

(51) International Patent Classification:
B65H 23/188 (2006.01)(21) International Application Number:
PCT/EP2010/067760(22) International Filing Date:
18 November 2010 (18.11.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
102009056293.1 30 November 2009 (30.11.2009) DE(71) Applicant (for all designated States except US): **EAST-MAN KODAK COMPANY** [US/US]; 343 State Street, Rochester, New York 14650 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **KAHL, Dirk** [DE/DE]; Rosenstrasse 3a, 24211 Preetz (DE). **PETER, Karlheinz Walter** [DE/DE]; Captain - Thiessen -, Weg 2, 24113 Molfsee (DE). **SPIELZ, Rolf Johannes** [DE/DE]; Zeisigweg 5, 24214 Gettorf (DE). **SCHMIDT, Ulrich** [DE/DE]; Kiebitzweg 12, 24211 Preetz (DE). **WECKER, Matthias** [DE/DE]; Am Wartheberg 1, 36179 Bebra-Asmushausen (DE).(74) Agent: **WEBER, Etienne**; Kodak, Campus Industriel, Département Brevets, Route de Demigny, Z.I Nord B.P. 21 F-71102 Chalon-sur-Saône Cedex (FR).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: DEVICE AND METHOD FOR CONTROLLING THE TENSION OF A SUBSTRATE WEB

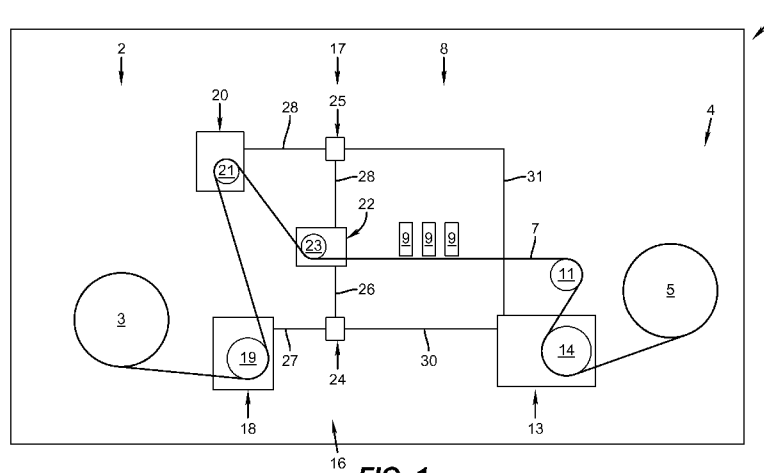


FIG. 1

(57) Abstract: A control device comprising a first driving unit (18) with a first driving roller (19) around which a substrate web (7) is partially guided and tensioned, and comprising a second driving unit (20) with a second driving roller (21) around which the substrate web is partially guided and tensioned, has been suggested in order to provide a control device (16) for controlling the tension of the substrate web that is conveyed along a transport path, said control device making it possible to avoid the problems of prior art. The first and the second driving units of this control device feature different rotational moments of inertia. Further provided are a measuring unit (22) for providing a measured value of the tension of the substrate web and a control unit in connection with said measuring unit and said first and second driving units, said control unit comprising a first and a second filtering unit displaying different filtering characteristics for filtering the measured value. The control unit comprises a first control device for controlling the first driving unit based on the measured value filtered by the first filtering unit, as well as a second control device for controlling the second driving unit based on the measured value filtered by the second filtering unit. Thus, the driving units are enabled in a manner that has been advantageously adapted to the dynamic behavior that is affected by the rotational moments of inertia of said driving units. Also disclosed is a method for controlling the tension of a substrate

[Continued on next page]



Published:

— *with international search report (Art. 21(3))*

web, said method comprising the steps of measuring the tension of the substrate web and of generating a measured value as a function of said tension. Then the measured value is filtered parallelly in a first and in a second filtering unit displaying different filtering characteristics and the first driving unit is controlled depending on the measured value filtered by the first filtering unit, and the second driving unit is controlled depending on the measured value filtered by the second filtering unit. In this method, the measured value is used, at the same time, as the control value for two different driving units and is, for this purpose, processed with respect to the dynamic characteristics of the driving units.

DEVICE AND METHOD FOR CONTROLLING THE TENSION OF A SUBSTRATE WEB

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a device and a method for
5 controlling the tension of a substrate web, said substrate web being conveyed
along a transport path.

BACKGROUND OF THE INVENTION

A plurality of machines for processing substrate webs, for example,
paper webs or fabric webs is known. These processing machines can perform a
10 multitude of process steps on the substrate web such as, for example, printing,
embossing and/or cutting. Most process steps require that the substrate web
display a tension that is as uniform as possible. If the substrate web is not
tensioned uniformly, process errors may occur in the substrate web such as, for
example, shifts of printed images, as well as tears and/or creases. In order to
15 maintain a uniform tension of the substrate web such processing machines
comprise tensile stress control arrangements.

