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(54) Specialty steamer for color development.

(57) A steamer for color development supplies saturated steam into a closed space for performing a steaming treatment on a substrate that has been subjected to a dyeing treatment and a treatment for imparting a fising agent. The steamer (2) has a row of substrate transport rolls (32) arranged in the upper part of the closed space. In order to detect the substrate, which droops between adjacent transport rolls and is transported by means of the respective transport rolls, the substrate detecting sensors (37), which consists of at least two units or which is of a continuous linear mechanism, are provided below the space between adjacent transport rolls in the direction of substrate drooping. If one of the sensors (37) located in the upper row is not capable of substrate detection, the rotational speed of the substrate transport roll (32) above that non-applicable sensor is decelerated; on the other hand, if any one of the sensors located in the lower row has detected the substrate (6), the rotational speed of the roll associated with that sensor is accelerated. The time for which the substrate (6) stays within the steamer can be controlled by ensuring that the drooping substrate will always be folded back between the upper and lower rows of sensors (37).

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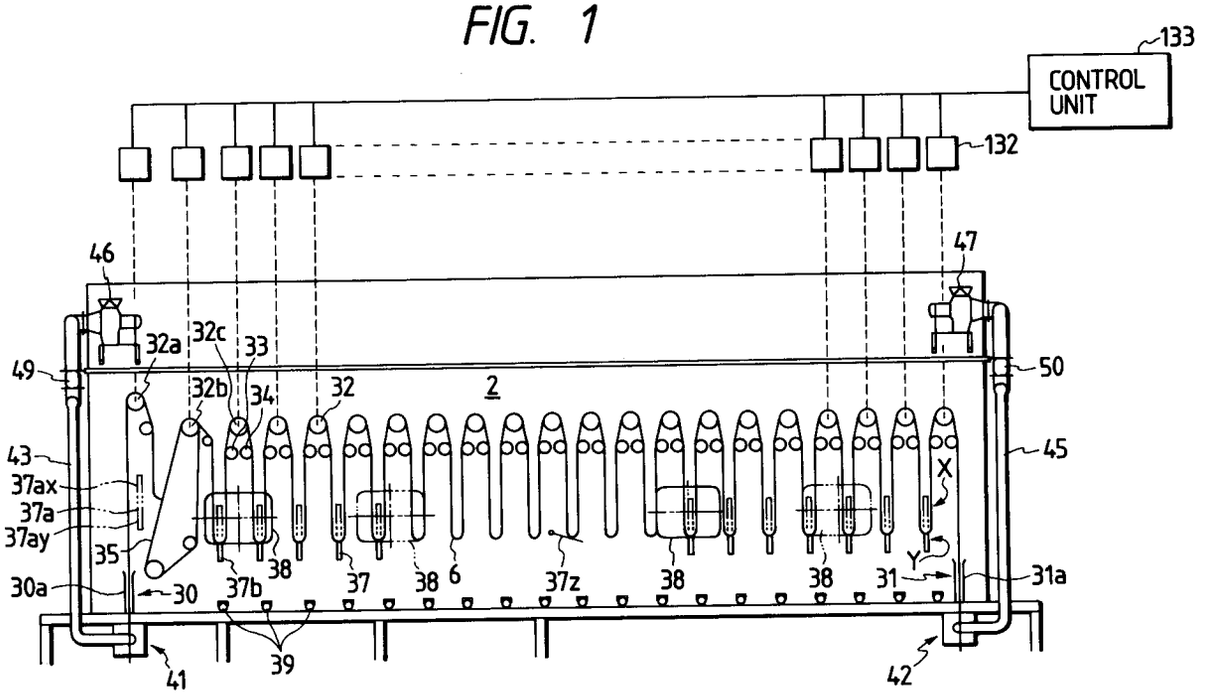
FIG. 1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CONTROL UNIT
132
46
47
49
50
45
43
37ax
37a
37ay
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30a
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32c
33
32b
34
32
2
37b
38
37
38
6
37z
38
38
31
31a
X
Y
41
39
42

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a specialty steamer for color develpment that is adapted for fixing dyes in fiber structures (which are hereafter sometimes referred to as "substrates").

