings.

[0042] A person skilled in the art will understand advantages of the corresponding embodiment and various other embodiments by reading the following detailed description of the corresponding embodiments with reference to the accompanying drawings listed below. In addition, features of the accompanying drawings discussed below are not necessarily drawn to scale. The features and size of the elements in the accompanying drawing may be enlarged or reduced to more clearly show the embodiments of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043] The present invention is further described below with reference to the accompanying drawings and the embodiments.

FIG. 1 is an overall schematic view of a transfer dyeing apparatus according to the present invention;

FIG. 2 is a schematic view of a direct dyeing group pair according to the present invention;

FIG. 3 is a schematic view of a transfer dyeing group pair according to the present invention;

FIG. 4 is a schematic view of a sealing device according to the present invention viewed along a direction perpendicularly to a moving direction of a fabric;

FIG. 5 is a schematic view of the sealing device in FIG. 4 viewed along the moving direction of the fabric; and

FIG. 6 is a schematic view of another permeation device according to the present invention.

DETAILED DESCRIPTION

[0044] Various illustrative embodiments of the present invention are described below. In this specification, various systems, structures and devices are schematically depicted in the drawings for purposes of explanation only and not to describe all features of an actual system, structure or device, such as a well-known function or structure not described in detail, so as to avoid obscuring the present invention in unnecessary detail. It will of course be appreciated that in the case of any actual application, numerous specific embodiment decisions should be made to achieve specific goals of developers or users, and that system-related and industry-related constraints should be met. These specific goals will vary from one application to another. Moreover, it should be appreciated that such a specific embodiment decision, while complex and time consuming, would nevertheless be a routine task for those of ordinary skill in the art having the benefit of this application.

[0045] The terms and phrases used herein should be understood and interpreted to have a meaning consistent with the understanding of those terms and phrases by those skilled in the relevant art. No special definition of a term or phrase, i.e. a definition that is different from the ordinary and customary meaning as understood by those skilled in the art, is intended to be implied by consistent usage of the terms or phrases herein. To the extent that a term or phrase is intended to have a special meaning, i.e. a meaning other than that understood by those skilled in the art, such a special definition will be expressly set forth in the specification in a definitional manner that directly and unequivocally provides a special definition of the term or phrase.

[0046] Unless the context requires otherwise, throughout the following description, the word "include/comprise" and variations thereof, such as "includes/including/comprises/comprising", are to be construed in an open, inclusive sense, that is as "including, but not limited to".

[0047] In the descriptions of this specification, descriptions using reference terms "an embodiment" , "one embodiment" , "some embodiments" , "an example" , "a specific example" , or "some examples" indicate that specific characteristics, structures, materials, or features described with reference to the embodiment or example are included in at least one embodiment or example of the present invention. Therefore, terms "in one embodiment" or "in an embodiment" appears in different places throughout this specification are not necessarily related to the same embodiment. In addition, the described specific features, structures, materials, or characteristics may be combined in a proper manner in any one or more of the embodiments or examples.

[0048] As used in this specification, unless otherwise clearly specified and defined, the singular indefinite article "a/an" and the definite article "the" include one or more referents. It should also be noted that the term "or" is generally employed in its sense including "and/or" unless explicitly stated or limited otherwise. For the purposes of this description, a phrase "A or B" means "(A), (B), or (A and B)". For purposes of the description, a phrase in the form of "at least one of A, B, or C" means " (A), (B), (C), (A and B), (A and C), (B and C), or (A, B and C)".

[0049] In addition, terms such as "first" and "second" are used only for the purpose of description, and should not be construed as indicating or implying relative importance or implying a quantity of indicated technical features. Therefore, a feature limited by "first" , "second" , or the like may explicitly or implicitly include one or more of the features. In the descriptions of the present invention, "a plurality of" means two or more, unless otherwise definitely and specifically limited.

[0050] In the present invention, unless otherwise clearly specified and defined, terms such as "installation" , "interconnection" , "communication" , "connection" , and "fixing" should be understood in a broad sense, for example, may be a fixing connection, a detachable connection, an integral connection, a mechanical connection, an electrical connection, a direct connection, an indirect connection by using an intermediate medium, or communication between interiors of two components. A person of ordinary skill in the art may understand the specific meanings of the foregoing terms in the present invention according to specific situations.

[0051] The apparatus described herein may also utilize one or more controllers to receive information and transform the received information to generate an output. The controller may include any type of computing device and computing circuit, or any type of processor or processing circuit capable of executing a series of instructions stored in a memory. The controller may include a plurality of processors and/or a multi-core central processing unit (CPU) and may include any type of processor, such as a microprocessor, a digital signal processor and a microcontroller. The controller may also include a memory to store data and/or algorithms to execute a series of instructions.

[0052] Specific embodiments of the present invention will be explained in detail below.

[0053] According to one embodiment of the present invention, a transfer dyeing apparatus 1 is provided as a whole with reference to FIG. 1. The transfer dyeing apparatus 1 may include the following parts: a fabric supply unit 2 (e.g. a cloth car), a spreading and filament-separating unit 3, a tension unit 4, a deviation-correcting and edge-aligning unit 5, a cloth feeding traction unit 6, a dyeing portion sleeve device 7, a permeation device 8, sealing devices 9, and an inerted gas filling device (not shown). The order of arrangement of the parts may be as shown in FIG. 1. An operator may manage and control the individual units and devices in a unified manner by issuing instructions to a central control unit (not shown) through a human-computer interaction unit (not shown), thereby achieving automated control.

[0054] A fabric to be dyed to which the transfer dyeing apparatus 1 of the present invention is applied may be denim cloth 10 or other cloths which need to be colored in an inerted gas environment. In the following descriptions, the denim cloth 10 is described as an example, but it is understood that the fabric is not limited to the denim cloth 10.

[0055] As can be seen in FIG. 1, the dyeing portion sleeve device 7 of the transfer dyeing apparatus 1 may be arranged in a dyeing box 11, and the permeation device 8 of the transfer dyeing apparatus 1 may be arranged in a permeation box 12. Viewed along a moving direction of the denim cloth 10, the permeation box 12 may be arranged downstream of the dyeing box 11 and in communication with the dyeing box 11 via a channel 13 by which the permeation box 12 and the dyeing box 11 are hermetically sealed relative to the environment. The channel 13 may be arranged at upper parts of the dyeing box 11 and the permeation box 12. In other embodiments, the dyeing box 11 and the permeation box 12 may be integrally formed with each other. That is, the dyeing box 11 and the permeation box 12 may be constructed as the same box, and the dyeing portion sleeve device 7 and the permeation device 8 may be arranged in this common box.

