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(54) INDUSTRIAL INKJET PRINTER WITH CURRENT CONSUMPTION MEASUREMENT FOR INK POLLUTION DETECTION

(57) The invention concerns a circuit for a CIJ printer, said circuit comprising:
- a power supply (5) for providing at least one deflection voltage to deflection electrodes for deflecting the drops;
- a conducting ink detecting unit (5, 10), to detect the presence of residual dry or liquid conducting ink on or in contact with said deflection electrodes, said unit comprising:
* a current detector (14) detecting a current provided by said power supply while applying said at least one deflection voltage;
* and a calculator (10) programmed to calculate at least one first value derived from said current during a period of time and to detect the presence of residual dry or liquid conducting ink on, or in contact with, at least one of said deflection electrodes, based on said at least one derived value.

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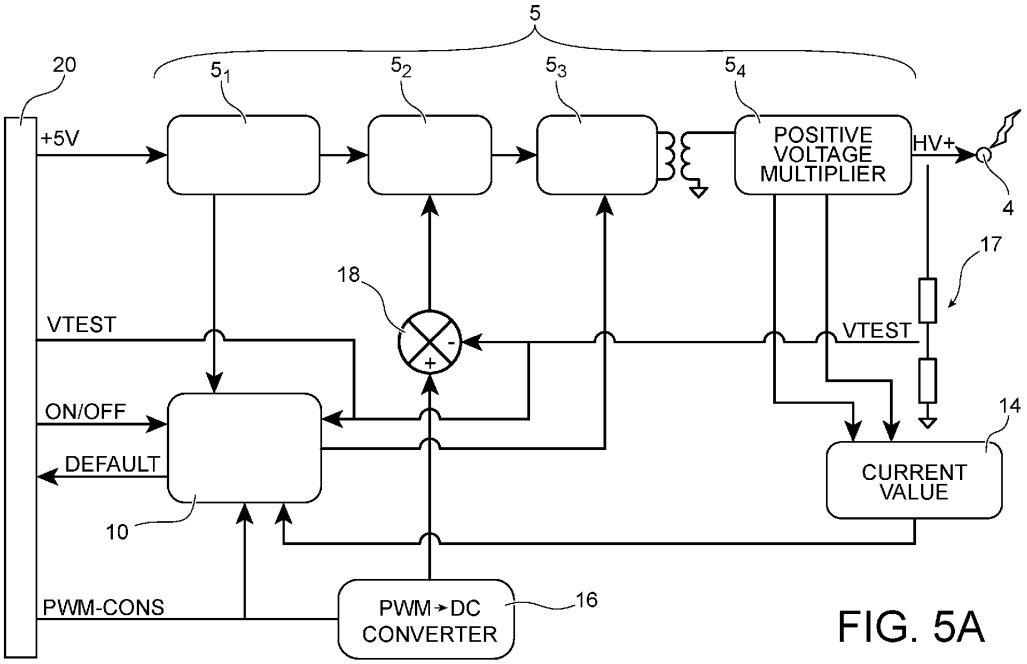

5
20
5_1
5_2
5_3
5_4
+5V
POSITIVE VOLTAGE MULTIPLIER
HV+
4
17
18
VTEST
VTEST
ON/OFF
DEFAULT
14
CURRENT VALUE
10
PWM-CONS
PWM→DC CONVERTER
16

FIG. 5A

Description

TECHNICAL FIELD AND PRIOR ART

[0001] The invention relates to the detection of ink pollution on, or in contact with, deflection electrodes of an industrial continuous inkjet printer.

[0002] Industrial continuous inkjet printers are known in the field of coding and industrial marking of various products, for example for marking barcodes or the date of expiry on food products, directly on the production line and at a high rate.

[0003] Two categories are distinguished among continuous inkjet printers:

- on the one hand, multi-deflected continuous jet printers wherein each drop of a single jet (or of a few jets) may be sent on various trajectories corresponding to different deflection commands for each drop, thereby achieving scanning of the area to be printed following a direction which is the deflection direction;
- on the other hand, binary continuous jet printers wherein a plurality of jets placed side by side each only have one trajectory intended for printing; by synchronously controlling at a given time all the jets, it is possible to print on the medium a pattern generally reproducing that of the distribution of the nozzles on the nozzle plate.

[0004] In both cases, the other direction for scanning the area to be printed is covered by a relative displacement of the printing head and of the medium to be printed.

[0005] These printers have several typical subassemblies, which are found in most industrial continuous inkjet printers available on the market. Indeed, these machines as they are used on production lines, are generally equipped with a printing head of small size which allows them to be integrated in reduced spaces.

[0006] In particular, deflection or deviation electrodes 4 (illustrated on figure 1A) enable deflecting the electrically charged drops which enter between these electrodes. The amplitude of the deflection depends on the charge and on the velocity of these drops. The deflected drops impact on the medium to be printed, the non-deflected drops being recovered by a gutter in order to return them towards the ink circuit so as to be recycled.

[0007] During operation of the printer, ink can be deposited and possibly dry on the deflection electrodes 4, due to a deviated jet or to splashing effect for example. This is illustrated on figure 1B where the electrodes 4 are stained by ink 7. This affects the ability of the electrodes 4 to correctly deflect the ink drops and can make the printhead not available until the printhead is cleaned. Ink can hardly be detected by an operator because the ink is usually dark, the holding or active plate 23 of the electrodes on or to which they are secured being often dark grey, and there is little contrast between the ink and the active plate on which it is deposited thereby making the ink pollution nearly invisible.