2. Description of the Related Art

In a steamer for color development of dyed fabric materials which was printed only one side thereof and heat-treated to fix the dye in the fabric as in the printing, or a steamer for heat-treating woven fabric materials which requires to avoid the application of tension thereto, a transport apparatus as shown in Fig. 3 has been commonly incorporated in the steamer. The mechanism for blowing out saturated steam is omitted from Fig. 3. The apparatus shown in Fig. 3 has an endless chain 71 that is stretched between opposite ends of each of the rolls 70 arranged in a row. When the chain 71 is driven over a rail 72, a substrate 73, in which a dye is to be fixed as it is hung over the individual rolls 70 in operative association with the drive of the chain 71, is transported through the interior of the steamer.

In the substrate transport apparatus for a steamer shown in Fig. 3, the substrate 73, which is hung over the individual rolls 70, is not advanced by the rotation of the rolls 70 but is merely advanced by the rotation of the the chain 71 as it is hung over the rolls 70 revolving about themselves in the same position so as to keep a predetermined length of droop. Under the circumstances, two separate operations have been necessary: first, before being supplied into the steamer, the substrate 73 which is delivered continuously must be hung over the successive rolls 70 in such a way that the substrate will droop between adjacent rolls; secondly, the substrate 73 must remain drooping between rolls within the steamer and yet it must be wound up smoothly as it emerges from the steamer. These two operations are usually performed manually. Further, even if they can be automated, a very sophisticated control technology is needed.

SUMMARY OF THE INVENTION

An object, therefore, of the present invention is to provide a color development steamer that is suitable for dyeing one side of a substrate or for steaming knitted fabrics with which there is the need to avoid the application of tension to the substrate, and which steamer is capable of controlling the transport of the substrate by a simple automatic control system.

The object of the present invention can be accomplished in the following manner. A specialty steamer is provided, for color development, which supplies saturated steam into a closed space for performing a heat treatment on a substrate that has been subjected to a dyeing treatment and a treatment for imparting a fixing agent. The steamer comprises a substrate entrance that is provided at an end of the steamer, a substrate exit that is provided at the other end, and a row of spaced apart substrate transport rolls arranged in order from the substrate entrance to the substrate exit and in the upper portion of the closed space. A substrate detecting means is provided in a position below the space between adjacent substrate transport rolls in order to detect a portion of the substrate which droops between adjacent substrate transport rolls as the substrate is transported by the respective substrate transport rolls. Further, the steamer includes a means for controlling the rotational speeds of the substrate transport rolls in such a way that in response to a detection signal from a particular substrate detecting means, the rotational speed of a substrate transport roll associated with the particular detecting means is controlled.

The surface of each substrate transport roll is desirably subjected to an anti-slip treatment that will provide a higher friction coefficient. Examples of such an anti-slip treatment include providing a number of spikes over the entire surface of the rolls, as well as covering the rolls with a coating of plastics, metals or other materials having a high friction coefficient. These treatments insure that the substrate can be transported as it remains drooping between rolls without slipping down. In another desired embodiment, each substrate detecting means either consists of at least two units disposed vertically in the direction of substrate drooping or comprises a continuous linear signal detecting mechanism. If necessary, an auxiliary roll may be provided near each substrate transport roll in two positions, one being upstream of the corresponding roll and the other downstream thereof in the direction of substrate transport. The auxiliary roll located upstream is intended to guide the substrate to be carried by the proper transport roll, whereas the auxiliary roll located downstream serves to prevent the substrate from winding itself around the transport rolls.

The specialty steamer for color development according to the present invention is optimal for use either as a steamer used for a printing in which only one side of the fiber structures (substrates) using dye solutions composed of reactive dyes or vat dyes is dyed, or as a steamer of knitted fabrics and other substrates with which there is the need to avoid the application of tension to the substrates.