[0056] The inerted gas filling device may fill the dyeing box 11 and the permeation box 12 with an inerted gas, such as nitrogen, via an inerted gas filling inlet 14. The inerted gas may be filled into the dyeing box 11 and the permeation box 12 from the inerted gas filling inlet 14 via gas filling pipelines 15 that are in parallel connection at the same time. It is of course also conceivable to fill only one of the dyeing box 11 and the permeation box 12 with the inerted gas based on the communication of the dyeing box 11 and the permeation box 12. However, the previous solution is better in terms of filling speed and gas filling uniformity.

[0057] In order to prevent the inerted gas from escaping from the dyeing box 11 and the permeation box 12 to the environment in the working state, the dyeing box 11 and the permeation box 12 may be respectively designed to be hermetically sealed relative to the environment at least in the working state. Therefore, the sealing device 9 may be arranged at a denim cloth inlet 16 of the dyeing box 11, and the sealing device 9 may be arranged at a denim cloth outlet 17 of the permeation box 12. Thus, at least in the working state of the transfer dyeing apparatus 1, the denim cloth 10 in the dyeing box 11 and the permeation box 12 may always be in an atmosphere of the inerted gas without contacting oxygen.

[0058] As can be seen in FIG. 1, the dyeing box 11 may be provided with a sliding door 18. The sliding door 18 may be driven by a transmission mechanism, such as a gear rack transmission mechanism for motor driving. In the working state of the transfer dyeing apparatus 1, the sliding door 18 is at a closed position shown in solid lines. On the other hand, in the case that it is needed to repair or replace components in the dyeing box 11, a motor may drive the sliding door 18 to be moved to an open position shown in dashed lines. Of course the movement of the sliding door 18 may also be implemented manually. In addition, the permeation box 12 may also be provided with a similar sliding door.

[0059] Next, exemplary embodiments of the dyeing portion sleeve device 7, the gas sealing devices 9, and the permeation device 8 of the transfer dyeing apparatus 1 of the present invention will be described in detail.

[0060] As can be seen in Fig. 1, the dyeing portion sleeve device 7 may include, from downstream to upstream, one pair of direct dyeing groups 19 and three pairs of transfer dyeing groups 20 arranged successively. A direct dyeing group pair may include two direct dyeing groups 19 that are opposite to each other relative to a vertical line (or the fabric). A transfer dyeing group pair

may include two transfer dyeing groups 20 that are opposite to each other relative to the same vertical line (or the fabric). The number of pairs and order of arrangement of the direct dyeing groups 19 and the transfer dyeing groups 20 in FIG. 1 is merely exemplary and may be adjusted in practice according to actual dyeing requirements. In general, the direct dyeing groups 19 and the transfer dyeing groups 20 are arranged in a rocket-type structure, in which case the transfer dyeing apparatus 1 may also be referred to as rocket-type transfer dyeing apparatus 1. In other embodiments, other suitable arrangement structures of the direct dyeing groups 19 and the transfer dyeing groups 20 are also considerable.

[0061] As can be seen in FIG. 2, a direct dyeing group pair may include two anilox rollers 21 opposed to each other and two closed scraper assemblies 22 that are respectively arranged outside the anilox rollers 21. Each of the direct dyeing groups 19 may thus include an anilox roller 21 and a closed scraper assembly 22.

[0062] In a working position, the closed scraper assembly 22 may be pressed against the corresponding anilox roller 21, whereby two scraper heads 23 of the closed scraper assembly 22 together with the surface of the anilox roller 21 between the two scraper heads 23 and an end sealing member (not shown) form a closed liquid accommodating chamber. In a non-working position, the scraper heads 23 may be separated from the anilox roller 21.

[0063] With reference to FIG. 1, the direct dyeing group 19 at the right side of the direct dyeing group pair, in particular the anilox roller 21 at the right side and its corresponding closed scraper assembly 22, may be mounted on a mounting block 24. The mounting block 24 may be moved on a guide rail (not shown) of the dyeing box 11 in a transverse linear guide manner. A servomotor 25 fixed on the dyeing box 11 may drive the mounting block 24 to move linearly via a provided transmission mechanism, so that the anilox roller 21 at the right side of the mounting block 24 may be moved toward and away from the anilox roller 21 at the left side that is opposite to the anilox roller 21 at the right side. The servomotor 25 and the provided transmission mechanism may form a propulsion mechanism of the mounting block 24. The direct dyeing group 19 at the left side, in particular the anilox roller 21 at the left side and its corresponding closed scraper assembly 22, may be mounted on the dyeing box 11.

[0064] It is of course also conceivable that the direct dyeing group 19 at the left side may be mounted on a mounting block 24, and the direct dyeing group 19 at the right side may be mounted on the dyeing box 11.

[0065] A pressure provided by the propulsion mechanism acting on the mounting block 24 to make the anilox roller 21 press against the denim cloth 10 may be independently adjustable. The pressure is adjusted and set by a control system and may be programmed to be increased or decreased gradually. In FIG. 1, the entire direct dyeing group 19 at the right side is driven by the propulsion mechanism to achieve engagement and disengagement with the direct dyeing group 19 at the left side, and a disengagement stroke is up to 2-5 cm.

[0066] Each of the anilox rollers 21 may be provided with its own servomotor (not shown) to drive the anilox roller individually. It is of course also conceivable for two anilox rollers 21 to be driven by a servomotor and a suitable transmission mechanism at the same time.

[0067] The denim cloth 10 may be moved between the two anilox rollers 21 so as to be sized. Therefore, a pretreatment liquid such as a dye well may be applied to the denim cloth 10 via the direct dyeing group pair in order to enhance the subsequent dyeing rate and dyeing effect.

[0068] As can be seen in FIG. 3, each pair of the transfer dyeing groups 20 may include two transfer rollers 26 that are opposite to each other, two plate rollers 27 respectively arranged outside the transfer rollers 26, and two closed scraper assemblies 22 respectively arranged outside the plate rollers 27. Each of the transfer dyeing groups 20 may thus include a transfer roller 26, a plate roller 27 and a closed scraper assembly 22. The plate roller 27 may be an intaglio printing plate roller, a flexographic printing plate roller, a rotary screen printing plate roller, an offset printing plate roller, or the like.

[0069] In a working position, the closed scraper assembly 22 may be pressed against the plate roller 27, whereby two scraper heads 23 of the closed scraper assembly 22 together with the surface of the plate roller 27 between the two scraper heads 23 and an end sealing member (not shown) form a closed liquid accommodating chamber. In a non-working position, the scraper heads 23 may be separated from the plate roller 27.