In particular in multi-color printing machines, it is necessary that
the substrate web tension of a substrate web be controlled as accurately as possible
in order to enable printing in a register-perfect manner. The description hereinafter
20 thus refers to the example of a printing machine in greater detail; however, it
should be noted that both the device, as well as the method for controlling the
substrate web tension, can be used with other processing machines.

A known design of a tensile stress control device comprises a force-
measuring box that measures the tension of the substrate web and emits a
25 corresponding measuring signal. The measuring signal is used for the control of an
associate driving unit.

Depending on the size of the driving unit that is used for controlling
the tensile stress, there are limits regarding the disturbances of the substrate web
tension that can be corrected by the driving system. However, the remaining errors
30 and fluctuations are not acceptable, in particular in the case of printing machines
because said errors and fluctuations can seriously compromise the printed image.

For example, in reel fed printing machines there are existing strict requirements regarding the achievable tensile stress and the allowed tensile stress errors. It is impossible to meet these requirements with the aforementioned conventional method, wherein a tensile stress control is based on a not specifically
5 processed measured value from force-measuring boxes.

With regard to the dimensioning of drive and control of a printing machine, in most cases the problem occurs that an electric motor with strong torque is necessary for the required mean substrate web tension. However, the rotors of these motors display large moments of inertia and long coil delay times
10 that make it difficult to correct high-dynamic disturbances of the substrate web tension. Here the coil delay time is understood as the ratio of coil inductance to coil resistance. Conversely, it can be said that small electric motors displaying a small moment of inertia of the rotor and low coil delay times provide the dynamics necessary for correcting the highly dynamic disturbances but cannot provide the
15 required torque.

SUMMARY OF THE INVENTION

It is, therefore, the object of the invention to create a control device and a control method that make it possible to avoid the aforementioned problems.

This object is achieved with a device in accordance with Claim 1, a
20 printing machine in accordance with Claim 5, as well as a with a method in accordance with Claim 10. Additional embodiments are disclosed by the subclaims.

In particular, the device for controlling the tension of a substrate web, said web being conveyed along a transport path, comprises a first driving unit
25 with a first driving roller around which the substrate web is partially guided and tensioned, and comprises a second driving unit with a second driving roller around which the substrate web is partially guided and tensioned. The first and the second driving units feature different rotational moments of inertia. Further provided are a measuring unit for providing a measured value of the tension of the substrate web
30 and a control unit in connection with said measuring unit and said first and second driving units, said control unit comprising a first and a second filtering unit displaying different filtering characteristics for filtering the measured value. The

control unit comprises a first control device for controlling the first driving unit based on the measured value filtered by the first filtering unit, as well as a second control device for controlling the second driving unit based on the measured value filtered by the second filtering unit. Thus, the driving units can be activated in a manner that has been advantageously adapted to the dynamic behavior that is affected by the rotational moments of inertia of said driving units.

Preferably, the filtering units comprise, respectively, a low-pass filter and a high-pass filter. Consequently, a driving unit with a small rotational moment of inertia can compensate for rapid tension changes measured with the use of a measured value filtered with the high-pass filter, and a driving unit with a large rotational moment of inertia can compensate for slow tension changes measured with the use of a measured value filtered with the low-pass filter.

In one exemplary embodiment of the device, at least one of the filtering units displays a filtering characteristic that depends on the conveying speed of the substrate web along the transport path. Thus, different dynamic behaviors of the driving units in the different speed ranges can be taken into consideration when said driving units are being activated.

In one exemplary embodiment of the device, the first driving unit displays a higher rotational inertia than the second driving unit. This is the case if, on the one hand, a heavy driving unit displaying high torque capacity is used and, on the other hand, a light-weight driving unit displaying low torque capacity is used. In this manner, it is possible to correct fast and slow disturbance values of the substrate web tension.

Furthermore, a printing machine is disclosed that, in addition, comprises a main drive for conveying a substrate web along a transport path, at least one printing unit and a device for controlling the tension of the substrate web in accordance with one of the aforementioned embodiments. The main drive prespecifies the process speed or printing speed.

Preferably, the control unit of the device for controlling the substrate web tension communicates with the main drive of the printing machine. Thus, a printing speed or process speed generated by the main drive can be taken into consideration during the control operation.

In the printing machine, the measuring unit of the device for controlling the tension of the substrate web is advantageously arranged between the second driving unit and the main drive – viewed in the direction of the transport path.

5 Preferably, the printing machine comprises a control unit for controlling the main drive, said control unit controlling a printing speed generated by the main drive. Thus, the printing speed can be generated by a powerful main drive, and disturbances of the substrate web tension can be corrected by the dynamic driving units.

10 Furthermore, the object of the invention is achieved by a method for controlling the tension of a substrate web, wherein the substrate web is at least partially guided and conveyed around a first and a second driving roller that feature different rotational moments of inertia.

 This method comprises the following steps: measuring the tension
15 of the substrate web and generating a measured value as a function of said tension; parallel filtering of the measured value in a first and in a second filtering unit displaying different filtering characteristics; controlling the first driving unit depending on the measured value filtered by the first filtering unit; and controlling the second driving unit depending on the measured value filtered by the second
20 filtering unit. Thus, the measured value is simultaneously used as the control value for two different driving units and is, for this purpose, processed with respect to the dynamic characteristics of the driving units.