The term "fiber structures" as used herein means natural vegetable fibers such as cellulose fibers, natural animal fibers such as wool, synthetic fibers, as well as blends and unions of these fibers.

According to the present invention, the substrate supplied into the steamer through the entrance is transported, as it is hung over a plurality of transport rolls, in such a way that a steaming treatment is carried out during the substrate transport. The rotational speed of each substrate transport roll is controlled by the associated substrate detecting means and rotational speed control means, and this enables management of the steaming period.

Each substrate detecting means may consist of at least two units arranged vertically in the direction of substrate drooping or, alternatively, the substrate detecting means may comprise a continuous linear mechanism. If one of the substrate detecting means located in the upper row is not capable of substrate detection, the rotational speed of the substrate transport roll associated with that nonapplicable sensor is accelerated; on the other hand, if any one of the substrate detecting means located in the lower row detects the substrate, the rotational speed of the substrate transport roll associated with that sensor is decelerated. In this way, it can be insured that the drooping substrate will always be folded back between the upper and lower rows of substrate detecting means, whereby one can control the time during which the substrate stays within the steamer.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows diagrammatically a steamer according to an example of the present invention;

Fig. 2 is a flow chart for describing control over the transport of a substrate in the steamer shown in Fig. 1; and

Fig. 3 is a diagram showing the substrate transport mechanism used in a conventional loop steamer.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An example of the present invention is described below with reference to the accompanying drawings.

First, the specialty steamer for color development which is to be used in the example under consideration is described with reference to Fig. 1.

The steamer 2 has an entrance 30 for the substrate 6 provided in the bottom at one end; it also has an exit 31 for the substrate provided at the other end in the bottom thereof. A row of substrate transport rolls 32 are arranged in the upper part of the steaming space between the substrate entrance 30 and exit 31. The first substrate transport roll 32a, which is the closest to the entrance 30, ensures that the substrate 6, emerging from the device capable of imparting the fixing solution by contact, is properly guided into the steamer 2. The transport rolls 32 are driven in such a controlled manner (for details, see below) that the substrate 6 is transported toward the exit 31 as it is hung over the sequence of transport rolls 32. Therefore, as shown in Fig. 1, the substrate 6 is transported in a serpentine path (it droops between adjacent transport rolls 32) and as the substrate 6 is transported in this way, it is heated sufficiently to achieve satisfactory dye fixation.

The means of transporting the substrate within the steamer 2 in the embodiment under consideration is optimal for the method of dyeing only one side of the substrate, as in printing. In this case, only the side of the substrate that does not come in contact with the rolls 32 is printed, thus permitting the substrate to be dyed to produce a good finish without being stained by the rolls 32. Needless to say, the transport means is also applicable to dyeing both sides of the substrate as in exhaustion dyeing.

In order to insure that the substrate 6 will be transported in a serpentine path as it droops between adjacent rolls 32, the surface of each roll 32 is subjected to an anti-slip treatment that will provide a higher friction coefficient. Examples of such an anti-slip treatment include providing a number of spikes over the entire surface of the rolls 32, as well as covering the rolls with a coating of plastics, metals or other materials having a high friction coefficient.

All transport rolls 32 except the first roll 32a and the subsequent second roll 32b are provided with auxiliary rolls 33 that are located near the rolls 32 in a position upstream of the rolls 32 in a direction of substrate transport to insure that the drooping substrate during transport is folded back and positively transferred to the next roll 32. On the other hand, all transport rolls 32, including the first and second rolls, are provided with auxiliary rolls 34 that are located near the rolls 32 in a position downstream of the rolls 32 in the direction of substrate transport to insure that the substrate 6 does not wind itself around the rolls 32 having a high friction coefficient.