[0008] For the same reasons, ink 7a can also be deposited and dry between the holding plate 23 of each electrode 4 and the electrode itself (as on figure 1C), in which case it cannot be seen by an operator. In this case as well it will affect the ability of the electrodes to correctly deflect the ink drops.

[0009] There is no method and no device to detect this pollution on said deflection electrodes.

[0010] Moreover, the inks are electrically conductive, and inks formulated with black carbon pigments for demanding applications where adhesion is critical remain conductive even after drying. Such residues of conductive ink lead to leakage current from high voltage potential.

[0011] There is therefore a need to detect such ink pollution in a CIJ printer easily and to stop the printer when such pollution is detected.

[0012] There is also a need to detect the time evolution of such ink pollution in a CIJ printer in order to anticipate a malfunction of the printer.

DISCUSSION OF THE INVENTION

[0013] The invention first concerns a circuit for one or more deflection electrode(s) of a single jet or multi jet continuous ink-jet printer, said circuit comprising :

- a power supply for providing at least one deflection voltage to said deflection electrodes of said printer for deflecting the drops;
- a conducting ink detecting unit, to detect the presence of residual dry or liquid conducting ink on or in contact with at least one of said deflection electrodes, said unit comprising:

    * a current detector detecting a current provided by said power supply while applying said at least one deflection voltage;
    * and a calculator or means programmed to calculate at least one first value derived from said current during a first period of time and to detect the presence of residual dry or liquid conducting ink on, or in contact with, at least one of said deflection electrodes, based on said at least one derived value.

[0014] Said CIJ printer may comprise a printhead including a drop generator for forming drops, at least one electrode for charging the drops and said one or more deflection electrodes for deflecting the drops. It may also comprise a controller, all or part of said circuit according to the invention forming part of said controller or of said printer head.

[0015] In a circuit according to the invention, said at least one derived value can comprise a statistical value of said current or its time derivative.

[0016] Said calculator can be programmed to compare

said first derived value with at least one first threshold value.

[0017] In a particular embodiment, said at least one derived value comprises a statistical value of said current and its time derivative, said calculator being programmed to compare said time derivative with at least one second threshold value to detect the presence of residual dry or liquid conducting ink on or in contact with said deflection electrodes.

[0018] In a circuit according to the invention, said calculator can be programmed to calculate at least one second derived value of said current during a second period of time, different than said first period of time (it is for example longer than said first period of time), and to detect the time evolution of the presence of residual dry or liquid conducting ink on or in contact with said deflection electrodes, based on said at least one second derived value. Said calculator can be programmed to compare said second derived value with at least one third threshold value.

[0019] In a circuit according to the invention, said calculator can be programmed to implement a detection of the current and its comparison with a threshold, the power supply of the deviation electrodes being interrupted, for example for security reasons, when the current is higher than said threshold.

[0020] In a circuit or a method according to the invention, said first derived value and/or respectively said second derived value, can comprise at least:

- a maximum value of said current during said first and/or respectively said second period of time,
- and/or a minimum value of said current during said first and/or respectively said second period of time,
- and/or a difference between both maximum and minimum values during said first and/or respectively said second period of time,
- and/or a variation of said current during said first and/or respectively said second period of time,
- and/or an average of said current during said first and/or respectively said second period of time.

[0021] In a circuit according to the invention, said conducting ink detecting unit can be programmed for triggering a signal when the presence of residual dry or liquid conducting ink on or in contact with at least one of said deflection electrodes is detected.

[0022] Said signal can trigger a cleaning of at least one of said deflection electrodes.

[0023] The calculator can be further programmed to calculate a third derived value of said current provided by said power supply after the cleaning of at least one of said deflection electrodes to detect the presence of residual dry or liquid conducting ink on, or in contact with, at least one of said deflection electrodes, based on said at least one third derived value over a third period of time.

[0024] Said third derived value can comprise a statistical value (as defined above) of said current or its time derivative.

[0025] Said calculator can be programmed to compare said third derived value with at least one fourth threshold value.

[0026] A circuit according to the invention can further comprise:

- at least one memory to memorize data of a current provided by said power supply for deflecting the drops as a function of a temperature in said printing head and means for measuring said temperature;
- possibly means for comparing said measured current provided to said electrodes and a memorized value of said current at said temperature.

[0027] In a circuit according to the invention, said power supply can be able to provide a voltage between 1kV and 10 kV or between - 1 kV and -10 kV.

[0028] The invention also concerns a method for controlling a single jet or multi jet continuous ink-jet printer or for controlling deflection electrodes of said printer, said method comprising:

- applying at least one deflection voltage to said deflection electrodes;
- and detecting the presence of residual dry or liquid conducting ink on said deflection electrodes by:

    * measuring a current provided to said deflection electrodes while applying said at least one deflection voltage;
    * calculating a first value, derived from said current (for example a statistical value of said current or its time derivative), during a first period of time;

- detecting the presence of residual dry or liquid conducting ink on said deflection electrodes based on said first derived value.

[0029] In a device or a method according to the invention, said CIJ printer may comprise a printhead including a drop generator for forming drops, at least one electrode for charging the drops and one or more deflection electrodes for deflecting the drops.

[0030] In a device or a method according to the invention, the ink is for example formulated with black carbon pigments.

SHORT DESCRIPTION OF THE FIGURES

[0031]

Figures 1A - 1C are examples of deflection electrodes and of ink pollution deposited on them.
Fig. 2 illustrates a method according to the invention.
Fig. 3 is a schematic example of a system according to the invention.

Figures 4A and 4B are examples of currents detected according to the invention.