[0070] With reference to FIG. 3, the transfer dyeing group 20 at the left side of the transfer dyeing group pair, in particular the plate roller 27 at the left side and its corresponding closed scraper assembly 22 and transfer roller 26, may be mounted on a mounting block 24. The mounting block 24 may be moved on a guide rail (not shown) of the dyeing box 11 in a transverse linear guide manner. A servomotor 25 fixed on the dyeing box 11 may drive the mounting block 24 to move linearly via a transmission mechanism, so that the transfer roller 26 at the left side of the mounting block 24 may be moved toward and away from the transfer roller 26 at the right side that is opposite to the transfer roller at the left side. The servomotor 25 and the provided transmission mechanism may form a propulsion mechanism of the mounting block 24. The transfer dyeing group 20 at the right side, in particular the plate roller 27 at the right side and its corresponding closed scraper assembly 22 and transfer roller 26, may be mounted on the dyeing box 11.

[0071] It is of course also conceivable that the transfer dyeing group 20 at the right side may be mounted on a mounting block 24, and the transfer dyeing group 20 at the left side may be mounted on the dyeing box 11, as shown in FIG. 1. In the embodiment shown in FIG. 1, the transfer dyeing groups 20 at the right side of the three pairs of transfer dyeing groups 20 are mounted on the

mounting blocks 24 respectively.

[0072] Similarly, a pressure provided by the propulsion mechanism acting on the mounting block 24 to make the transfer roller 26 press against the denim cloth 10 may be independently adjustable. The pressure is adjusted and set by a control system and may be programmed to be increased or decreased gradually. In FIG. 3, the entire transfer dyeing group 20 at the left side is driven by the propulsion mechanism to achieve engagement and disengagement with the transfer dyeing group 20 at the right side, and a disengagement stroke is up to 2-5 cm.

[0073] The transfer roller 26 may be a rubber-coated hard material roller. The surface of the transfer roller 26 may be coated with seamless rubber. The rubber is natural rubber, styrene butadiene rubber, polyurethane rubber, or any other rubber that has a good affinity for water-based inks. Preferably, the rubber coated on the surface of the transfer roller 26 has a Shore hardness of 85-90 degrees.

[0074] Since the transfer roller 26 in each of the transfer dyeing groups 20 is a rubber-coated hard material roller, an outer diameter of the transfer roller 26 is slightly larger than that of the plate roller 27, thus providing some tolerance space. During the transfer printing process, when the transfer roller 26 with the rubber coated surface is in contact with the plate roller 27, the rubber coated on the surface of the transfer roller 26 is deformed by a certain pressure; when the surface of the plate roller 27 is separated from the rubber coated surface of the transfer roller 26, the rubber coated surface can be rapidly restored. Preferably, the outer diameter of the plate roller 27 is smaller than the outer diameter of the transfer roller 26, and the outer diameter of the transfer roller 26 is smaller than or equal to the outer diameter of the plate roller 27 + 1 mm, i.e. the outer diameter of the transfer roller 26 is larger than the outer diameter of the plate roller 27, but a difference therebetween is less than 1 mm.

[0075] In the illustrated embodiment, for each pair of the transfer dyeing groups 20, the axis of each of the transfer rollers 26 and the axis of each of the plate rollers 27 are in parallel and in the same plane.

[0076] Each of the transfer dyeing groups 20 includes a pressing assembly 28. The pressing assembly 28 may be configured to provide an adjustable pressure of the plate roller 27 against the transfer roller 26. The pressing assembly 28 is configured to adjust the amount of inks, and the pressure is mainly used to stick out the ink in intaglio ink cells. In the embodiment shown in FIG. 3, the pressing assembly 28 includes an actuator 29 and an eccentric bushing 30. The actuator 29 includes a cylinder body and a piston rod. In FIG. 3, a cylinder body of the transfer dyeing group 20 at the left side is pivotally connected to the mounting block 24, and a cylinder body of the transfer dyeing group 20 at the right side is pivotally connected to the dyeing box 11. The actuator 29 may be of a hydraulic type, a pneumatic type, or an electric type. In the case that the actuator 29 is of a hydraulic or a pneumatic type, the extension length of the piston rod may be adjusted by adjusting a fluid pressure in the chamber of the cylinder body. Preferably, the actuator 29 may be a servo actuator, such as a servo electric cylinder.

[0077] The pressing assembly 28 may also include a swing arm 31 and a connecting rod 32. The swing arm 31 is pivotally connected to the mounting block 24 or the dyeing box 11 via a swing arm pivot 33 located substantially at the center of the swing arm 31. The swing arm 31 may include a first end and a second end. The first end of the swing arm 31 is pivotally connected to a protruding end of the piston rod of the actuator 29 through a pin. The second end of the swing arm 31 is pivotally connected to one end of the connecting rod 32 through a pin. The other end of the connecting rod 32 is pivotally connected to the eccentric bushing 30. The eccentric bushing may be provided for the plate roller 27, whereby the plate roller 27 may be moved toward or away from the transfer roller 26 by rotating the eccentric bushing 30 with the actuator 29.

[0078] Of course, it will be apparent to those skilled in the art that, apart from the swing arm-connecting rod manner described herein, the rotation of the eccentric bushing 30 by the actuator 29 may be accomplished using any other transmission manners. Optionally, a handle may be arranged at an end of the swing arm pivot for manual adjustment of the rotation of the eccentric bushing 30 by an operator at the debugging stage.

[0079] When the eccentric bushing 30 is rotated and the plate roller 27 is moved to an abutment position, the distance between the plate roller 27 and the transfer roller 26 is decreased, and these two rollers are pressed together, thereby generating a pressure making the plate roller 27 press against the transfer roller 26. However, when the eccentric bushing 30 is rotated and the plate roller 27 is moved to a stop position, the distance between the plate roller 27 and the transfer roller 26 is increased, these two rollers are not pressed against each other (may or may not contact), and the plate roller 27 does not provide pressure to the transfer roller 26.

[0080] In operation, the plate roller 27 may be moved to different abutment positions as desired by rotating the eccentric bushing 30 with the pressing assembly 28. Through rotating the eccentric bushing 30 to move the plate roller 27 to different abutment positions, the distance between the plate roller 27 and the transfer roller 26 may be adjusted, thereby adjusting the generated pressure making the plate roller 27 press against the transfer roller 26. Also, since rubber has the characteristics of flexibility, resilience, low hardness, etc., the deformation of the transfer roller 26 may be finely controlled by the adjustment of the generated pressure.

[0081] The eccentric bushing 30 may be set at the stop position initially. When a pressure is applied, the actuator 29 is actuated to extend the piston rod, and the swing arm 31 is driven to pivot about a central axis of the swing arm pivot 33, thereby driving the movement of the connecting rod 32 connected to the swing arm 31. The move-

ment of the connecting rod 32 in turn causes the rotation of the eccentric bushing 30. The rotation of the eccentric bushing 30 makes the plate roller 27 move to an abutment position (referring to FIG. 3). The distance between the plate roller 27 and the transfer roller 26 is decreased, and these two rollers are pressed against each other, thereby providing the pressure making the plate roller 27 press against the transfer roller 26. In contrast, when no pressure is needed, the actuator 29 is actuated to retract the piston rod, and the swing arm 31 is driven to pivot about a central axis of the swing arm pivot 33, thereby driving the movement of the connecting rod 32 connected to the swing arm 31. The movement of the connecting rod 32 in turn causes the rotation of the eccentric bushing 30. The rotation of the eccentric bushing 30 makes the plate roller 27 move to a stop position. The distance between the plate roller 27 and the transfer roller 26 is increased, and these two rollers are not pressed against each other, whereby the plate roller 27 no longer applies pressure on the transfer roller 26. The stroke of the piston rod of the actuator 29 may be set to 80-200 mm, preferably 100 mm.