An endless belt 35 runs over the second transport roll 32 in such a way as to form a transport path that is inclined toward the first transport roll 32a. At least two units 37ax and 37ay of a first sensor 37a for substrate detection are provided vertically in a position that is below the first transport roll 32a and which face the endless belt 35. Two units 37x and 37y of a substrate detecting

sensor 37 are also provided vertically for the second and subsequent transport rolls 32 in a position that is below the space between adjacent rolls.

The sensors 37 may be of any type that is capable of detecting the substrate 6, as exemplified by photosensors, touch sensors, etc. In the present embodiment, sensors 37a and 37b are photosensors and sensor 37z is a touch sensor.

A plurality of openable inspection doors 38 are provided, as required, in the side wall of the steamer 2.

The steamer 2 is supplied with steam that is blown in through a plurality of inlets 39 that are provided uniformly along the entire length of the bottom of the steamer 2 in such a way that they are arranged in the direction of substrate transport. Pressure-controlled steam from a boiler (not shown) is blown into the steamer 2. Steam deflecting covers (not shown) are provided above the steam inlets 39 to insure that the steam gushing out of the inlets will not make direct contact with the substrate.

Drain baffle walls 30a and 31a are provided within the steamer 2 around the entrance 30 and exit 31, respectively, to insure that steam condensate will not leak out of the steamer 2 through the entrance 30 and the exit 31. Steam chambers 41 and 42 are provided on the side of the exterior wall of the steamer 2 away from the drain baffle walls 30a and 31a, respectively; the steam discharged through the entrance 30 and exit 31 will stay temporarily in the chambers 41 and 42 and then passes through riser pipes 43 and 45 that run on the outer surface of the side walls of the steamer 2 before it is eventually discharged to ambient through exhaust fans 46 and 47. Dampers 49 and 50 are provided approximately halfway along the pipes 43 and 45, respectively, and by adjusting the degree of their opening, the quantity of steam present in the steamer 2 can be controlled. The quantity of steam in the steamer 2 is detected with a pressure sensor (not shown) and a signal for the detected value is transmitted to damper controls (not shown).

Next, the method of controlling the substrate 6 so that it can be transported in a serpentine path through the steamer 2 is described. First, the leading edge of the substrate 6 to be dyed is connected by sewing to a guide cloth that is preliminarily stretched over all rolls 32 in the steamer 2. Then, the substrate 6, as it is guided by the cloth, is fed into the steamer 2 through the entrance 30. When the interior of the steamer 2 is fully saturated with steam, the individual transport rolls 32 start to be driven. If the leading edge of the substrate 6 is detected by the first sensor 37a, the endless belt 35 on the second roll 32b through a variable speed driving motor member 132 starts to be driven, causing the substrate 6 to be transported with its leading edge folded back toward the transport roll 32b. If the second sensor 37b between the second transport roll 32b and the third transport roll 32c detects the drooping of the substrate, the third transport roll 32c will start to rotate. In this way, transport rolls positioned downstream of the direction of substrate transport start to rotate successively and the substrate will be transported as it droops between adjacent transport rolls 32.

The printed fabric entering the steamer 2 may have already gained a moisture content. However, on account of the printing paste, the fabric is hard and lacks suppleness. Hence, the fabric might swing in the direction of transport when it bends. The endless belt 35 is provided in order to prevent the occurrence of such a swing.

The sensors 37 provided between the second transport roll 32b and subsequent rolls 32 are capable of controlling the rotating speeds of the associated rolls 32 through the variable speed driving motor member 132 to insure that the folded portions of the substrate 6 will always be positioned within the range that can be detected by the upper and lower rows of sensors. Stated more specifically, if any one of the sensor units 37x in the upper row x is activated, the rotational speed of roll 32 located downstream of that sensor 37 is decelerated; on the other hand, if any one of the sensor units 37y in the lower row y is activated, the same rotational speed of roll 32 located downstream of the sensor 37 is accelerated. Thus, the rotation of rolls 32 through the driving motor 132 is controlled in such a way that the loop of the substrate is positioned at all times in the middle of the distance between the two units 37x and 37y of sensor 37 in the upper and lower rows x and y, respectively.