 Preferably, the step of filtering the measured value comprises low-pass filtering and high-pass filtering so that fast and slow disturbances of the
25 substrate web tension can be corrected by a fast-responding driving unit and by a slow-responding driving unit, respectively.

 Advantageously, the method comprises conveying the substrate web by means of a main drive along the transport path. This means that the printing speed is generated by a main drive using a simple control, and disturbances of the
30 substrate web tension can be corrected by the first and second driving units.

 In one exemplary embodiment of the method, the step of filtering the measured value occurs depending on a conveying speed of the substrate web

along the transport path, so that any different dynamic behavior of the driving units in different speed ranges can be taken into account.

With the method, preferably a nominal tension of the substrate web is taken into consideration regarding the control of the first driving unit.

- 5 Furthermore, an offset preferably is taken into consideration regarding the control of the second driving unit.

The invention, as well as additional details thereof, will be explained in detail hereinafter with the use of exemplary embodiments and with reference to the figures.

10 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 a schematic side view of a printing machine, said printing machine comprising a device for controlling the tension of a substrate web;

Fig. 2 a schematic view of the control concept of the device for controlling the tension of a substrate web; and

- 15 Fig. 3 a flow chart showing the process of a method for controlling the tension of a substrate web.

DETAILED DESCRIPTION OF THE INVENTION

- It should be noted that the terms top, bottom, right and left, as well as similar directions used in the description hereinafter, relate to alignments or arrangements shown in the figures and are only intended for describing the exemplary embodiments. However, these expressions must not be understood to have a restrictive meaning.

- Fig. 1 shows a schematic side view of a printing machine 1 as an example of a processing machine. The printing machine 1 comprises a feeder 2 with a first substrate web roll 3 and an output means 4 with a second substrate web roll 5. A substrate web 7 extends along a transport path from the first substrate web roll 3 to the second substrate web roll 5. Between the feeder 2 and the output means 4 and along the transport path of the substrate web 7, there is a printing region 8 with several printing stations 9 for different colors being arranged in said printing region. The substrate web 7 is also guided in the printing machine 1 over at least one deflecting roller 11 in order to define the transport path and the wrap angle, these enabling a reliable transmission of the driving torques of the rollers to

the substrate web 7. Furthermore, the printing machine 1 comprises a main driving unit 13 with a main driving roller 14, the latter being intended for conveying the substrate web 7 from the first substrate web roll 3 in the direction toward the second substrate web roll 5.

5 Furthermore, the printing machine 1 comprises a tension control device 16 that is arranged between the first substrate web roll 3 in the feeder 2 and the printing region 8 comprising the print heads 9. The tension control device 16 comprises a control unit 17, a first driving unit 18 with a first driving roller 19, and a second driving unit 20 with a second driving roller 21, as well as a measuring
10 unit 22 with a measuring roller 23. It should be noted that the measuring unit 22 may also be designed without measuring roller, said unit being able to measure the tension of the substrate web 7. The first driving roller 19, the second driving roller 21 and the measuring roller 23 are arranged in such a manner that the substrate web extends in the form of an S-shaped loop around the rollers 19, 21 and 21, 23.

15 The control unit 17 of the tension control device 16 comprises a first control device 24 for controlling the first driving unit 18 as well as a second control device 25 for controlling the second driving unit 20. For easier explanation, the first and the second control devices 24 and 25 are shown as separate control devices in Figs. 1 and 2; however, in practical applications, they
20 may also be components of a control unit, said unit controlling a multitude of processes of the printing machine 1.

A signal line 26 is disposed to connect the measuring unit 22 with the first control device 24 which, in turn, is connected with the associate driving unit 18 via an additional signal line 27. In the same manner, the measuring unit 22
25 is connected – via a signal line 28 – with the second control device 25 which, in turn, is connected with the associate second driving unit 20 via a signal line 29. The main driving unit 13 is connected with the first control device 24 via a signal line 30 and is further connected with the second control device 25 via a signal line 31.

30 Fig. 2 shows, in detail, the design of the first and second control devices 24, 25. The first control device 24 for the first driving unit 18 comprises a low-pass filter block 34, a PI controller block 35, a position control block 36, a

speed control block 37, a torque control block 38, as well as a function or mapping block 39. An input of the low-pass filter block 34 is connected with an output of the measuring unit via the signal line 26, in order to receive a measured value that is in relation to the measured tension of the substrate web 7. Between the low-pass filter block 34 and the PI controller block 35 there is arranged a node 40, wherein a nominal tension, as well as the negative output signal of the low-pass filter block, are combined and transmitted to the PI controller block 35. Between the output of the PI controller block 35 and the input of the position control block 36, there are sequentially arranged two nodes 41, 42. At node 41, the output signal of the PI controller block 35, said signal having been processed by means of the function $(1+X)$, as well as a speed signal from the main driving unit 13 are combined and transmitted further to the subsequent node 42. At node 42, the output signal of the node 41, as well as a negative output signal of the mapping block 39 are combined and transmitted to the input of the position control block 36. Another node 43 is arranged between the position control block 36 and the speed control block 37. At the node 43, an output value of the position control block 36, as well as an actual rotational speed signal of the motor, said signal having a negative sign, are combined by the first driving unit 18 and are transmitted to the input of the speed control block 37. The output of the speed control block 37 is connected with the input of the torque control block 38. The output of the torque control block 38 is connected with the first driving unit 18.

