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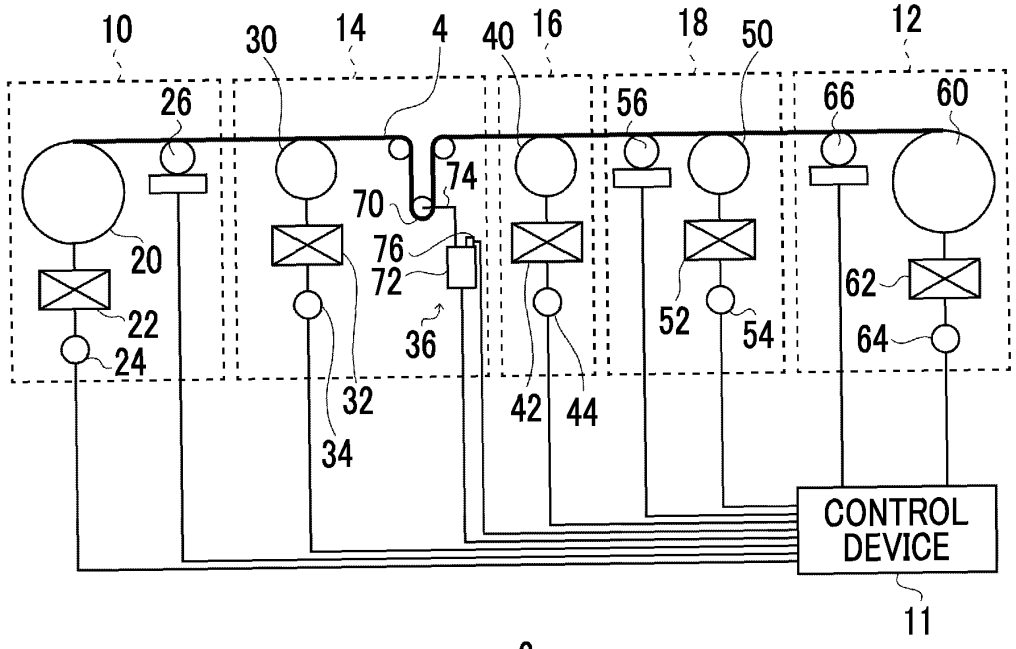
(54) DANCER CALIBRATION AND CONTROL DEVICE

(57) A technology to reduce a load of a calibration work of a dancer mechanism (36) is provided. A control device (11) is a control device of a roll-to-roll transfer system including a dancer roller (70) that applies tension to a web (4), and a sensor (76) that detects a position of the dancer roller (70). The control device (11) includes a display control unit (102) that displays, on a predetermined display unit, a screen including a first button for storing a detection value of the sensor (76) as a first detection value indicating that the dancer roller (70) is at a first position, and a second button for storing a detection value of the sensor (76) as a second detection value indicating that the dancer roller (70) is at a second position; and a dancer position identifying unit (108) that identifies a position of the dancer roller (70) indicated by the detection value of the sensor (76) using the first detection value and the second detection value.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a control device of a roll-to-roll transfer system.

Description of Related Art

[0002] In a roll-to-roll transfer system, a long object (web) such as paper, film, or metal foil is unwound from a roll and is moved through a roller, and various kinds of processing are performed on the web on a movement path thereof. In general, the web is transferred in a state where tension set as a production condition is applied to the web such that the web does not sag on the movement path and processing is easily performed. In order to achieve this, a web processing system includes a dancer mechanism or a tension detector, and performs control to maintain the set tension of the web (for example, Japanese Unexamined Patent Publication No. 2013-173598).

SUMMARY OF THE INVENTION

[0003] In order to use the dancer mechanism, calibration is required in advance . It is best to reduce the load of a calibration work.

[0004] The invention is made in view of such circumstances, and one of the exemplary purposes of an aspect thereof is to provide a technology that can reduce the load of a calibration work of a dancer mechanism.

[0005] In order to solve the above-described problem, a control device according to an aspect of the invention is a control device of a roll-to-roll transfer system including a dancer roller that applies tension to a web, and a sensor that detects a position of the dancer roller, and the control device includes a display control unit that displays, on a predetermined display unit, a screen including a first button for storing a detection value of the sensor as a first detection value indicating that the dancer roller is at a first position, and a second button for storing a detection value of the sensor as a second detection value indicating that the dancer roller is at a second position; and a dancer position identifying unit that identifies a position of the dancer roller indicated by the detection value of the sensor using the first detection value and the second detection value.