With the droop width of the substrate 6 being controlled in the manner described above, the time for which the substrate 6 stays within the steamer 2 can be adjusted to an optimal value in accordance with the material of the substrate, the mode of its weaving, its thickness and the method of dyeing the substrate 6. It should be noted here that the transport of the substrate 6 in a serpentine path is controlled by the associated control 133.

A flow chart for controlling the drive of the transport roll as well as the above-described control over the transport of the substrate in a serpentine path is shown in Fig. 2.

According to the present invention, a heat treatment for fixing dye that has been adsorbed on only one side of a substrate as in printing or a heat treatment subsequent to the dyeing of fiber structures such as knitted fabrics with which there is the need to avoid the application of tension to the substrate can be performed without causing any adverse effects on the finish of the dyeings.

Although the present invention has been fully described by way of the preferred embodiments thereof with reference to the accompanying drawings, various changes and modifications will be apparent to those having skill in this field. Therefore, unless these changes and modifications otherwise depart from the scope of the present invention, they should be construed as included therein.

Claims

1. In a specialty steamer for color development that supplies saturated steam into a closed space for performing a heat treatment on a substrate that has been subjected to a dyeing treatment and a treatment for imparting a fixing agent, the steamer having opposite ends and the closed space including an upper portion and a lower portion, said specialty steamer comprising: a substrate entrance provided at one end of said steamer; a substrate exit provided at the other end of said steamer; a row of spaced apart substrate transport rolls arranged in order from said substrate entrance to said substrate exit and in the upper portion of the closed space; a substrate detecting means provided in a position below the space between adjacent substrate transport rolls in order to detect a portion of the substrate which droops between adjacent substrate transport rolls as the substrate is transported by the respective substrate transport rolls; and a means for controlling the rotational speeds of the substrate transport rolls in such a way that in response to a detection signal from a particular substrate detecting means, the rotational speed of a substrate transport roll associated with said particular detecting means is controlled.

2. The specialty steamer according to claim 1, wherein each substrate transport roll includes a surface which contacts the substrate, said surface being subjected to an anti-slip treatment thereby to provide a higher friction coefficient than with an untreated surface.