The second control device 25 comprises a high-pass filter block 46, a P controller block 47, as well as a torque control block 48. The output of the measuring unit 22 to which the measured value based on the substrate web tension is applied, is connected with the input of the high-pass filter block 46 via the signal line 28. A node 49 is arranged between the high-pass filter block 46 and the P controller block 47. At the node 49, a value of 0, as well as a negative output signal of the high-pass filter block 46 are combined and transmitted to the input of the P controller block 47. Another node 50 is arranged between the output of the P controller block 47 and the input of the torque control block 48. At node 50, the output value of the P controller block 47 and an offset are combined and transmitted to the input of the torque control block 48. A rotational speed limit

tapped from the second driving unit 20 is transmitted to the input of the torque control block 48 in order to act there on the input value into the torque control block 48. The output of the torque control block 48 is connected with the second driving unit 20.

5 The main driving unit 13 is connected with the low-pass filter block 34 via signal line 30 and is connected with the high-pass filter block 46 via signal line 31. Thus, depending on the control pattern, the filtering characteristics of the low-pass filter block 34 and/or the high-pass filter block 46 can be adjusted depending on the process speed or printing speed of the main driving unit 13. It
10 should be noted that the connection of the main driving unit 13 with the high-pass and low-pass filter blocks 34, 46 of the first and second control devices 24, 25 is not absolutely necessary.

 With reference to Fig. 3, the basic design of the control method is described hereinafter in greater detail with the tension control device 16 in
15 operative position. In this method, the tension of the substrate web 7 is basically measured with the aid of a measuring unit 22, and its measured value is processed further in different filtering devices and used for controlling the first and second driving units.

 To put it more precisely, the tension of the substrate web 7 is
20 measured with the aid of the measuring unit 22 in step 60. The output signal resulting therefrom or the measured value of the measuring unit 22 is then transmitted parallel to the low-pass filter block 34 being the first filtering unit (step 61) and also to the high-pass filter block 46 being the second filtering unit (step 62). A first filtered measured value results from the processing operation in the
25 low-pass filter unit 34, said first filtered measured value being used for controlling the first driving unit 18 (step 62). A second filtered measured value results from the processing operation in the high-pass filter block 46, said second filtered measured value being used for controlling the second driving unit 20 (step 64).

 As is obvious from Fig. 2, the instantaneous printing speed or
30 process speed is additionally transmitted from the main driving unit 13 – via the signal lines 30, 31 – to the low-pass filter block 34 as well as also to the high-pass filter block 46. The filtering characteristics of the low-pass filter block 34 and/or

the high-pass filter block 46 are then adjusted based on the process speed, for example, as a function of a mapping field, a function, or as a function of a prespecified setting. As it were, it may, depending on the process speed, be desirable to change the dynamic behavior of the first and the second driving units.

- 5 However, it should be noted that the signal lines 30, 31 and the adjustment of the filtering characteristics that depends on the process speed are not necessary for each exemplary embodiment.

Processing of the first filtered measured value as the output value of the low-pass filter block 34 will now again be described in more detail with
10 reference to Fig. 2. The first filtered measured value is given a negative sign and transmitted to the node 40 of the first control device 24. At the node 40, the first filtered measured value is added to a prespecified nominal tension, and the result is transmitted as the input value into the PI controller block 35 and processed there. The output value of the PI controller block 35 is processed using the function
15 $(1+x)$ and transmitted to the node 41 of the first control device 24. The node 41 also receives a speed signal from the main drive 13. The output value of the node 41 is then transmitted further to the node 42. The actual rotational speed of the motor is continually tapped from the first driving unit 18 and transmitted to the function or mapping block 39. In the mapping block 39, the actual rotational speed
20 of the motor is changed in accordance with a mapping field, a function or a look-up table, and is also transmitted – as the changed actual rotational speed of the motor with a negative sign – to the node 42. In node 42, the changed negative actual rotational speed of the motor is combined with the output value of the node 41 and transmitted as the input value into the position control block 36 and
25 processed there. The output value of the position control block 36 is transmitted to the node 43, with the actual rotational speed of the motor of the first driving unit having a negative sign also being transmitted to said node. The negative actual rotational speed of the motor and the output value from the position control block 36 are combined in node 43 and entered as the input value in the speed control
30 block 37 and processed there. The output value resulting from the speed control block is transmitted directly as the input value into the torque control block 38.

The torque control block 38 processes this input value, ultimately transmitting said input value to the first driving unit 18.