[0006] Another aspect of the invention is also a control device. This device is a control device of a roll-to-roll transfer system including a dancer roller that applies tension to a web, and an actuator that applies thrust to the dancer roller, and the control device includes a display control unit that displays, on a predetermined display unit, a screen including a first button for storing a manipulated variable applied to the actuator as a first manipulated variable for applying first thrust to the dancer roller, and a second button for storing a manipulated variable applied to the actuator as a second manipulated variable for applying second thrust to the dancer roller; and a manipulated variable identifying unit that identifies a manipulated variable for the actuator to apply desired thrust to the dancer roller using the first manipulated variable and the second manipulated variable.

[0007] Note that any combination of the above-described components, and those in which the components and expressions of the present invention are mutually replaced between methods, devices, systems, and the like are also effective as an aspect of the invention.

[0008] According to the invention, it is possible to reduce the load of a calibration work of a dancer mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a schematic view illustrating a configuration of a roll-to-roll transfer system according to an embodiment.

Fig. 2 is a block diagram illustrating a functional configuration of a control device of Fig. 1.

Fig. 3 is a diagram illustrating a sensor calibration screen displayed by a display control unit of Fig. 2.

Fig. 4 is a diagram illustrating an actuator calibration screen displayed by the display control unit of Fig. 2.

DETAILED DESCRIPTION OF THE INVENTION

[0010] Hereinafter, the present invention will be described based on preferred embodiments with reference to the drawings. The same or equivalent components, members, and processes illustrated in the drawings are denoted by the same reference numerals, and repeated description will be appropriately omitted. The embodiments do not limit the invention, and are merely examples, not all features and combinations thereof described in the embodiments are necessarily essential to the invention.

[0011] Fig. 1 is a schematic view illustrating a configuration of a roll-to-roll transfer system (hereinafter, simply referred to as a transfer system) 2 according to an embodiment. The transfer system 2 includes an unwinding unit 10 that unwinds a web 4, a first feed unit 14, a second feed unit 16, and a third feed unit 18 which transfer the unwound web 4, a winding unit 12 that winds the web 4, and a control device 11 that control these units.

[0012] The web 4 is a band-shaped or sheet-shaped base material such as paper or film, and is continuously present along the movement path. A predetermined process is performed on the web 4 on the movement path. The predetermined process may be a processing process such as printing processing, stretching processing, molding processing, coating processing, laminating

processing, or slit processing, or may be a process of winding the web 4 from a large unwinding roll to a plurality of small winding rolls. The web 4 is transferred in a state where tension set as a production condition is applied to the web 4 such that the web 4 does not sag on the movement path and processing is easily performed.

[0013] The unwinding unit 10 includes an unwinding roll 20, a gear 22, a motor 24, and a tension detector 26. The motor 24 rotates the unwinding roll 20 via the gear 22. The unwinding roll 20 gives a speed according to a rotating speed and a diameter of the unwinding roll 20, to the web 4 to be unwound from the unwinding roll 20.

[0014] The tension detector 26 is configured to detect the tension of the web 4 unwound from the unwinding roll 20, that is, the tension of the web 4 between the unwinding roll 20 and a feed roller 30 (described later) . The control device 11 controls the speed of the motor 24, and thus a speed difference between the motor 24 and a motor 34 (described later) so that the tension of the web 4 between the unwinding roll 20 and the feed roller 30 is maintained at a predetermined target value.

[0015] The first feed unit 14 includes the feed roller 30, a gear 32, the motor 34, and a dancer mechanism 36. The motor 34 rotates the feed roller 30 via the gear 32. The feed roller 30 gives a speed according to the rotating speed and the diameter thereof, to the web 4.

[0016] The dancer mechanism 36 is provided on a downstream side of the feed roller 30, in the movement path of the web 4. The dancer mechanism 36 includes a dancer roller 70, an actuator 72, and a sensor 76. The dancer roller 70 is not particularly limited, but is supported to be movable in an up-down direction in this embodiment. The actuator 72 applies thrust to the dancer roller 70. The actuator 72 in this embodiment has a rod 74 connected to the dancer roller 70, and applies thrust to the dancer roller 70 via the rod 74. The dancer roller 70 that has received thrust presses the web 4. Thereby, the tension is applied to the web 4. The control device 11 controls the actuator 72 so that the tension of the web 4 between the feed roller 30 and a feed roller 40 is maintained at a predetermined target value.