Figures 5A and 5B are examples of electrical circuits which can be implemented in the frame of the present invention.

Fig. 6 is an example of a CIJ printer to which the invention can apply.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0032] Figure 2 is a schematic view of a deflection electrode 4 of a CIJ printer. A power supply 5 supplies the electrode 4 with a high voltage V, for example between + 1 kV and + 10 kV.

[0033] A current I is also provided to the electrode 4 by said power supply while applying said deflection voltage. If the electrode 4 is clean, the current I is equal to the current I_1 circulating in said electrode. Due to pollution, for example one or more drops 7 of liquid conductive ink and/or dry conductive ink deposited on the electrode 4, current I is modified: an additional current I_2 circulates in the conductive ink 7 in parallel to the current I_1 in the electrode 4. It then further circulates to ground or in the cover of the printing head.

[0034] Current I can be measured, for example continuously or on a regular basis, any variation of its measured value indicating the presence of one or more drop(s) of ink and/or of dry ink on or against the electrode.

[0035] The same holds for any value, a so-called derived value, calculated from current I, for example the average value of said current I and/or its time derivative dI/dt and/or any other statistical value, for example :

- a maximum value and/or a minimum value of said current during a given period of time,
- and/or a difference between both maximum and minimum values during said period of time,
- and/or an average of said current during said period of time.

[0036] One or more of these values can be compared with one or more threshold value. For example the mean value of the current over a period of time can be compared to a first threshold value and the time derivative of said mean value can be compared to a second threshold value, different from the first threshold value.

[0037] Depending on the period of time, different situations can be detected, for example:

- a detection over a 1st period of time may indicate the presence of a pollution on the electrode;
- a detection over a 2nd period of time, longer than said 1st period of time, may indicate the formation of pollution on the electrode.

[0038] Thus, one or more of the above values can be:

- measured or calculated over different periods of time, for example a 1st (short) period of time T_1 (for example 5 mn) and a 2nd period of time T_2 (longer than T_1, for example T_2 = 24 h);
- compared with the appropriate different threshold values, for example a 1st threshold value and a 2nd threshold value (different from the 1st one) .

[0039] If one or more of said values crosses one or more of said threshold value (s), a signal can be triggered, indicating the need for cleaning the electrode(s): for example the printer may be stopped and/or a warning can be displayed on a display device, informing an operator of the need for cleaning or said signal can trigger an automatic cleaning step.

[0040] A cleaning step of said electrode 4 can be followed by a step of measuring or calculating one or more of said above value(s) and comparing it/them with a corresponding threshold value(s) to decide whether the cleaning was performed appropriately and whether no pollution remains on said electrode. This threshold value can be different than the threshold value before cleaning, since there can be some kind of hysteresis effect. One or more further cleaning step(s) can be performed depending on the result of the comparison.

[0041] A system according to the invention, for example to implement the above method, is illustrated on figure 3. It comprises:

- supply means 5 (or voltage supply) for supplying the electrode 4 with the appropriate voltage to the electrode;
- electronic means 10, for example a microprocessor or a microcontroller;
- a circuit 14 for measuring the current I equal to the sum of the current I_1 in the electrode 4 and of the additional current I_2 which circulates in the conductive ink 7 in parallel to I_1.

[0042] Said supply means 5 provides said voltage to circuit 14, said circuit 14 sending to said electronic means 10 a signal representative of the current $I = I_1 + I_2$.

[0043] Electronic means 10, for example a microprocessor or a microcontroller are programmed:

- to receive said value of said current I measured by the circuit 14 and to compare it and/or one or more of the above derived value(s), calculated on the basis of said current I, with one or more corresponding threshold value(s);
- to provide a signal to stop the printer and/or a signal indicative of a pollution on the electrode, said signal informing an operator of the need for cleaning and/or a signal triggering an automatic cleaning step;
- possibly to receive and/or send more information from and/or to said supply means 5 possibly through one or more communication link(s) 25.

[0044] One or more threshold value(s) can be stored in memory are(s) of said electronic means 10, for example in a factory before any use of the printer or during a calibration step or after the first use of said printer.

[0045] A temperature sensor 12 can also be included in the system, providing to the electronic means 10 an information about the temperature of the printing head: indeed a variation of current I or of one or more of any derived value may not be indicative of a pollution but may result from a temperature variation. A correlation between a variation of I and/or of any of its derived value(s) and a temperature variation may indicate that variation of I or of any current based value may result from said temperature variation but not from a pollution of said electrode.

[0046] Figures 4A and 4B show the results of tests performed on a CIJ printer in which a bad break off of the ink jet was generated, resulting in pollution of the deflection electrode.

[0047] As can be seen on figure 4A (case of a pollution with a standard dye liquid ink), the current I progressively rises until it reaches a threshold value I_t (at t_1) which stops the printer. After the ink has dried, the printer can be restarted (at t_2), but the electrodes remain stained with dry ink.

[0048] Figure 4B shows a test comprising 2 successive cleaning operations of an electrode on which black carbon ink was deposited. The successive cleanings lead to a reduction of the level of I.

[0049] These results confirm that the invention allows detection of ink pollution on deflection electrodes.