Now, processing of the measured value of the measuring unit 22 in the second control device 25 will also be described in greater detail with reference to Fig. 2. The output value or measured value of the measuring unit 22 is transmitted to the input of the high-pass filter block 46 and processed therein. The output value of the high-pass filter block 46 is given a negative sign and transmitted to the node 49. The node 49 also picks up a control value "0" and transmits the value resulting from the two input values as the input value to the P controller block 47, where the input value is processed. The output value exiting from the P controller block is combined with a prespecified offset at node 50 and made available as the input value to the torque control block 48. However, before the combined offset and the output value of the P controller block 47 are used as the input value for the torque control block 48, there is a check to determine whether this input value for the torque control block 48 exceeds the rotational speed limit that is being tapped from the second driving unit 20. If the rotational speed limit is exceeded, the input value for the torque control block 48 is limited. If the rotational speed limit is not exceeded, the input value is made available to the torque control block 48 without any further change. The torque control block 48 processes this input value and outputs its output value to the second driving unit 20.

In summary, it can be said that the measured signal of a measuring unit is first split and then filtered separately, and then subjected to separate signal processing in order to find its use in the control of different driving units. Thus, the measured signal is used, at the same time, as a as a control value for two different driving units and is processed, for this purpose, in view of the dynamic characteristics of the driving units.

In the practical application in a reel fed printing machine displaying a printing speed of 0.13 m/sec to 2.5 m/sec, a substrate web tension on the order of 120 to 550 N with a tolerance of 1% is generated with the aid of the presented device and the method for controlling the substrate web tension shown here.

The invention has been described with reference to a preferred exemplary embodiment, wherein individual features of the described exemplary embodiment may be left out, unless they are absolutely necessary. For the person skilled in the art, there are numerous possible and obvious modifications and
5 embodiments, without departing from the inventive idea.

PART LISTFig. 1:

	1	Printing machine
	2	Feeder
5	3	Web roll
	4	Output means
	5	Web roll
	7	Substrate web
	8	Printing region
10	9	Printing station
	11	Deflecting roller
	13	Main driving unit
	14	Driving roller
	16	Tension control device
15	17	Control unit
	18	First driving unit
	19	First driving roller
	20	Second driving unit
	21	Second driving roller
20	22	Measuring unit
	23	Measuring roller
	24	First control device
	25	Second control device
	26	Signal line
25	27	Signal line
	28	Signal line
	30	Signal line

Fig. 2:

30	19	Actual rotational speed limit
	21	Rotational speed limit
	48	Torque control

	38	Torque control
	50	Offset
	47	P Controller
	37	Speed control
5	46	High-pass filter
	36	Position control
	35	PI Controller
	40	Nominal tension
	34	Low-pass filter

10

Fig. 3:

	60	Measuring of the tension of the substrate web
		Measured value
	61	Processing in the first filtering device (low-pass filter)
15	62	Processing in the second filtering device (high-pass filter)
		First filtered measured value
	63	Activating the first driving unit
		Second filtered measured value
	64	Activating the second driving unit

20

CLAIMS

1. Device (16) for controlling the tension of a substrate web (7) that is conveyed along a transport path, said device comprising the following:
- a first driving unit (18) with a first driving roller (19) around which a substrate web (7) is partially guided and tensioned;
 - a second driving unit (20) with a second driving roller (21) around which the substrate web (7) is partially guided and tensioned,
 - with the first and the second driving units (18, 20) featuring different rotational moments of inertia;
 - a measuring unit (22) for delivery of a measured value of the tension of the substrate web (7);
 - a control unit (17) in connection with the measuring unit (22) and the first and second driving units (18, 20), said control unit comprising a first and a second filtering unit (34, 46) displaying different filtering characteristics for filtering the measured value,
 - said control unit (17) comprising a first control device (24) for controlling the first driving unit (18) based on the measured value filtered by the first filtering device (34), as well as a second control device (25) for controlling the second driving unit (20) based on the measured value filtered by the second filtering device (46).
2. Device (16) as in Claim 1, with the filtering devices (34, 46) comprising a low-pass filter and/or a high-pass filter.
3. Device (16) as in one of the previous claims, with at least one of the filtering devices (34, 46) displaying a filtering characteristic that depends on the conveying speed of the substrate web (7) along the transport path.
4. Device (16) as in one of the previous claims, with the first driving unit (18) displaying a higher rotational inertia than the second driving unit (20).

5. Printing machine (1) comprising the following:
a main drive (13) for conveying a substrate web (7) along a transport path;
at least one printing unit (9); and
a device (16) for controlling the tension of the substrate web (7) as
5 in one of the Claims 1 through 4.

6. Printing machine (1) as in Claim 5, with the control unit (17)
of the device for controlling the substrate web tension being connected with the
main drive (13) of the printing machine (1).

10

7. Printing machine (1) as in Claim 5 or 6, with the measuring
unit (22) of the device (16) for controlling the substrate web tension being
arranged between the second driving unit (20) and the main drive (13) – viewed in
the direction of the transport path.