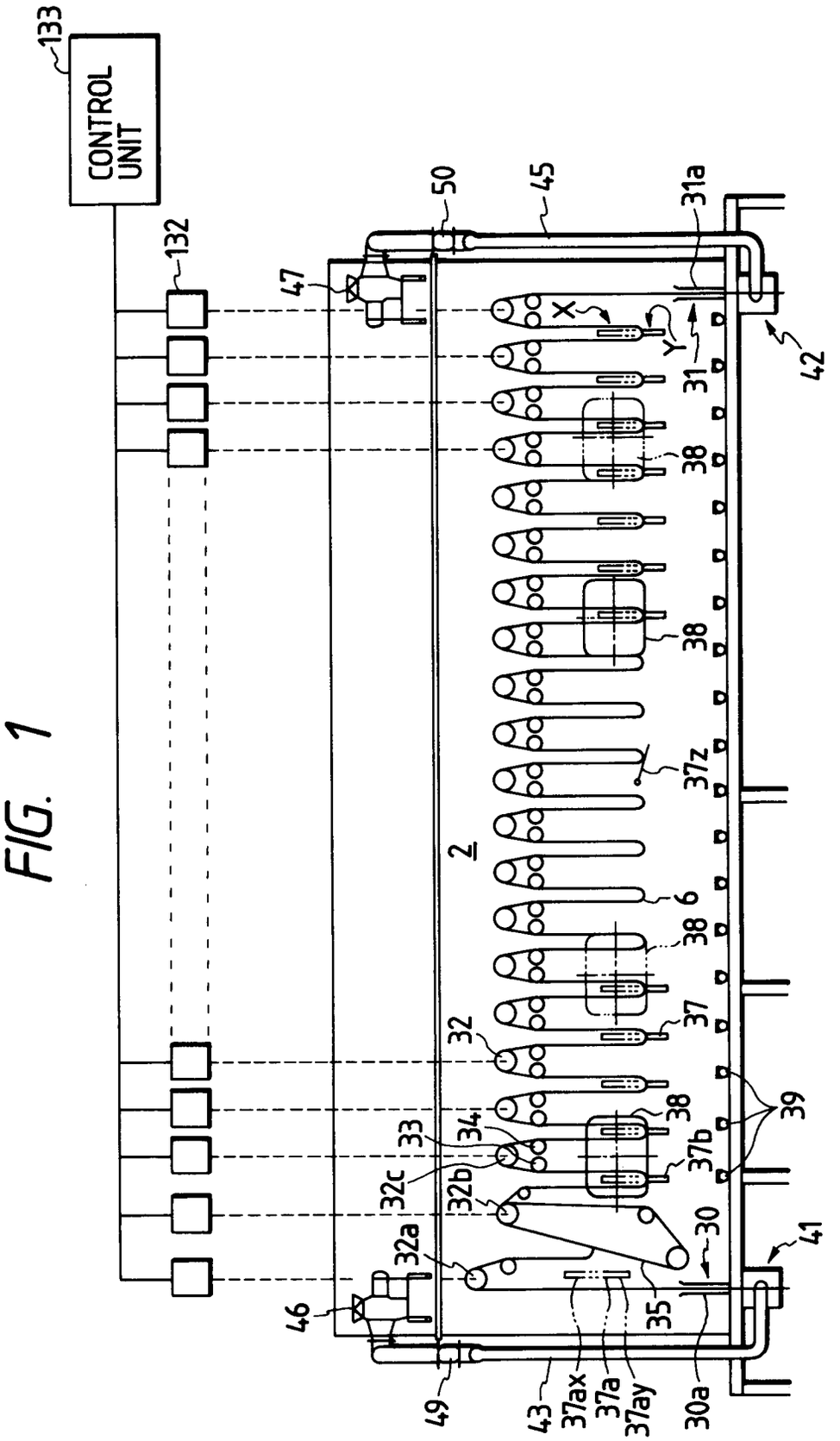
3. The specialty steamer according to claim 1, wherein each substrate detecting means comprises at least two units disposed vertically in a direction of substrate drooping.

4. The specialty steamer according to claim 1, wherein each substrate detecting means comprises a continuous linear signal detecting mechanism.

5. The specialty steamer according to claim 1, further comprising an auxiliary roll provided near each substrate transport roll in two positions, one position being upstream of a corresponding substrate transport roll and the other position downstream thereof in a direction of substrate transport.

6. The specialty steamer according to claim 1, wherein said steamer supplies steam for a steaming treatment that is performed in dyeing fiber structures using dye solutions comprising one of reactive dyes and vat dyes.

FIG. 1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132
47
50
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31a
X
Y
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37z
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32
38
39
33
34
37b
32c
32b
30
41
32a
35
46
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43
37ax
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37ay
30a