[0017] The sensor 76 detects the position of the dancer roller 70. The sensor 76 in this embodiment detects the position of the dancer roller 70 by detecting the position of the rod 74. The sensor 76 outputs a detection value indicating the position of the dancer roller 70 to the control device 11 at a predetermined cycle.

[0018] The second feed unit 16 includes the feed roller 40, a gear 42, and a motor 44. The motor 44 rotates the feed roller 40 via the gear 42. The feed roller 40 gives a speed according to the rotating speed and the diameter thereof, to the web 4. In this example, the second feed unit 16 is a speed reference unit. Accordingly, the control device 11 rotates the motor 44 and thus the feed roller 40 at a constant reference speed.

[0019] The third feed unit 18 includes a feed roller 50, a gear 52, a motor 54, and a tension detector 56. The motor 54 rotates the feed roller 50 via the gear 52. The feed roller 50 gives a speed according to the rotating speed and the diameter thereof, to the web 4. The tension detector 56 is configured to detect the tension of the web 4 between the feed roller 40 and the feed roller 50. The control device 11 controls the speed of the motor 54, and thus a speed difference between the motor 54 and the motor 44 so that the tension of the web 4 between the feed roller 40 and the feed roller 50 is maintained at a predetermined target value.

[0020] The winding unit 12 includes a winding roll 60, a gear 62, a motor 64, and a tension detector 66. The tension detector 66 is configured to detect the tension of the web 4 between the feed roller 50 and the winding roll 60. The motor 64 rotates the winding roll 60 via the gear 62. The winding roll 60 winds up the web 4. The control device 11 controls the speed of the motor 64, and thus a speed difference between the motor 64 and the motor 54 so that the tension of the web 4 between the feed roller 50 and the winding roll 60 is maintained at a predetermined target value.

[0021] Fig. 2 is a block diagram illustrating a functional configuration of the control device 11. Each block illustrated herein can be realized by an element such as a CPU of a computer or a machine device in terms of hardware, and is realized by a computer program or the like in terms of software, but here, the functional blocks realized by cooperation thereof are drawn. Accordingly, it is understood by those skilled in the art that the functional blocks can be realized in various forms by combining hardware and software.

[0022] The control device 11 includes a display control unit 102, a calibration support unit 104, a unit control unit 106, a dancer position identifying unit 108, a manipulated variable identifying unit 110, and a storage unit 112. The storage unit 112 stores data which is referred to and updated by each unit. The display control unit 102 displays various screens on a predetermined displayunit. The display control unit 102 displays, for example, a sensor calibration screen or an actuator calibration screen which will be described later.

[0023] The calibration support unit 104 supports calibration of the sensor 76 and the actuator 72. The dancer position identifying unit 108 identifies the position of the dancer roller 70 at a predetermined cycle on the basis of the detection value from the sensor 76. The manipulated variable identifying unit 110 identifies the manipulated variable for the actuator 72 to apply desired thrust to the dancer roller 70. The details of the calibration support unit 104, the dancer position identifying unit 108, and the manipulated variable identifying unit 110 will be described later.

[0024] The unit control unit 106 controls the unwinding unit 10, the winding unit 12, the first feed unit 14, the second feed unit 16, and the third feed unit 18. Specifically, the unit control unit 106 controls the motors 24, 34, 44, 54, and 64 of the units and the dancer mechanism 36 so that the tension of the web 4 is maintained at a predetermined target value. In particular, the unit control

unit 106 controls the actuator 72 by using the position of the dancer roller 70 identified by the dancer position identifying unit 108 and the manipulated variable identified by the manipulated variable identifying unit 110.

[0025] Fig. 3 is a diagram illustrating a dancer position calibration screen that is displayed on a predetermined display unit by the display control unit 102. In a detection value display field 126, the latest detection value (voltage value in this example) from the sensor 76 is displayed.

[0026] A user clicks a first set button 120 in a state where the dancer roller 70 is moved to a +100% position. Then, the calibration support unit 104 stores the latest detection value (voltage value in this example) from the sensor 76 at this time, in the storage unit 112 as a first detection value indicating that the dancer roller 70 is at the +100% position. The "+100% position" is a position of the dancer roller 70 at which the path of the web 4 is the shortest, and is an upper end position in a stroke range of the dancer roller 70 in the example of Fig. 1.