15

8. Printing machine (1) as in one of the Claims 5 through 7,
said printing machine comprising a control unit for controlling the main drive (13),
said control unit controlling the printing speed generated by the main drive (13).

20

9. Method for controlling the tension of a substrate web (7),
wherein the substrate web is at least partially guided and conveyed around one first
and one second driving rollers (19, 21) that feature different rotational moments of
inertia, said method comprising the following steps:

measuring the tension of the substrate web (7) and generating a
25 measured value as a function of said tension;

parallel filtering of the measured value in a first and in a second
filtering unit (34, 46) displaying different filtering characteristics;

controlling the first driving unit (18) as a function of the measured
value filtered by the first filtering unit (34); and

30

controlling the second driving unit (20) as a function of the
measured value filtered by the second filtering unit (46).

10. Method as in Claim 9, wherein the step of filtering the measured value comprises a low-pass filtering and/or a high-pass filtering.

5 11. Method as in one of the claims 9 or 10, wherein the substrate web (7) is conveyed by a main drive (13) along the transport path.

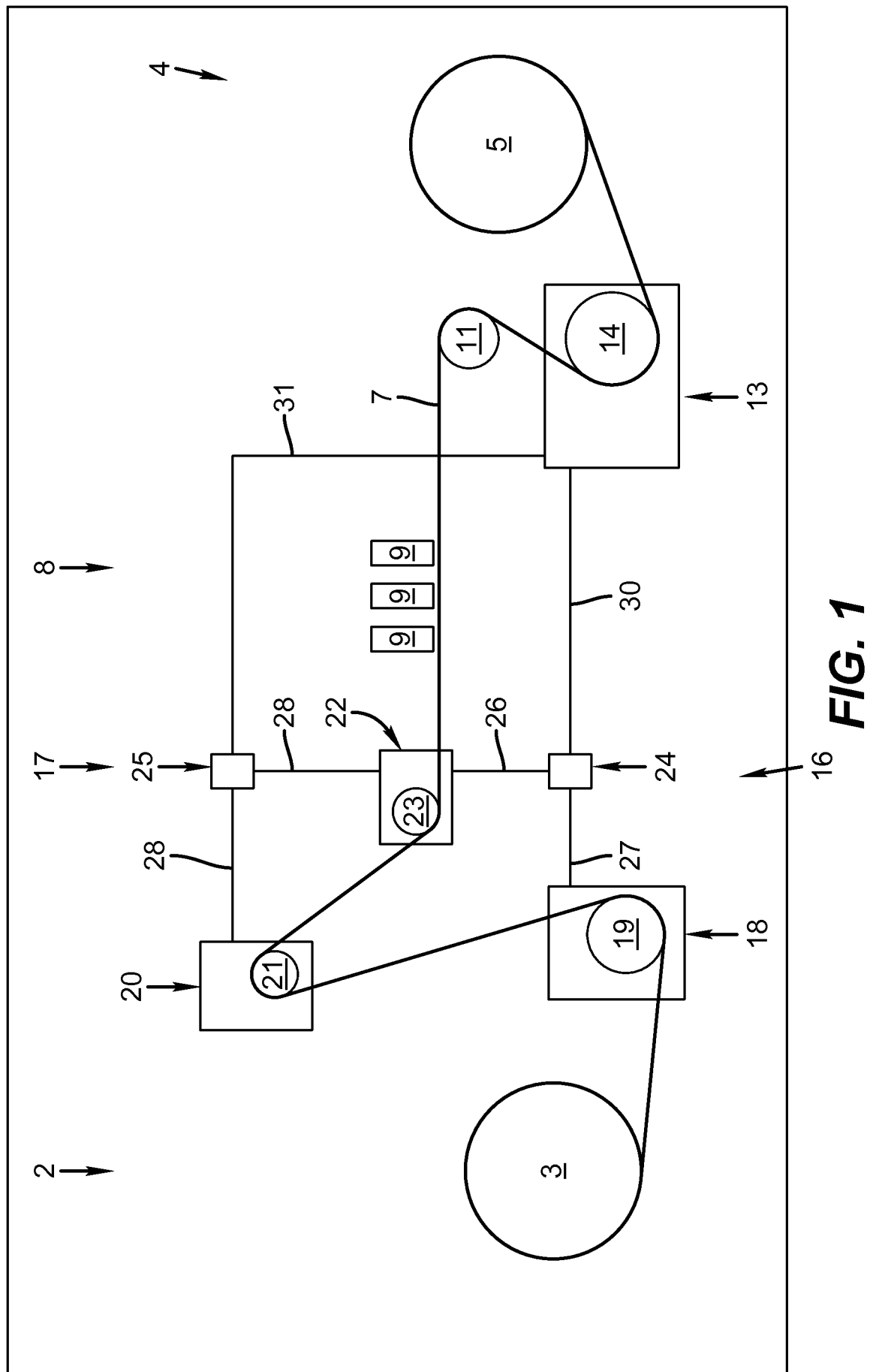
12. Method as in one of the Claims 9 through 11, wherein the step of filtering the measured value occurs depending on a conveying speed of the substrate web (7) along the transport path.