[0082] Each of the transfer dyeing groups 20 may also include a plate changing device 34. The plate roller 27 may be changed as needed via the plate changing device 34.

[0083] Each of the transfer dyeing groups 20 may also include a slant plate pulling device 35. The position and the angle of the transfer roller 26 may be finely adjusted via the slant plate pulling device 35 to achieve precise alignment of the transfer roller 26 with an adjacent roller.

[0084] Each of the transfer dyeing groups 20 may also include an axial plate pulling device 36 provided for the plate roller 27. The axial plate pulling device 36 may include an axial plate pulling motor and a corresponding transmission mechanism so as to adjust an axial position of the plate roller 27.

[0085] Each of the plate rollers 27 and each of the transfer rollers 26 may be respectively provided with their own servomotor 25 to drive the plate roller 27 and the transfer roller 26 individually. It is of course also conceivable that only the transfer roller 26 is provided with its own servomotor 25, while the plate roller 27 and the transfer roller 26 are driven by a synchronizing device, such as a synchromesh gear, at the same time.

[0086] The denim cloth 10 from the direct dyeing group pair may be moved between the two transfer rollers 26 of each of transfer dyeing group pairs and be applied with a dye, such as an indigo dye and a sulfur dye. The successive arrangement of a plurality of the transfer dyeing group pairs (three pairs herein) ensures that the surface of the denim cloth 10 is uniformly coated with sufficient dyes.

[0087] Since the dye coating of the denim cloth 10 may be carried out in an inerted gas atmosphere in the dyeing box, the indigo dye and the sulfur dye may be well reduced to a leuco so as to color the denim cloth 10.

[0088] A sealing device 9 may be arranged at a denim cloth inlet 16 in the lower part of the dyeing box 11, and a sealing device 9 may be arranged at a denim cloth outlet 17 in the lower part of the permeation box 12. These two sealing devices 9 may be the same or different. The sealing device 9 hermetically seals the dyeing box 11 and the permeation box 12 to prevent the inerted gas from escaping therefrom.

[0089] In FIG. 1, each of the sealing devices 9 is simply shown as a pair of airbags 37 having a cylindrical cross-section. A preferred embodiment of the sealing device 9 is shown in FIG. 4 and FIG. 5. The sealing device 9 may have a housing 38 and a plurality of airbag pairs arranged successively therein. The housing 38 may be fixedly arranged at the denim cloth inlet 16 of the dyeing box 11 and the denim cloth outlet 17 of the permeation box 12, and the housing 38 may have a cloth inlet and a cloth outlet substantially corresponding to the cross-sectional structure of the denim cloth 10 on side walls of the housing 38 that are opposite to each other. Each of the airbag pairs may include two airbags 37 arranged vertically. Each of two ends of each of the airbags 37 are provided with a fixing device 39, and the airbag 37 may be fixed (preferably non-rotatably) on the side wall of the housing 38 via the fixing devices 39 on the two ends.

[0090] The sealing device 9 may also have an inflation device provided for the airbags 37. The inflation device may include an air pump 40 and a pipeline system 41 connected between the air pump 40 and the airbags 37. The air pump 40 is capable of inflating gas, such as air, into each of the airbags 37 via the pipeline system 41. In the embodiment shown in FIG. 4 and FIG. 5, the inflation device has an air pump 40 and the pipeline systems 41 that is connected to each airbags 37 in a parallel-connection manner. This design has the advantage of using fewer parts and allowing all of the airbags 37 to be inflated at the same time. However, it is also conceivable to provide one individual set of the air pump 40 and the pipeline system 41 for each of the airbags 37. This design facilitates separate inflation of each of the airbags 37. Other arrangements of the air pump 40 and the pipeline system 41 are also considerable as long as inflation of each of airbags 37 can be achieved. Corresponding switches or valves may also be arranged in the pipeline system 41 for turning on or off the inflation of a certain airbag 37 or some airbags 37.

[0091] Each of the airbags 37 may be provided with an air pressure indicator (not shown), and it can be determined whether an air pressure in the airbag 37 has reached a predetermined threshold via the air pressure indicator. When the air pressure indicator detects that the air pressure in the airbag 37 is lower than the predetermined threshold, the airbag 37 may be inflated with air via the air pump 40. When the threshold is reached, the inflation of the airbag 37 should be stopped. The process may be carried out manually, but may also be automated by a corresponding control device.

[0092] The airbag 37 substantially has a uniform circular cross-section (referring to FIG. 4) over the entire

length of the airbag 37 after being filled with air, but other suitably shaped cross-sections are also conceivable. The circular cross-section of the airbag 37 is advantageous because each pair of the airbags 37 that are opposite to each other, after inflation, may thus be substantially in line contact with the denim cloth 10. The line contact may apply a greater pressure and is therefore more secure for hermetically sealing. In addition, the length of the contact line of the airbags 37 that are opposite to each other may preferably be greater than the width of the denim cloth 10 (referring to FIG. 5), whereby the denim cloth 10 may be hermetically sealed and surrounded by each pair of the airbags 37, thereby apparently improving the sealing effect. Of course, it is also considerable that the airbags 37 after inflation are in contact with the denim cloth 10 in a surface contact manner.

[0093] The surface of the airbag 37 is designed to be smooth, so that the denim cloth 10 can move through or slide between the airbags 37 that are opposite to each other, while the inerted gas in the dyeing box 11 and in the permeation box 12 cannot pass between the airbags 37, thereby effectively blocking the escape of the inerted gas.

[0094] In the embodiment shown in FIG. 4 and FIG. 5, three pairs of the airbags 37 in the inflated state along the moving direction of the denim cloth 10 are exemplarily shown, and the denim cloth 10 moves between each pair of the airbags 27 successively. Each of the airbags 37 is pressed laterally against one another. The airbags at the left and right sides are pressed against the side walls of the housing 38, respectively. The two ends of each of the airbags 37 are pressed against the side walls of the housing 38. Thus, a space as close as possible is formed among the three airbags 37 in the upper row, the three airbags 37 in the lower row, and the side walls of the housing 38.