[0050] Figures 5A and 5B schematize the electronic means of a preferred embodiment of a circuit for performing the invention. These means notably include:

- A power supply 16, for example a PWM-controlled DC-DC converter ; its output is compared with voltage V_{test} (see below) and the result of the comparison drives the power supply 5 ;
- a microcontroller 10, able or programmed to compare the measured current $I = I_1 + I_2$ (measured by circuit 14, see below) to a threshold value and/or to calculate one or more derived value(s) of said current over one or more period (s) of time and possibly to compare any of said value (s) with one or more other threshold value(s); as explained above, the microcontroller 10 may generate a default signal, triggered for example by one or more of the above values crossing one or more threshold value(s);
- high voltage power supply generator means 5 which allow generation of voltages of several thousand volts to be applied to the deflection plates 4 (only one such voltage is generated and applied to one electrode on figure 5A, 2 voltages +V and -V are generated and applied respectively to electrode 4a and 4b of figure 5B);
- a circuit 14, comprising for example a resistor or a resistor bridge, is for measuring the current consumed by voltage multiplier 5_4; the value of the measured current being provided to microcontroller 10;
- a divider 17 is for measuring a voltage (between 0 and 5 V for example) based on or representative of the voltage provided to the deflection electrodes 4 and its output is supplied to comparator 18;
- circuit 5_1 measures the current absorbed by voltage supply 5_2; the value of the measured current is provided to microcontroller 10, which reads it and adapts the frequency of the transformer 5_3 accordingly, in order to minimize the current consumption and therefore the heating of the printing head;
- circuit 5_2 provides the transformer 5s with a voltage value between 0 and 5V, said value being controlled by circuit 16 and the outlet V_{test} of circuit 17.As already explained, a temperature sensor (not represented) may further be included, allowing measurement of the temperature in the head. Its output value can be provided to microcontroller 10.

[0051] A detailed example of a CIJ printer to which the invention can apply is illustrated on figure 6. It comprises a printing head 1 which is remotely deployed, generally by several meters, with respect to the body 20 of the printer, also called console, in which the hydraulic and electric functions required for operating and controlling the head are elaborated. Reference 11 is a medium to be printed with drops generated by the CIJ printer.

[0052] The console therefore contains an ink circuit 100 and a controller 110 for driving the printer connected to the head through an umbilical 15. Alternatively, as disclosed in WO2011/098345, electronic means can be contained in the printing head.

[0053] The umbilical 15 connects the console 20 to the printing head 1 and contains the hydraulic and electric connections for supplying the head with hydraulic fluids (ink, solvent) and appropriate electrical voltages and signals.

[0054] The printing head 1 includes a set of means for generating and controlling the jet, i.e. a drop generator 2, a charging electrode 7, possibly a device for detecting drops 8, a set of deflection electrodes 4, and a gutter 3 for recovering the drops.

[0055] From the drop generator 2, electrically conducting pressurized ink, conveyed from the ink circuit 100, is issued through at least one calibrated nozzle 5, thereby forming at least one ink jet 9.

[0056] Under the action of a periodic stimulation device (not shown) controlled by a signal from the controller, the ink jet is broken at regular time intervals, corresponding to the period of the stimulation signal, in a specific location of the jet downstream from the nozzle.

[0057] This forced fragmentation of the inkjet is usually induced in a so-called "breaking" point 6 of the jet. The most often used stimulation device is a piezoelectric ceramic placed in the ink upstream from the nozzle.

[0058] At the so-called "breaking point" of the jet, the

continuous jet is transformed into a sequence 9 of identical and regularly spaced out ink drops. This drop sequence makes its way following a trajectory corresponding to the ejection axis of the drops, which substantially reaches by the geometrical design of the printing head, the center of the recovery gutter 3.

[0059] The charging electrode 7, individual for each jet, is located in the vicinity of the breaking point of the jet. It is intended to selectively charge each of the formed drops to a predetermined electric charge value. To do this, as the ink is maintained at a set electric potential in the drop generator, a determined voltage is applied to the charging electrode 7, different for each drop.

[0060] An amount of electric charges depending on the voltage level of the electrode 7, is generated on the jet upstream from the breaking point of the jet by an electrostatic influence and is picked up by the drop at the moment when it breaks away from the jet. The charging voltage to be applied to each jet can be generated by the controller 110 (as explained below more in detail) and conveyed towards the head 1. It may be noted that this charging control is individual for each jet present in the multi-deflected continuous ink jet head. Indeed, the charging sequences and the time course of the signal are different for each jet.

[0061] The charging signal is synchronized with the stimulation signal, but with a phase lag specific to each jet as determined with the device described below.

[0062] A device for detecting drops 8 may be positioned downstream from the charging electrode 7, providing the controller 110 with a signal which allows it to measure the electric charge actually loaded on the drops as well as the velocity of these drops in the head. This device 8 senses the current induced by a capacitive effect when the specifically charged drops pass close to the sensitive surface of one or more electrostatic sensor(s). An example of this type of device is described in patent FR 2 636 884 of Markem-Imaje.

[0063] This signal can be conveyed up to the controller.

[0064] Downstream from the charging electrode, the deflection electrodes 4 are placed on either side of the trajectory of the drops. Both of these plates are brought to a fixed relative electric potential of ± several thousand volts, producing an electric field Ed substantially perpendicular to the trajectory of the drops. This potential difference can be generated at the console 110 and is transmitted to the head with suitable electric insulation. These electrodes 4 can be subject to ink pollution as explained in connection with figures 1A and 1B.

[0065] The electric field Ed is therefore capable of deflecting the electrically charged drops which enter between the plates 4. The amplitude of the deflection depends on the charge and on the velocity of these drops. These deflected trajectories 10 escape from the gutter 3 in order to impact on the medium to be printed 11.

[0066] The placement of the drops, inside the impact matrix of drops to be printed on this medium 11, is obtained by combining the individual deflection given to the drops of the jet and the relative displacement between the head and the medium 11 to be printed.