10

13. Method as in one of the Claims 9 through 12, wherein a nominal tension of the substrate web (7) is taken into consideration for the control of the first driving unit (18).

15

14. Method as in one of the Claims 9 through 13, wherein the offset is taken into consideration for the control of the second driving unit (20).



2/3

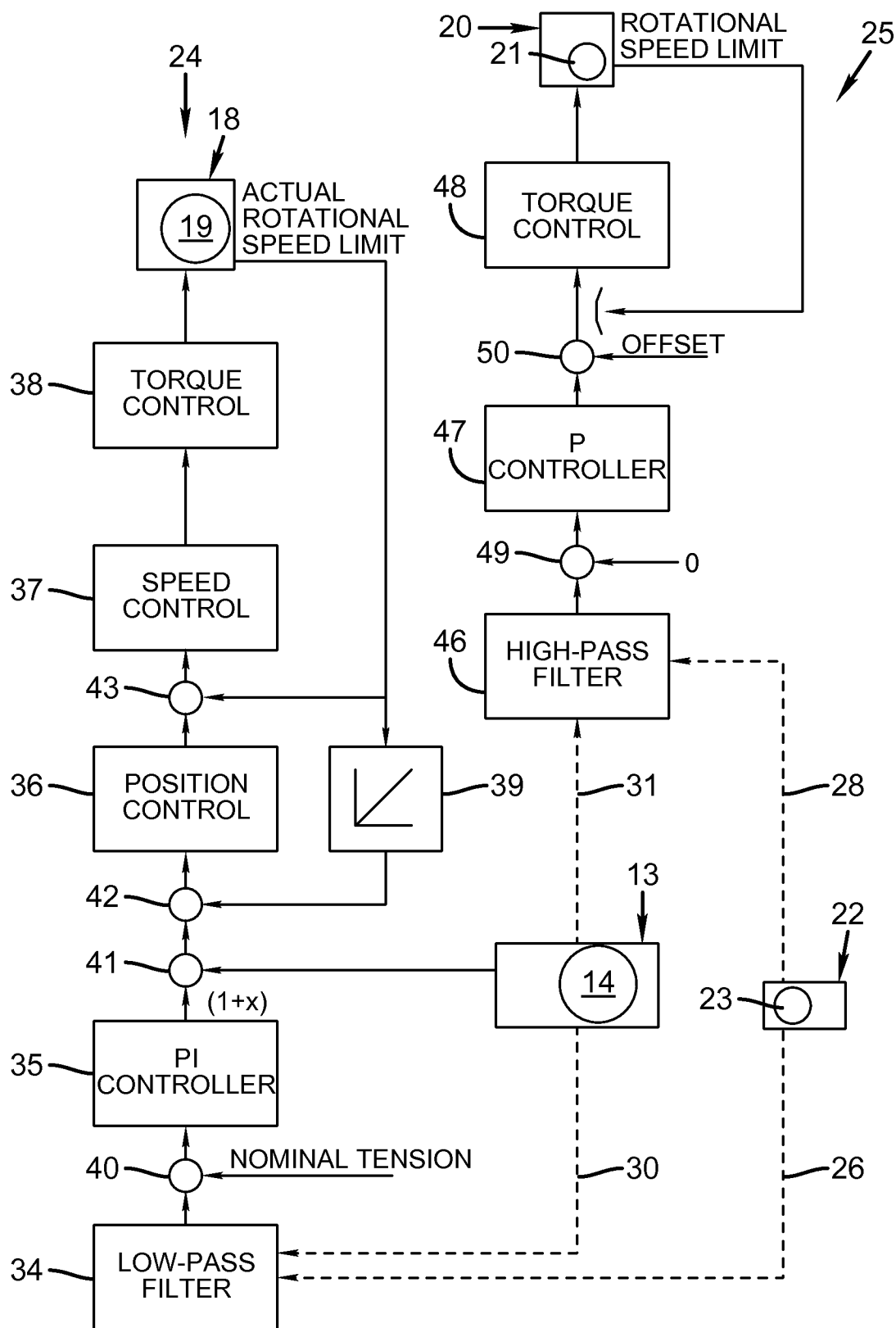
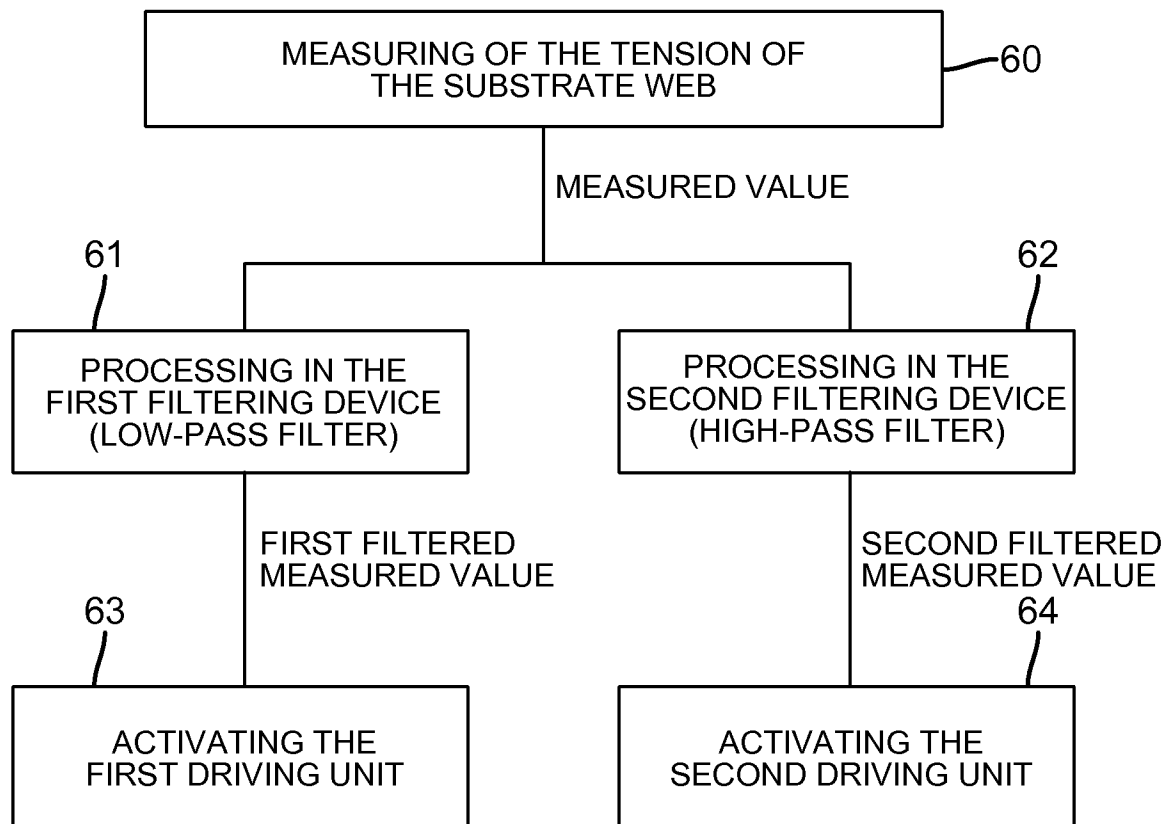