FIG. 2

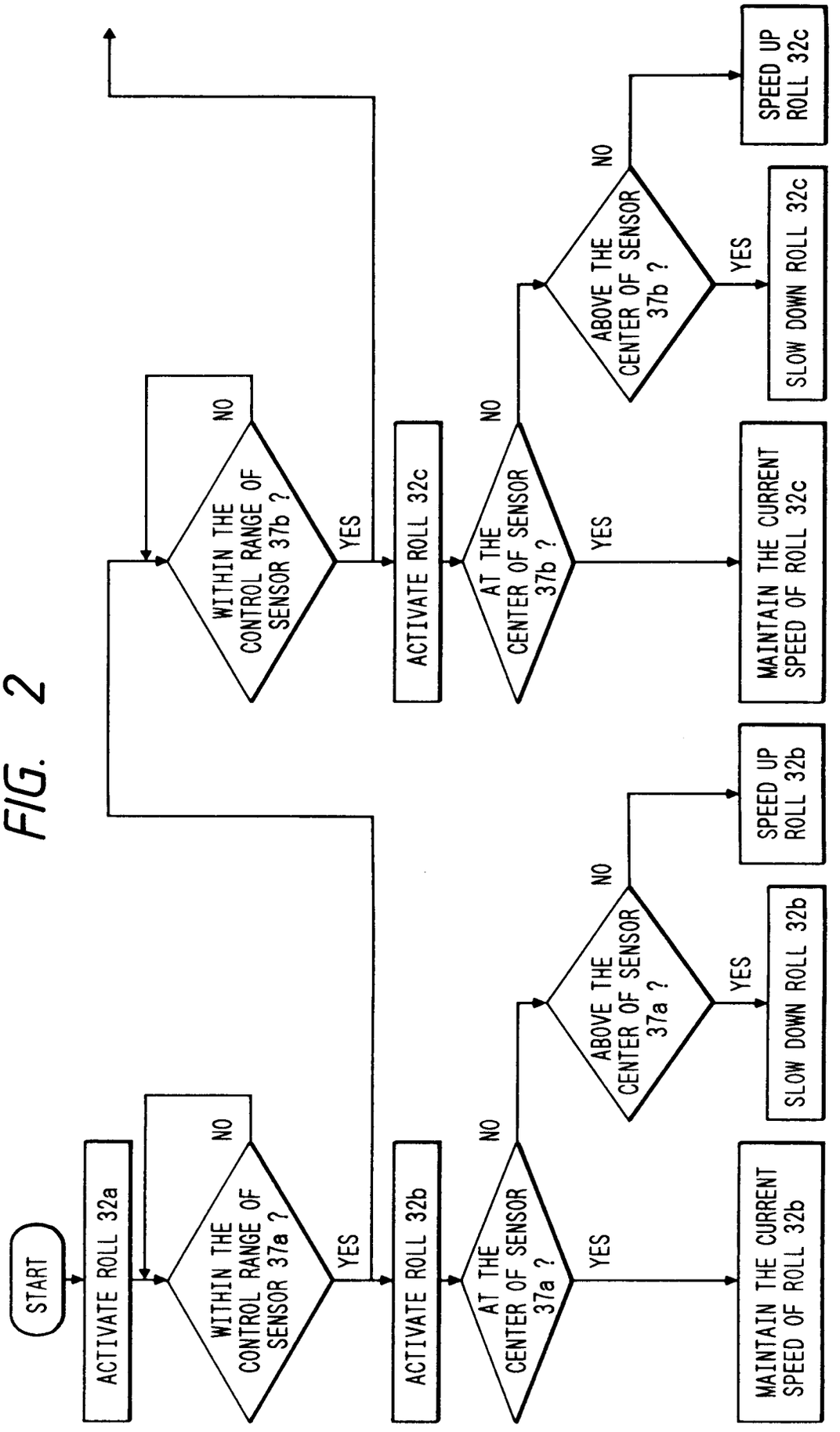
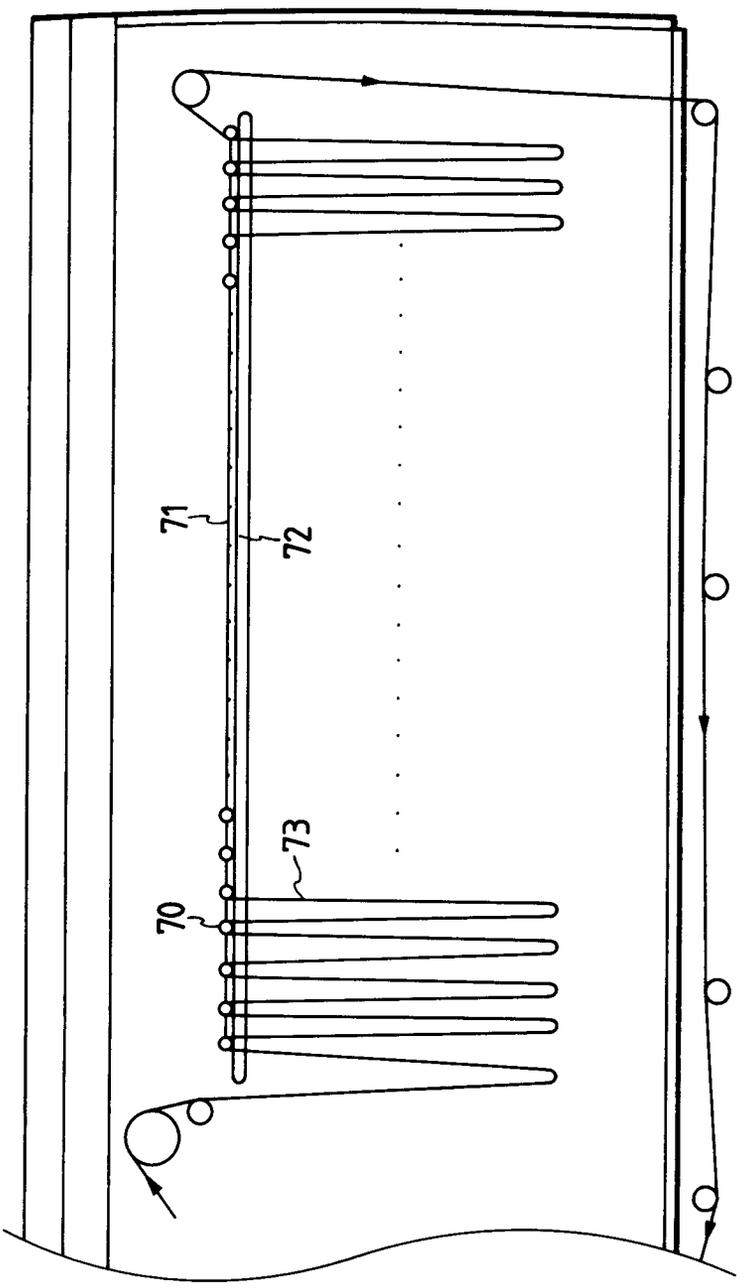