[0095] However, since the two ends of the airbag 37 may not fully attach to the side walls of the housing 38 (referring to FIG. 5, that is, the abutment area is smaller than the cross-sectional area of the airbag 37), there will typically still be the inerted gas escaping out of the closed space in the housing 38 via gaps at the two ends of the airbag 37. Hence, the housing 38 of the sealing device 9 may also be provided with a return port 42 for the inerted gas, preferably above or below the housing 38. The return port 42 is defined through one side wall of the housing 38, so that the inerted gas can be returned again via the return port 42 to an inerted gas charging device through a pipeline not shown. This not only prevents the inerted gas from escaping from the cloth outlet to the environment but also enables the reuse of the inerted gas.

[0096] Referring to FIG. 1, according to an embodiment, the permeation device 8 may include an upper row and a lower row of guide rollers 43. The guide rollers 43 may be preferably rotatably arranged, for example, on the side wall of the permeation box 12 with their axial ends. Each row of the guide rollers 43 includes a plurality of the guide rollers 43 (there are nine guide rollers herein) arranged successively, and the axes of the guide rollers 43 may be in the same plane. The two rows of the guide rollers 43 may be staggered and spaced apart from each other, for example by approximately the distance of one guide roller 43. Thus, the denim cloth 10 entering the permeation box 12 may extend serpentinely in a plurality of denim sections 44 via the guide rollers 43. In this embodiment, the denim sections 44 in the permeation box 12 may be substantially longitudinally arranged via the permeation device 8. This longitudinal arranged layout may be suitable for woven fabrics. For example, the denim sections 44 extend in parallel and the movements of the adjacent denim sections 44 are in opposite directions. Of course, the adjacent denim sections 44 may also form a certain angle which should be as small as possible to maximize the number of the denim sections 44. Thus, it is possible to maximize the residence time of the denim cloth 10 in the permeation box 12, so that the dye sufficiently permeates from the surface of the denim cloth 10 to the inside thereof. The dye is, for example, an indigo dye and a sulfur dye applied to the denim cloth 10 via the dyeing portion sleeve device 7. This thus provides a sufficient time for the dye to be reduced to a leuco in an inerted gas atmosphere in order to better color the denim cloth 10. The cloth holding capacity of the permeation box 12 may be within the range of 20-80 meters.

[0097] Referring to FIG. 6, according to another embodiment, the permeation device 8 may include a left column and a right column of guide rollers 43. Reference may be made to the embodiment shown in FIG. 1 for other arrangement structures of the permeation device 8 of the embodiment shown in FIG. 6. In the embodiment shown in FIG. 6, the denim section 44 in the permeation box 12 may be substantially transversely arranged via the permeation device 8. This transverse arranged layout may be suitable for knitted fabrics.

[0098] The permeation box 12 may be further provided with an inerted gas concentration detecting device (not shown) therein, which may detect and control the concentration of the inerted gas inside the permeation box 12, so that the concentration of the inerted gas therein is always within a range most favorable for coloring the denim cloth 10.

[0099] Although the present invention is shown and described with reference to the specific exemplary embodiments, the present invention is not limited by these exemplary embodiments.

Claims

1. A transfer dyeing apparatus, comprising:

a dyeing box, filled with an inerted gas;
a dyeing portion sleeve device, arranged in the dyeing box and configured to dye a surface of a fabric with a dye;
a permeation box, arranged downstream of the

dyeing box in a moving direction of the fabric and filled with an inerted gas; and
a permeation device, arranged in the permeation box and configured to enable the dye on the surface of the fabric to permeate into the fabric, wherein the dyeing box and the permeation box are in communication with each other, the fabric sequentially passes through the dyeing box and the permeation box, and sealing devices are arranged at a fabric inlet of the dyeing box and a fabric outlet of the permeation box respectively, so that the dyeing box and the permeation box are hermetically sealed relative to an environment.

2. The transfer dyeing apparatus of claim 1, wherein the dyeing box is in communication with the permeation box via a channel allowing the passing of the inerted gas and the fabric.

3. The transfer dyeing apparatus of claim 1, wherein the dyeing box and the permeation box are integrally formed with each other.

4. The transfer dyeing apparatus of any one of claims 1 to 3, wherein the sealing device has a housing and an airbag pair in the housing, a side wall of the housing is provided with a cloth inlet and a cloth outlet allowing the passing of the fabric, and the airbag pair comprises two airbags that are opposite to each other and the fabric can pass between the two airbags.

5. The transfer dyeing apparatus of claim 4, wherein the number of the airbag pair is at least two, and each of the airbag pairs is successively arranged in the moving direction of the fabric.

6. The transfer dyeing apparatus of claim 4, wherein the two airbags of the airbag pair contact the fabric in a line-contact manner or a surface-contact manner.

7. The transfer dyeing apparatus of claim 4, wherein each of two ends of each of the airbags are provided with a fixing device, and the airbag is fixed on the side wall of the housing via the fixing devices.

8. The transfer dyeing apparatus of claim 4, wherein the sealing device has an inflation device provided for the airbags, the inflation device comprises an air pump and a pipeline system connected between the air pump and the airbags, and the air pump is capable of inflating air into each of the airbags via the pipeline system.

9. The transfer dyeing apparatus of claim 4, wherein each of the airbags is provided with an air pressure indicator, and it can be determined whether an air pressure in each of the airbags has reached a predetermined threshold via the air pressure indicator.

10. The transfer dyeing apparatus of claim 4, wherein the airbag has a uniform circular cross-section over a substantially entire length of the airbag after being filled with air.

11. The transfer dyeing apparatus of claim 4, wherein a length of the airbag is greater than a width of the fabric, so that the fabric can be hermetically sealed and surrounded by the airbags circumferentially.

12. The transfer dyeing apparatus of claim 4, wherein a surface of the airbag is configured to allow the fabric to be capable of sliding between the two airbags that are opposite to each other while the inerted gas cannot pass between the airbags.

13. The transfer dyeing apparatus of claim 4, wherein the airbag is pressed laterally against either the side wall of the housing or an adjacent airbag, so that a hermetically sealed space is substantially formed between the two airbags that are opposite to each other.

14. The transfer dyeing apparatus of claim 4, wherein the sealing device has a return port penetrating through the side wall of the housing, and the inerted gas entering the housing can be recycled via the return port.

15. The transfer dyeing apparatus of any one of claims 1 to 3, wherein the dyeing box and the permeation box are provided with a common inerted gas filling device capable of filling the dyeing box and the permeation box with the inerted gas via gas filling pipelines in parallel connection at the same time.

16. The transfer dyeing apparatus of any one of claims 1 to 3, wherein the permeation device comprises at least two rows of guide rollers, and each of the rows of the guide rollers is spaced apart from one another.

17. The transfer dyeing apparatus of claim 16, wherein each of the rows of the guide rollers comprises a plurality of the guide rollers arranged successively, and the guide rollers in different rows are staggered and spaced apart from each other.