FIG. 2

3/3

**FIG. 3**

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2010/067760

A. CLASSIFICATION OF SUBJECT MATTER

INV. B65H23/188

ADD.

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)

B65H

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 practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 485 386 A (ANDREASSON BENGT [SE]) 16 January 1996 (1996-01-16) column 2, line 35 - line 60; figures -----	1,9
A	US 4 004 510 A (ROCH ROGER) 25 January 1977 (1977-01-25) page 2, line 14 - line 35; figures -----	1,9
A	US 2007/131036 A1 (SCHULTZE STEPHAN [DE]) 14 June 2007 (2007-06-14) paragraph [0025]; claims 1,10,17; figures -----	1,9
A	US 2005/167460 A1 (FRANZ MICHAEL J [US] ET AL) 4 August 2005 (2005-08-04) paragraph [0028]; figures ----- -/--	1,9



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 document 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

2 February 2011

Date of mailing of the international search report

15/02/2011

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Haaken, Willy

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2010/067760

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2009/039130 A1 (SCHULTZE STEPHAN [DE] ET AL) 12 February 2009 (2009-02-12) paragraph [0012] - paragraph [0017]; figures -----	1,9

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2010/067760

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5485386	A	16-01-1996	AU 9072891 A DE 69114302 D1 DE 69114302 T2 EP 0561884 A1 SE 467665 B SE 9003961 A WO 9210419 A1	08-07-1992 07-12-1995 30-05-1996 29-09-1993 24-08-1992 13-06-1992 25-06-1992
US 4004510	A	25-01-1977	CA 1033438 A1 CH 574363 A5 DE 2452756 A1 ES 431898 A1 FR 2250696 A1 GB 1484185 A IT 1025384 B JP 959483 C JP 50083107 A JP 53043327 B SE 407394 B SE 7414172 A	20-06-1978 15-04-1976 22-05-1975 16-10-1976 06-06-1975 01-09-1977 10-08-1978 28-06-1979 05-07-1975 18-11-1978 26-03-1979 14-05-1975
US 2007131036	A1	14-06-2007	AT 457282 T DE 102005058810 A1 EP 1795470 A1 JP 2007163480 A	15-02-2010 14-06-2007 13-06-2007 28-06-2007
US 2005167460	A1	04-08-2005	AT 486035 T AU 2005212239 A1 AU 2008202605 A1 CA 2554373 A1 CN 1910099 A EP 1711424 A1 JP 2007519589 T WO 2005077798 A1	15-11-2010 25-08-2005 03-07-2008 25-08-2005 07-02-2007 18-10-2006 19-07-2007 25-08-2005
US 2009039130	A1	12-02-2009	CN 101362564 A DE 102007037564 A1	11-02-2009 19-02-2009