[0027] Further, the user clicks a second set button 122 in a state where the dancer roller 70 is moved to a -100% position. Then, the calibration support unit 104 stores the latest detection value from the sensor 76 at this time, in the storage unit 112 as a second detection value indicating that the dancer roller 70 is at the -100% position. The "-100% position" is a position of the dancer roller 70 at which the path of the web 4 is the longest, and is a lower end position in the stroke range of the dancer roller 70 in the example of Fig. 1.

[0028] The dancer position identifying unit 108 identifies the position of the dancer roller 70 indicated by the detection value of the sensor 76, by linear interpolation using the first detection value and the second detection value.

[0029] In a dancer position display field 124, the position of the dancer roller 70 identified from the detection value of the sensor by linear interpolation using the first detection value and the second detection value is displayed. For example, the user moves the dancer roller 70 to a position near a 0% position (intermediate position in the stroke range), and checks whether the display in the dancer position display field 124 is a value close to 0%. Thereby, it can be checked whether the sensor 76 is correctly calibrated.

[0030] Fig. 4 is a diagram illustrating a dancer thrust calibration screen that is displayed on a predetermined display unit by the display control unit 102. The thrust is input to a first thrust input field 130. Hereinafter, the thrust input to the first thrust input field 130 is referred to as first thrust. As the first thrust, thrust which is within a range that the dancer roller 70 can apply to the web 4 and which is equal to or greater than the thrust to be applied is adopted. The first thrust may be the maximum thrust that can be applied, that is, the maximum thrust in the specification of the dancer mechanism 36.

[0031] When a first set button 132 is clicked, the calibration support unit 104 calculates the manipulated variable (drive voltage in this example) of the actuator 72 for applying the first thrust, on the basis of a predetermined calculation formula. The calibration support unit 104 displays the calculated manipulated variable in a manipulated variable display field 146, and drives the actuator 72 with the manipulated variable.

[0032] In a case where thrust lower than the first thrust is applied to the dancer roller 70, an Up button 148 is clicked. Then, the calibration support unit 104 increase the manipulated variable displayed in the manipulated variable display field 146 by a predetermined value, and drives the actuator 72 with the increased manipulated variable.

[0033] In a case where thrust higher than the first thrust is applied to the dancer roller 70, a Down button 150 is clicked. Then, the calibration support unit 104 decreases the manipulated variable displayed in the manipulated variable display field 146 by a predetermined value, and drives the actuator 72 with the decreased manipulated variable.

[0034] The user clicks the Up button 148 and/or the Down button 150 until the first thrust is actually applied to the dancer roller 70.

[0035] In a case where the first thrust is actually applied to the dancer roller 70, a first save button 136 is clicked. Then, the calibration support unit 104 stores the manipulated variable at this time in the storage unit as a first manipulated variable for applying the first thrust to the dancer roller 70, and displays the manipulated variable in a first manipulated variable display field 134.

[0036] Whether the first thrust is actually applied to the dancer roller 70 may be determined by installing, for example, a tension detector. Further, whether the first thrust is actually applied to the dancer roller 70 may be determined by applying the same load as the first thrust to the dancer roller 70 using a weight or the like and checking whether the dancer roller 70 is balanced at the 0% position.

[0037] Thrust lower than the first thrust is input to a second thrust input field 138. Hereinafter, the thrust input to the second thrust input field 138 is referred to as second thrust. As the second thrust, thrust which is within a range that the dancer roller 70 can apply to the web 4 and which is equal to or less than the thrust to be applied is adopted. The second thrust may be the minimum thrust that can be applied, that is, the minimum thrust in the specification of the dancer mechanism 36.

[0038] When a second set button 140 is clicked, the manipulated variable of the actuator 72 for applying the second thrust is calculated on the basis of the above-described calculation formula. The calibration support unit 104 displays the calculated manipulated variable in the manipulated variable display field 146, and drives the actuator 72 with the manipulated variable.

[0039] In a case where the second thrust is not applied to the dancer roller 70, the Up button 148 and/or the Down button 150 is clicked until the second thrust is actually applied to the dancer roller 70, as in the case of the first thrust.

[0040] In a case where the second thrust is actually applied to the dancer roller 70, a second save button 144 is clicked. Then, the calibration support unit 104 stores the manipulated variable at this time in the storage unit as a second manipulated variable for applying the second thrust to the dancer roller 70, and displays the manipulated variable in a second manipulated variable display field 142.