START
ACTIVATE ROLL 32a
WITHIN THE CONTROL RANGE OF SENSOR 37a ?
NO
YES
ACTIVATE ROLL 32b
AT THE CENTER OF SENSOR 37a ?
NO
YES
ABOVE THE CENTER OF SENSOR 37a ?
NO
YES
SPEED UP ROLL 32b
SLOW DOWN ROLL 32b
MAINTAIN THE CURRENT SPEED OF ROLL 32b
WITHIN THE CONTROL RANGE OF SENSOR 37b ?
NO
YES
ACTIVATE ROLL 32c
AT THE CENTER OF SENSOR 37b ?
NO
YES
ABOVE THE CENTER OF SENSOR 37b ?
NO
YES
SPEED UP ROLL 32c
SLOW DOWN ROLL 32c
MAINTAIN THE CURRENT SPEED OF ROLL 32c

FIG. 3



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EUROPEAN SEARCH REPORT

Application Number

EP 93 10 9055

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	US-A-3 492 838 (REINERS ET AL) * column 2, line 40 - column 3, line 23; figures 1-3 *	1-3	D06B17/06
A	US-A-3 805 560 (FLEISSNER) * column 3, line 4 - line 11; figures 1-5 *	1,5	
A	FR-A-2 472 045 (BABCOCK TEXTILMASCHINEN KG (GMBH & CO.))		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D06B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 SEPTEMBER 1993	VAN GELDER P.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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