[0067] The gutter 3 for recovering the non-printed drops captures the unused ink in order to return it towards the ink circuit 100 so as to be recycled. The non-printed drops are those which have not been charged or for which the charge is too small for having their deflection lead them out of the gutter.

[0068] Such a device may further include one or more hydraulic component(s), for hydraulic switching, and/or fluid distribution and/or protective components. Some of these components can be passive such as valves, conduits or filters. Others can be active, such as solenoid valves, and require electric control which can be elaborated at the controller 110 and transmitted by the umbilical 15 up to the head 1.

[0069] The different functions of the device can be connected to the controller 110 through conductors which themselves also pass through the umbilical cable 15.

[0070] A printer console 21 mainly contains the ink circuit 100, the controller 110 for controlling the printer and a user interface 120 allowing interaction with the printer.

[0071] The ink circuit 100 mainly implements the following functions:

* providing pressurized ink of adequate quality and concentration (by mixing recycled ink and solvent) to the drop generator of the head 1,
* recovering and recycling the fluids not used for printing returning from the gutter of the head 1,
* suction for purging the drop generator located in the head 1,
* providing solvent to the head 1 for rinsing carried out during head maintenance operations.

[0072] It is also possible to add to the functions above, the provision of pressurized air for pressurizing the head, useful for protecting the head from external pollution.

[0073] These 5 functions are each associated with a conduit connecting the ink circuit 100 and the head 1.

[0074] The controller 110 can consist of one or more electronic cards and of on-board software packages which ensure the driving of the ink circuit 100 and of the printing head 1.

[0075] As regards the driving of the head, the different electronic analog and logic functions with which the members of the head may be activated through the umbilical 15 can be implemented on the card of the controller 110.

[0076] In a variant disclosed in WO2011/098345, the analog electronic means and the logic electronic means for driving the head 1 as well as one or more power supply means are implemented by an electronic circuit in the actual head 1. In this case, the ink circuit 100 essentially includes the means already described above in connection with Fig. 6, in order to ensure the same functions of providing the ink, of recovering and recycling the non-

used fluids, of suction for purging the drop generator 2, of providing solvent to the head for rinsing, and optionally providing pressurized air for pressurizing the head 1.

[0077] The invention offers the following advantages:

- it has an increased sensitivity with respect to printers and their circuits implementing a single detection of the current and its comparison with a single threshold, the power supply of the deviation electrodes being interrupted for security reasons when the current is higher than said threshold;
- it has the ability to detect (residual) pollution before starting up the jet after cleaning operation, shutdown or any other operation, and require, recommend or launch maintenance procedure
- it has the ability to detect and analyze pollution evolution during printing and alert an operator that a cleaning process will be soon necessary and allow him to plan it at best time for production line rather than stop suddenly the printer.

Claims

1. A circuit for one or more deflection electrodes (4) of a single jet or multi jet continuous ink-jet printer, comprising:

- a power supply (5) for providing at least one deflection voltage to said deflection electrodes for deflecting the drops;

characterized in that said circuit further comprises:

- a conducting ink detecting unit (5, 10), to detect the presence of residual dry or liquid conducting ink on or in contact with said deflection electrodes, said unit comprising:

* a current detector (14) detecting a current provided by said power supply while applying said at least one deflection voltage;
* and a calculator (10) programmed to calculate at least one first value derived from said current during a first period of time and to detect the presence of residual dry or liquid conducting ink on, or in contact with, at least one of said deflection electrodes, based on said at least one derived value.

2. A circuit according to claim 1, said at least one derived value comprising a statistical value of said current or its time derivative.

3. A circuit according to claim 1 or 2, said calculator (10) being programmed to compare said first derived value with at least one first threshold value.

4. A circuit according to any of claims 1 to 3, said at least one derived value comprising a statistical value of said current and its time derivative, said calculator (10) being programmed to compare said time derivative with at least one second threshold value to detect the presence of residual dry or liquid conducting ink on or in contact with said deflection electrodes.

5. A circuit according to any of claims 1 to 4, said calculator (10) being programmed to calculate at least one second derived value of said current during a second period of time, different than said first period of time, and to detect the time evolution of the presence of residual dry or liquid conducting ink on or in contact with said deflection electrodes, based on said at least one second derived value.

6. A circuit according to claim 5, said calculator (10) being programmed to compare said second derived value with at least one third threshold value.

7. A circuit according to claim 5 or 6, said second period of time being longer than said first period of time.

8. A circuit according to any of claims 1 to 7, said first derived value and/or respectively said second derived value, comprising at least:

- a maximum value of said current during said first and/or respectively said second period of time,
- and/or a minimum value of said current during said first and/or respectively said second period of time,
- and/or a difference between both maximum and minimum values during said first and/or respectively said second period of time,
- and/or a variation of said current during said first and/or respectively said second period of time,
- and/or an average of said current during said first and/or respectively said second period of time.

9. A circuit according to any of claims 1 to 8, said conducting ink detecting unit being programmed for triggering a signal when the presence of residual dry or liquid conducting ink on or in contact with at least one of said deflection electrodes is detected.

10. A circuit according to claim 9, said signal triggering a cleaning of at least one of said deflection electrodes (4).

11. A circuit according to claim 10, said calculator being programmed to calculate a third derived value of said current provided by said power supply after the

cleaning of at least one of said deflection electrodes (4) to detect the presence of residual dry or liquid conducting ink on, or in contact with, at least one of said deflection electrodes, based on said at least one third derived value.