[0041] Whether the second thrust is actually applied to the dancer roller 70 may be determined in the same manner as in the case of the first thrust.

[0042] The manipulated variable identifying unit 110 identifies the manipulated variable for the actuator 72 to apply desired thrust to the dancer roller 70, by the linear interpolation using the first manipulated variable and the second manipulated variable.

[0043] With the control device 11 described above, the first detection value and the second detection value are stored by the button operation on the screen, and the position of the dancer roller 70 indicated by the detection value of the sensor 76 is automatically identified on the basis of the first detection value and the second detection value. Thereby, the load on the user is reduced.

[0044] Further, with the control device 11, the first manipulated variable and the second manipulated variable are stored by the button operation on the screen, and the manipulated variable for applying desired thrust to the dancer roller 70 is automatically identified on the basis of first manipulated variable and the second manipulated variable. Thereby, the load on the user is reduced.

[0045] The present invention has been described above on the basis of the embodiments. The embodiments are exemplifications, and those skilled in the art will understand that various modifications can be made for the combinations of the components and processing processes, and such modifications are also within the scope of the invention.

Brief Description of the Reference Symbols

[0046]

2:	roll-to-roll transfer system
4:	web
11:	control device
102:	display control unit
106:	unit control unit
108:	dancer position identifying unit
110:	manipulated variable identifying unit

Claims

1. A control device (11) of a roll-to-roll transfer system including a dancer roller (70) that applies tension to a web (4), and a sensor (76) that detects a position of the dancer roller (70), the control device (11) comprising:

   a display control unit (102) that displays, on a predetermined display unit, a screen including a first button for storing a detection value of the sensor (76) as a first detection value indicating that the dancer roller (70) is at a first position, and a second button for storing a detection value of the sensor (76) as a second detection value indicating that the dancer roller (70) is at a second position; and

   a dancer position identifying unit (108) that identifies a position of the dancer roller (70) indicated by the detection value of the sensor (76) using the first detection value and the second detection value.

2. A control device (11) of a roll-to-roll transfer system including a dancer roller (70) that applies tension to a web (4), and an actuator (72) that applies thrust to the dancer roller (70), the control device (11) comprising:

   a display control unit (102) that displays, on a predetermined display unit, a screen including a first button for storing a manipulated variable applied to the actuator (72) as a first manipulated variable for applying first thrust to the dancer roller (70), and a second button for storing a manipulated variable applied to the actuator (72) as a second manipulated variable for applying second thrust to the dancer roller (70); and

   a manipulated variable identifying unit (110) that identifies a manipulated variable for the actuator (72) to apply desired thrust to the dancer roller (70) using the first manipulated variable and the second manipulated variable.