18. The transfer dyeing apparatus of claim 16, wherein the fabric entering the permeation box extends serpentinely in a plurality of fabric sections via the guide rollers and substantially longitudinally.

19. The transfer dyeing apparatus of claim 18, wherein adjacent fabric sections extend in parallel and movements of the adjacent fabric sections are in opposite

directions.

20. The transfer dyeing apparatus of any one of claims 1 to 3, wherein the dyeing portion sleeve device has a direct dyeing group pair and a transfer dyeing group pair successively arranged in the moving direction of the fabric, the direct dyeing group pair has two direct dyeing groups which are arranged symmetrically relative to the fabric and comprise anilox rollers, and the transfer dyeing group pair has two transfer dyeing groups which are arranged symmetrically relative to the fabric and comprise plate rollers and transfer rollers.

21. The transfer dyeing apparatus of claim 20, wherein the number of the transfer dyeing group pair is at least two.

22. The transfer dyeing apparatus of claim 20, wherein one of the direct dyeing groups of the direct dyeing group pair is arranged on a mounting block, and the mounting block is capable of being moved on a guide rail of the dyeing box in a transverse linear guide manner so as to drive one of the direct dyeing groups to move toward or away from the other direct dyeing group.

23. The transfer dyeing apparatus of claim 20, wherein one of the transfer dyeing groups of the transfer dyeing group pair is arranged on a mounting block, and the mounting block is capable of being moved on a guide rail of the dyeing box in a transverse linear guide manner, so as to drive one of the transfer dyeing groups to move toward or away from the other transfer dyeing group.

24. The transfer dyeing apparatus of claim 20, wherein the transfer dyeing group comprises a pressing assembly configured to adjustably provide a pressure of the plate roller against the transfer roller, and the pressing assembly is capable of making the plate roller selectively move between an abutment position and a stop position; at the abutment position, the plate roller abuts against the transfer roller so as to generate the pressure of the plate roller against the transfer roller; at the stop position, the plate roller does not abut against the transfer roller.

25. The transfer dyeing apparatus of claim 20, wherein the transfer dyeing group comprises a plate changing device, and the plate roller can be changed via the plate changing device.

26. The transfer dyeing apparatus of claim 20, wherein the transfer dyeing group comprises a slant plate pulling device, and a position and an angle of the transfer roller can be finely adjusted via the slant plate pulling device.

27. The transfer dyeing apparatus of claim 20, wherein the transfer dyeing group comprises an axial plate pulling device provided for the plate roller so as to adjust an axial position of the plate roller.

28. The transfer dyeing apparatus of any one of claims 1 to 3, wherein the dyeing box is provided with a sliding door movable between a hermetically sealed closed position and an open position, where at the open position of the sliding door, the interior of the dyeing box is accessible from the exterior of the dyeing box.

29. The transfer dyeing apparatus of any one of claims 1 to 3, wherein the fabric is denim.

30. The transfer dyeing apparatus of any one of claims 1 to 3, wherein the inerted gas is nitrogen.

31. The transfer dyeing apparatus of any one of claims 1 to 3, wherein the permeation device comprises at least two columns of guide rollers, and each of the columns of the guide rollers is spaced apart from one another.

32. The transfer dyeing apparatus of claim 31, wherein each of the columns of the guide rollers comprises a plurality of guide rollers arranged successively, and the guide rollers in different columns are staggered and spaced apart from each other.

33. The transfer dyeing apparatus of claim 31, wherein the fabric entering the permeation box extends serpentinely in a plurality of fabric sections via the guide rollers and substantially transversely.

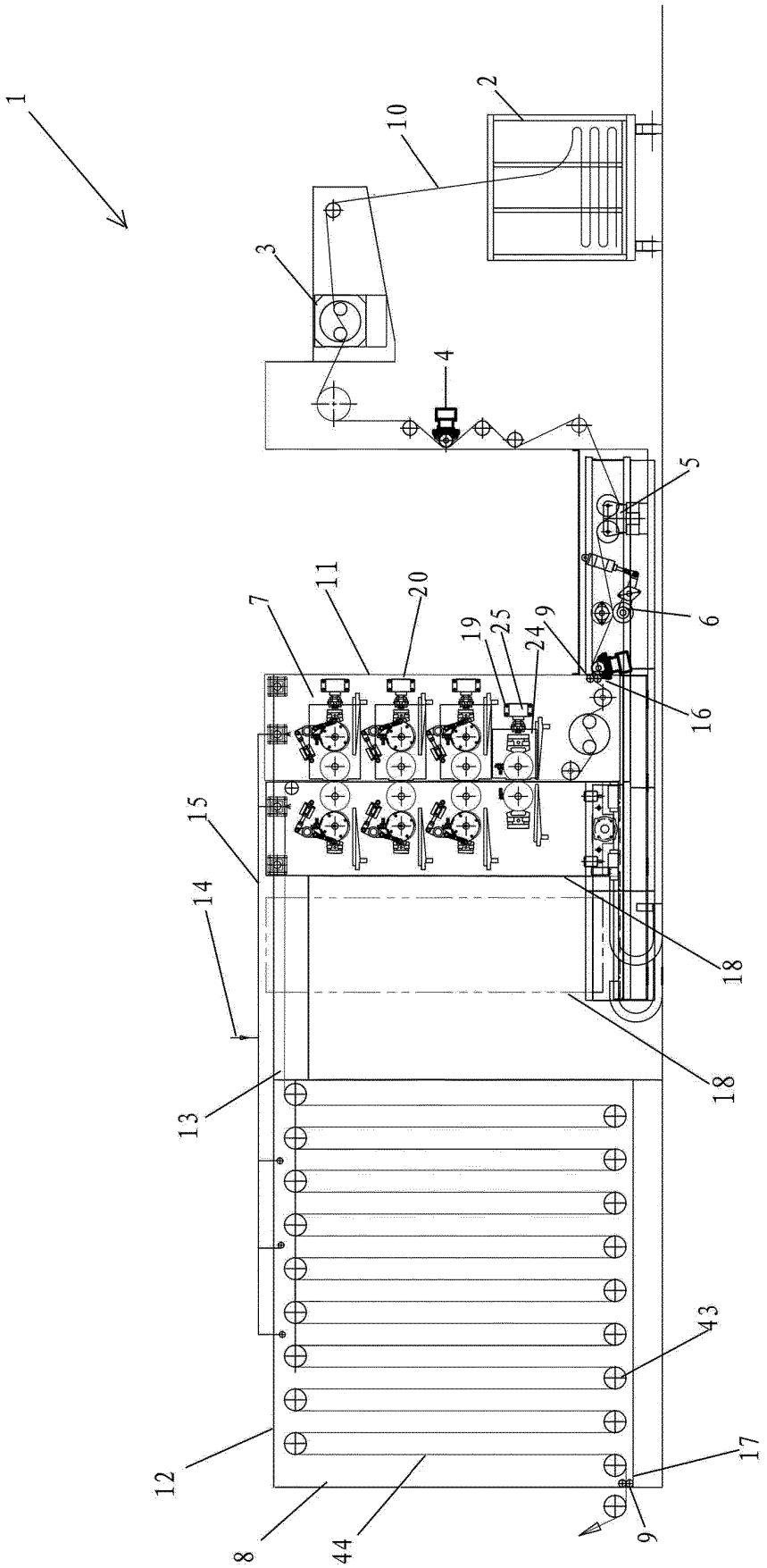

FIG. 1

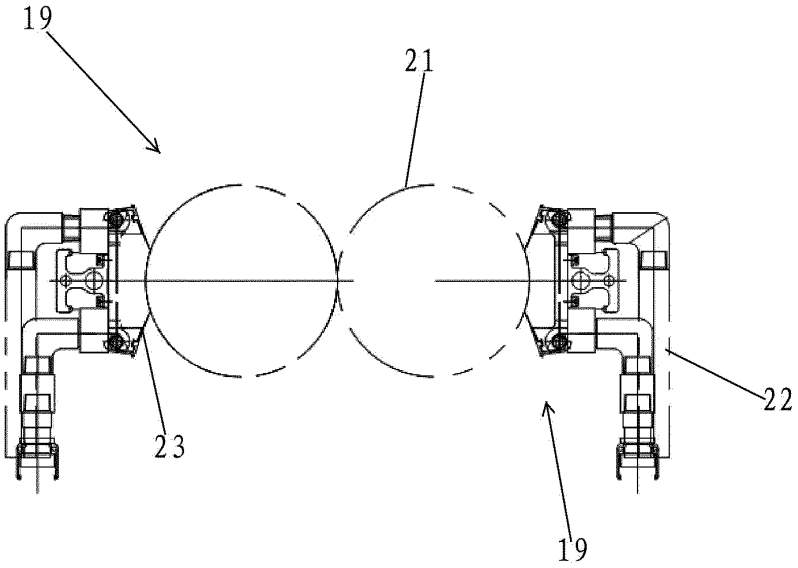
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FIG. 2

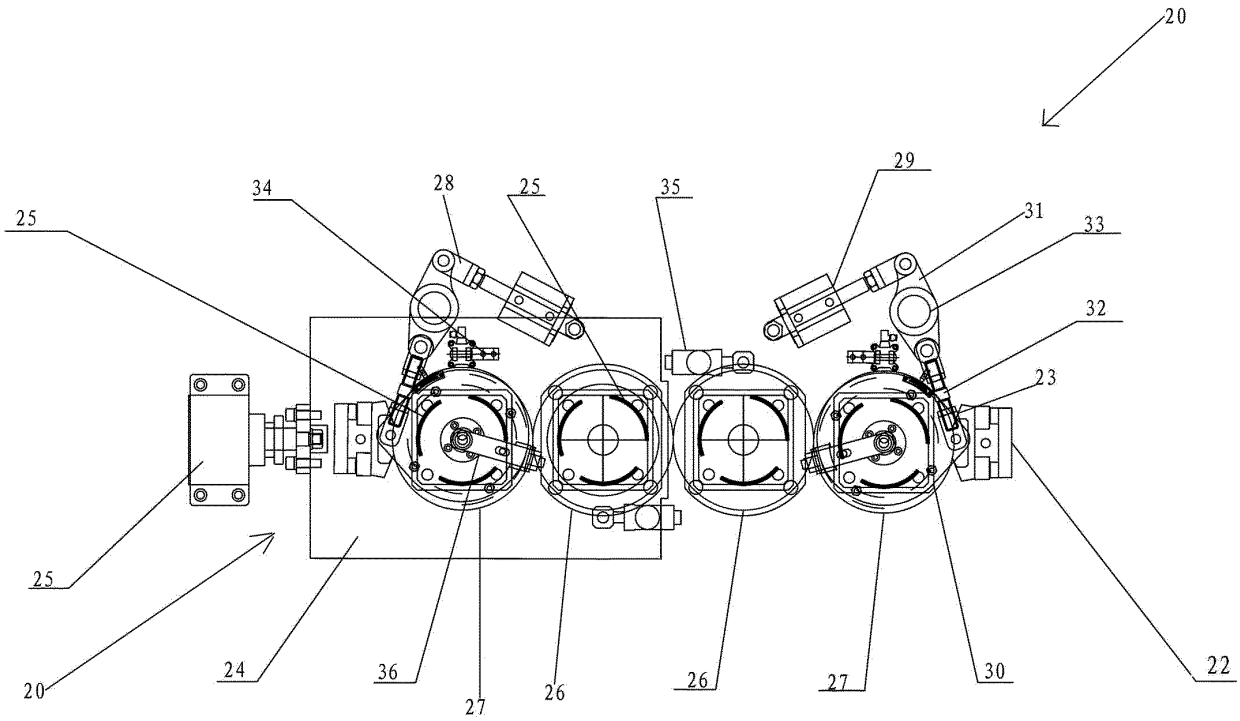
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FIG. 3