FIG. 1

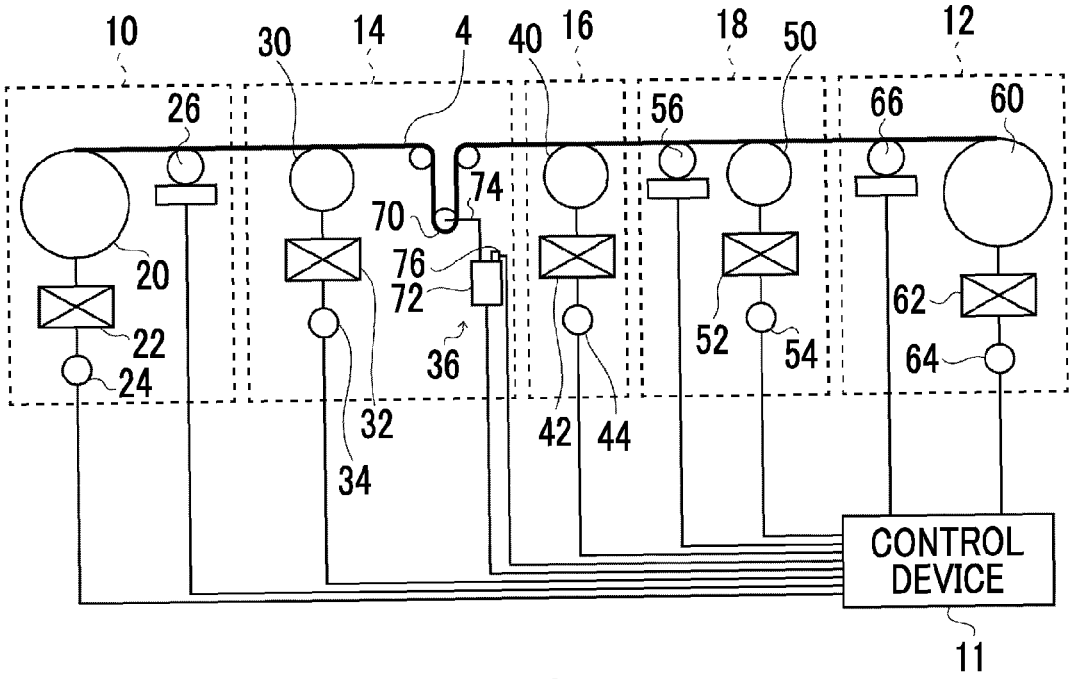

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FIG. 2

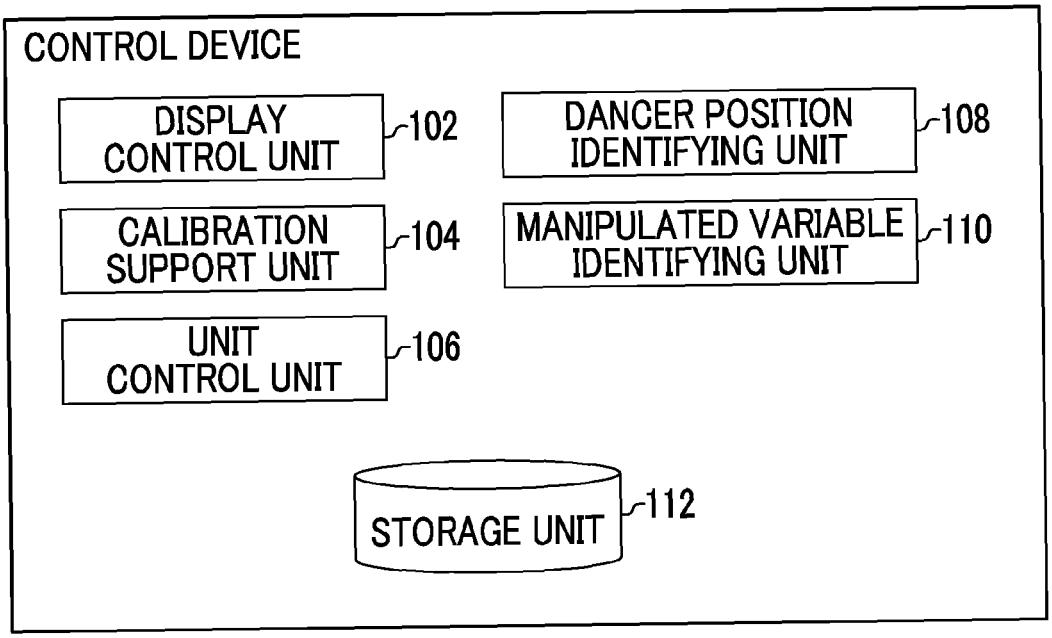

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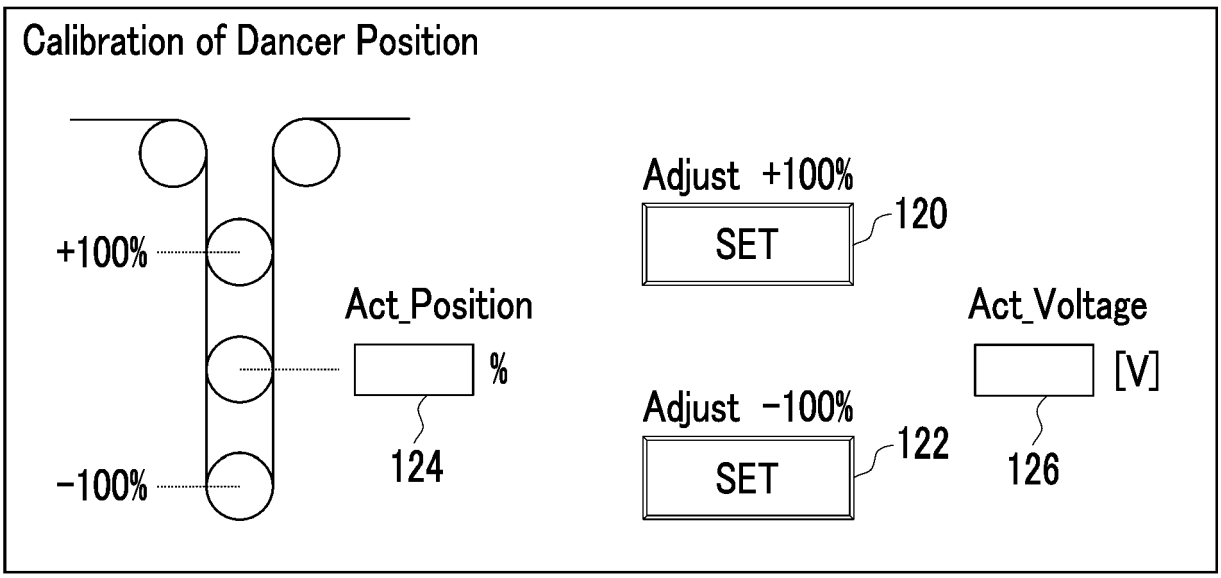
FIG. 3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-100%
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SET
120
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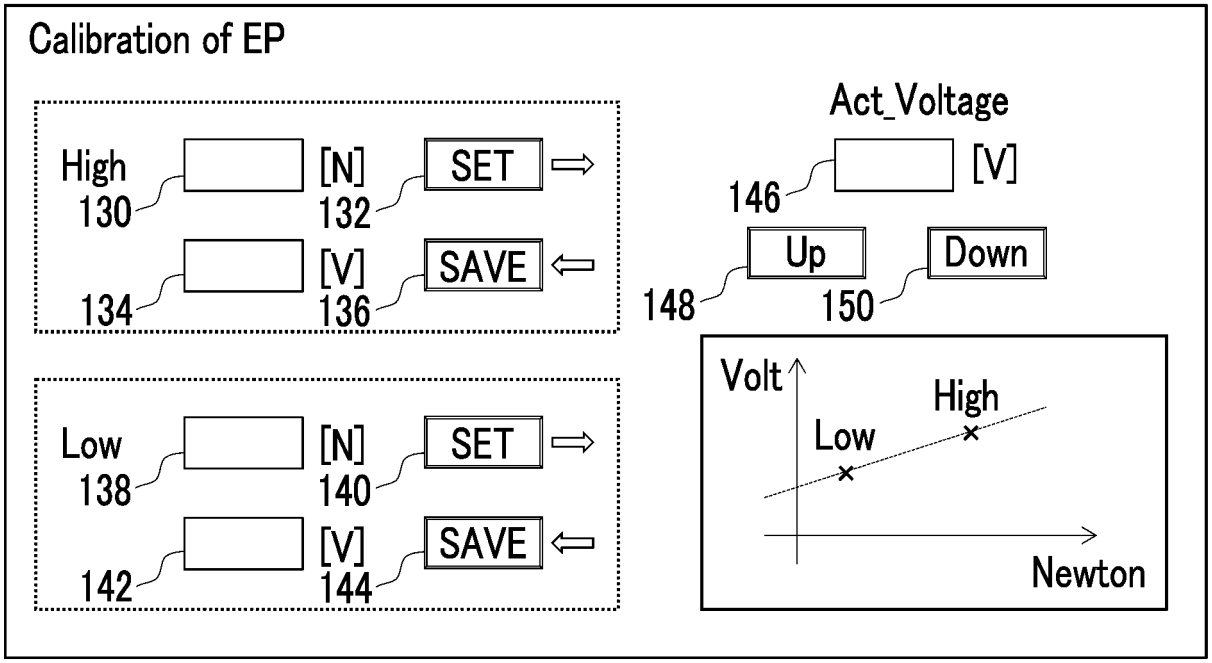
126

FIG. 4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Newton

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EUROPEAN SEARCH REPORT

Application Number
EP 21 15 2065

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A	JP S63 92563 A (NIRECO CORP) 23 April 1988 (1988-04-23) * abstract * * the whole document *	1,2	TECHNICAL FIELDS SEARCHED (IPC) B65H
A	EP 3 590 877 A1 (OCE HOLDING BV [NL]) 8 January 2020 (2020-01-08) * abstract; figure 1 * * paragraph [0020] * * paragraph [0039] * * the whole document *	1,2	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 June 2021	Piekarski, Adam

CATEGORY OF CITED DOCUMENTS

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15-06-2021

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