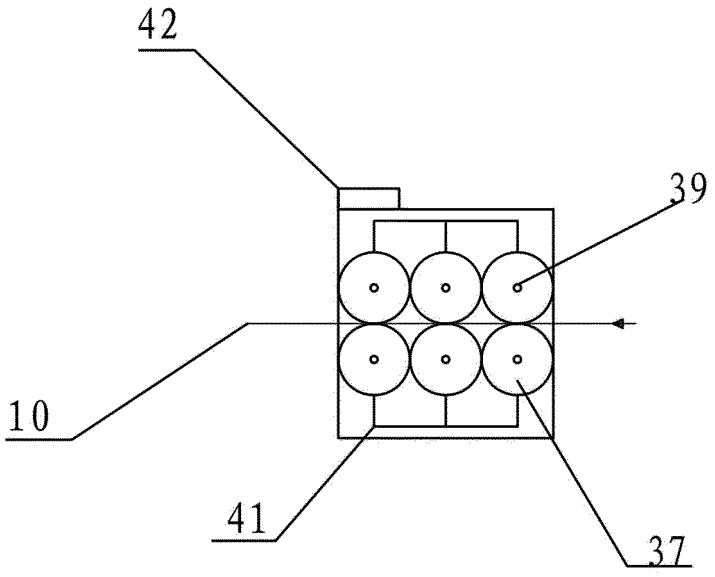

FIG. 4

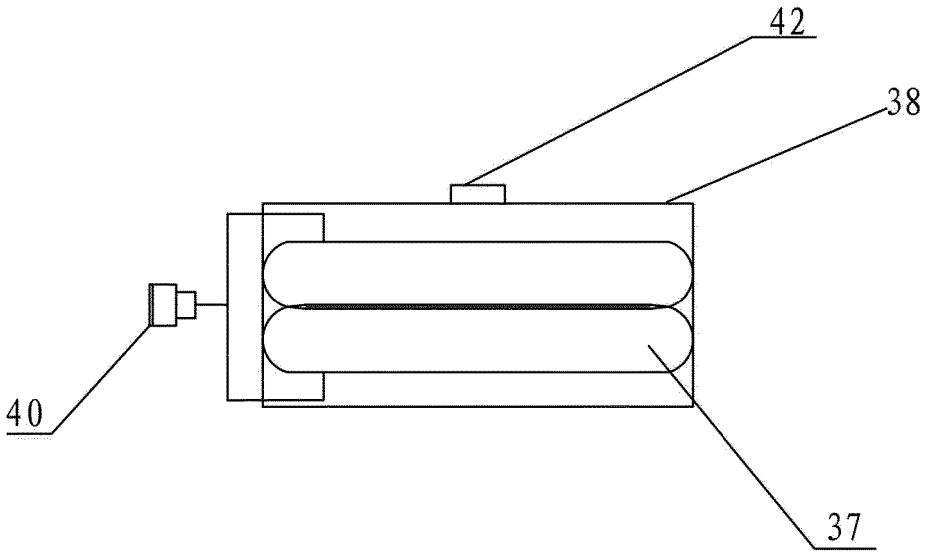

FIG. 5

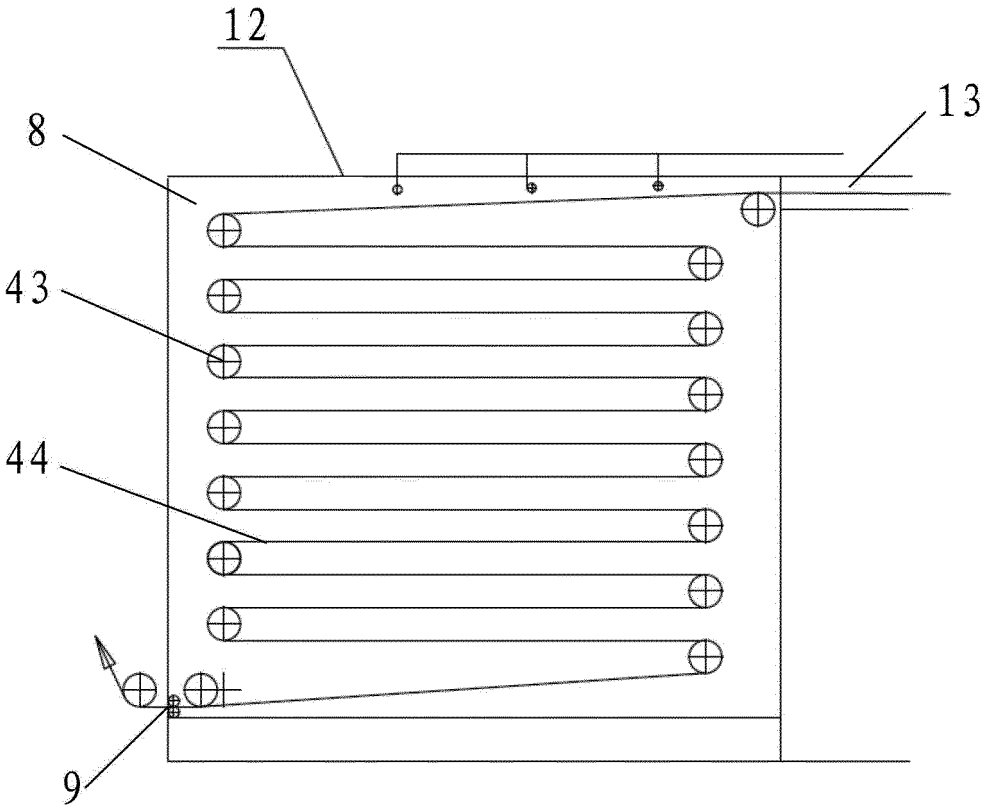

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/087649

A. CLASSIFICATION OF SUBJECT MATTER

D06B 1/14(2006.01)i; D06B 3/10(2006.01)i; D06B 23/20(2006.01)i; D06B 23/04(2006.01)i; D06B 1/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, VEN, CNTXT, CNKI, ISI WEB OF SCIENCE: 长胜纺织科技发展, 转移染色, 钟博文, 印染, 染色, 印花, 转印, 转移, 靛蓝染料, 硫化染料, 还原染料, 还原性染料, 牛仔布, 牛仔面料, 惰性气体, 惰性化气体, 氮气 , 稀有气体, 染色箱, 渗透箱, 渗透, 气囊, 密封, 密闭, 气密密封, DYE+, DENIM, JEAN, INERT W GAS+, NOBLE W GAS+, NITROGEN, GAS, AIR, GASBAG, BAG, FLOAT, CELL, SEAL, TIGHT, AIRTIGHT, HERMETIC, OBFURAGE, LEAD, CLOSED

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 112481865 A (NEWTECH TEXTILE TECHNOLOGY DEVELOPMENT (SHANGHAI) CO., LTD. et al.) 12 March 2021 (2021-03-12) claims 1-10, description paragraphs 0008-0040	1-33
X	CN 110036075 A (INDIGO MILL DESIGNS LLC) 19 July 2019 (2019-07-19) claims 11-21, description paragraphs 0036-0046, figures 1-2	1-3, 15-19, 28-33
X	CN 101389801 A (MASTER SRL) 18 March 2009 (2009-03-18) description page 6 paragraph 1 - description page 9 paragraph 9	1-3, 15-19, 28-33
A	CN 109196157 A (MASTER SRL) 11 January 2019 (2019-01-11) entire document	1-33
A	CN 206644421 U (XINXIANG JINGHONG PRINTING AND DYEING CO., LTD.) 17 November 2017 (2017-11-17) entire document	1-33
A	CN 101018902 A (MASTER S.A.S DI RONCHI FRANCESCO & C.) 15 August 2007 (2007-08-15) entire document	1-33

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 August 2021	**19 August 2021**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/087649

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	DE 4342313 A1 (SUCKER & FRANZ MUELLER GMBH) 14 June 1995 (1995-06-14) entire document	1-33

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/087649

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CN	112481865	A	12 March 2021	None			
CN	110036075	A	19 July 2019	EP	3510106	A4	26 August 2020
				US	10619292	B2	14 April 2020
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				WO	2007080134	A1	19 July 2007
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				IN	200803517	P4	13 March 2009
				BR	200706449	B1	05 September 2017
				BR	PI0706449	A2	29 March 2011
				IN	262085	B	01 August 2014
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