12. A circuit according to claim 11, said calculator (10) being programmed to compare said third derived value with at least one fourth threshold value.

13. A circuit according to any of claims 1 to 12, further comprising at least one memory to memorize data of a current provided by said power supply for deflecting the drops as a function of a temperature in said printing head and means (12) for measuring said temperature.

14. A circuit according to claim 13, further comprising means (10) for comparing said measured current provided to said electrodes and a memorized value of said current at said temperature.

15. A method for controlling a single jet or multi jet continuous ink-jet printer, including a drop generator for forming drops, at least one electrode for charging the drops and deflection electrodes for deflecting the drops, said method comprising:

- applying at least one deflection voltage to said deflection electrodes;
- and detecting the presence of residual dry or liquid conducting ink on said deflection electrodes by:

  * measuring a current provided to said deflection electrodes while applying said at least one deflection voltage;
  * calculating a first value, derived from said current, during a first period of time;

- detecting the presence of residual dry or liquid conducting ink on said deflection electrodes based on said first derived value.

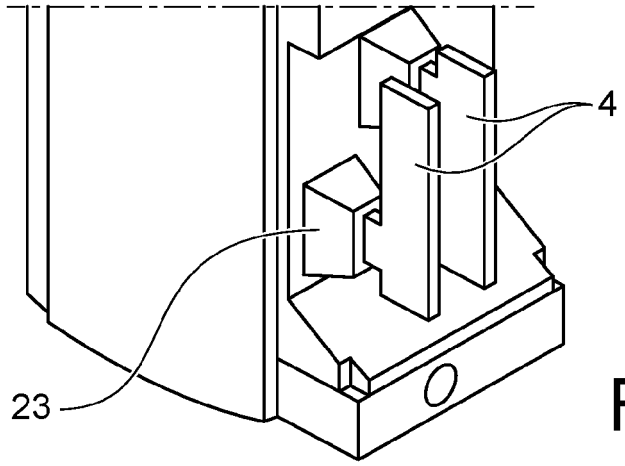


FIG. 1A

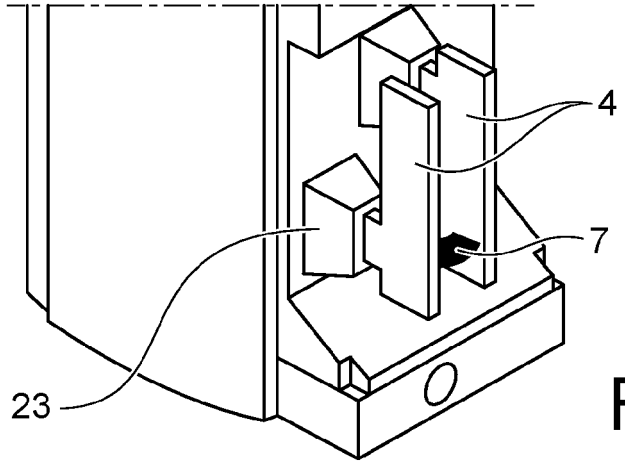


FIG. 1B

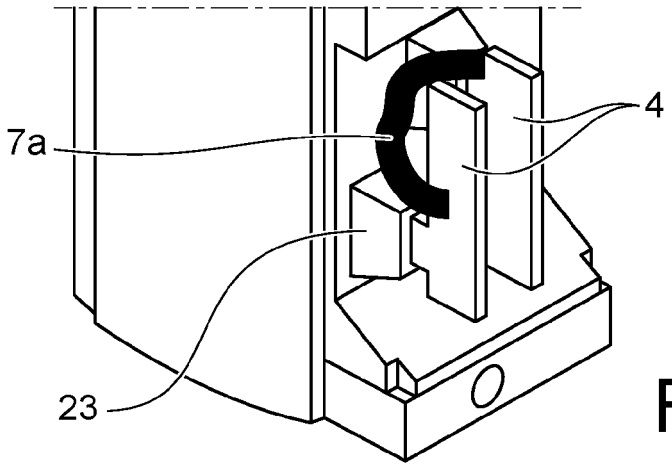


FIG. 1C

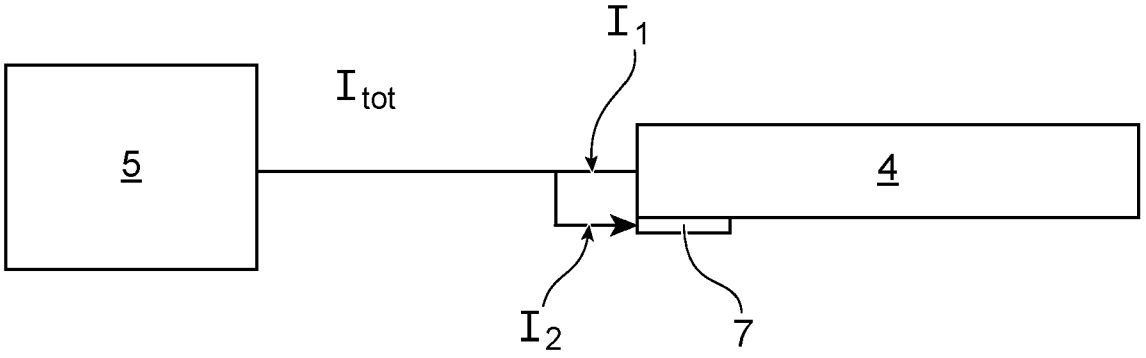


FIG. 2

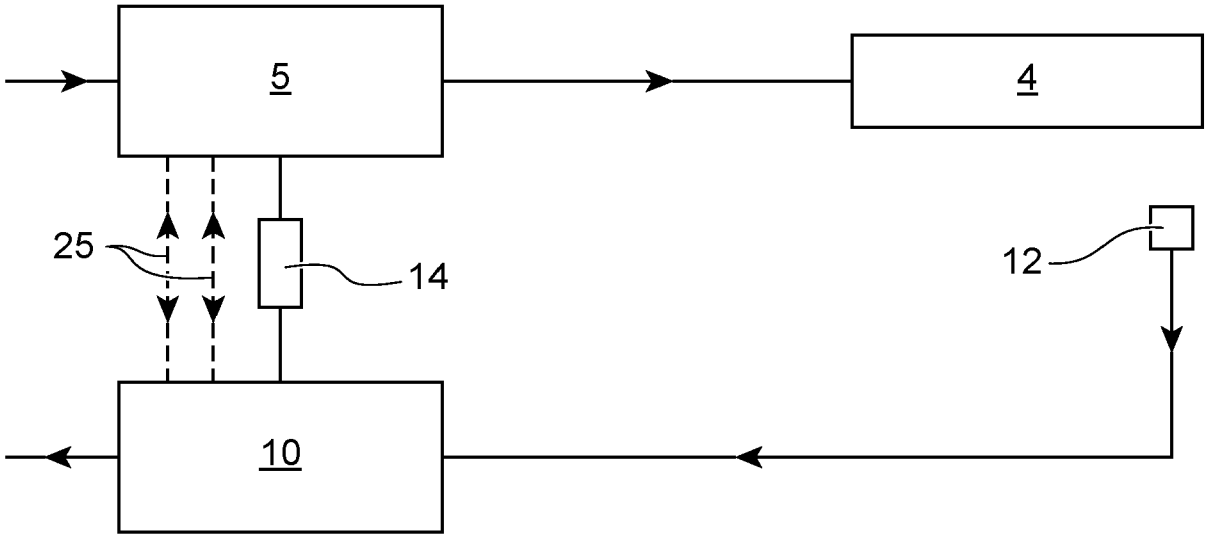


FIG. 3

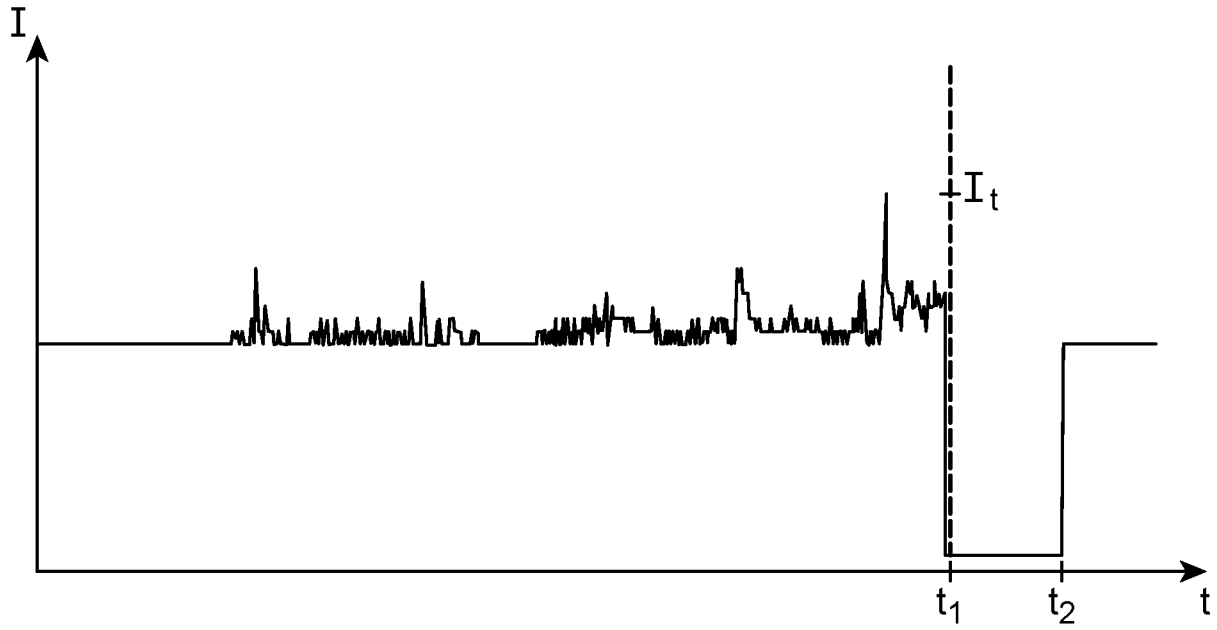


FIG. 4A

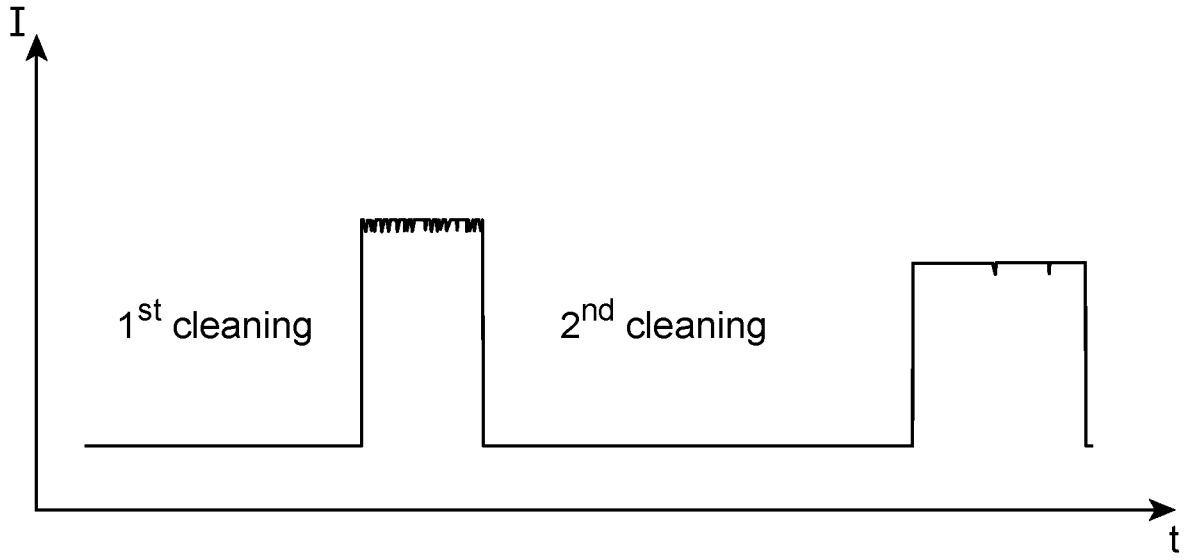
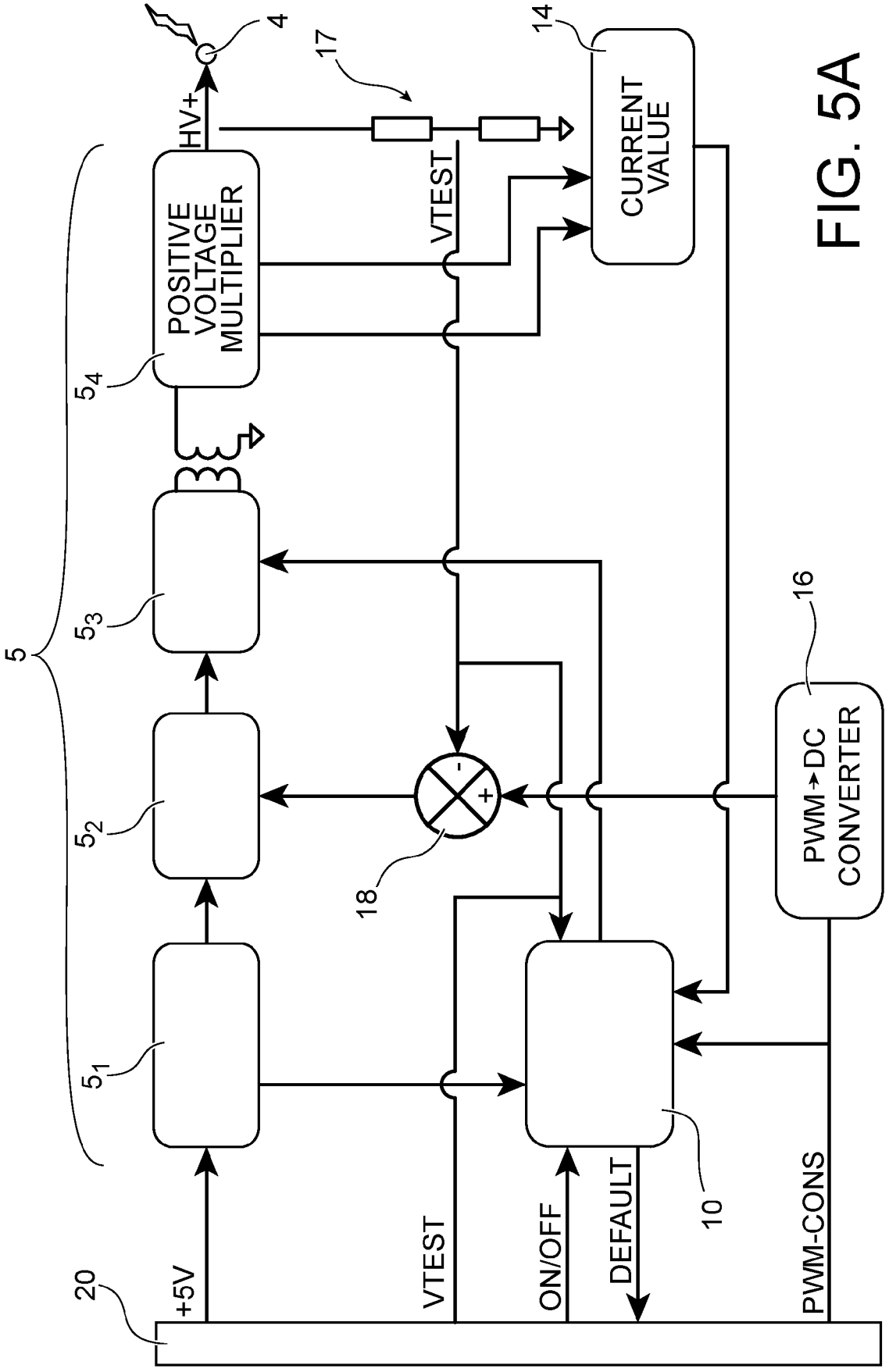


FIG. 4B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17
14
HV+
VTEST
CURRENT VALUE
POSITIVE VOLTAGE MULTIPLIER
5
5₄
5₃
5₂
5₁
18
16
PWM→DC CONVERTER
10
20
+5V
VTEST
ON/OFF
DEFAULT
PWM-CONS

FIG. 5A

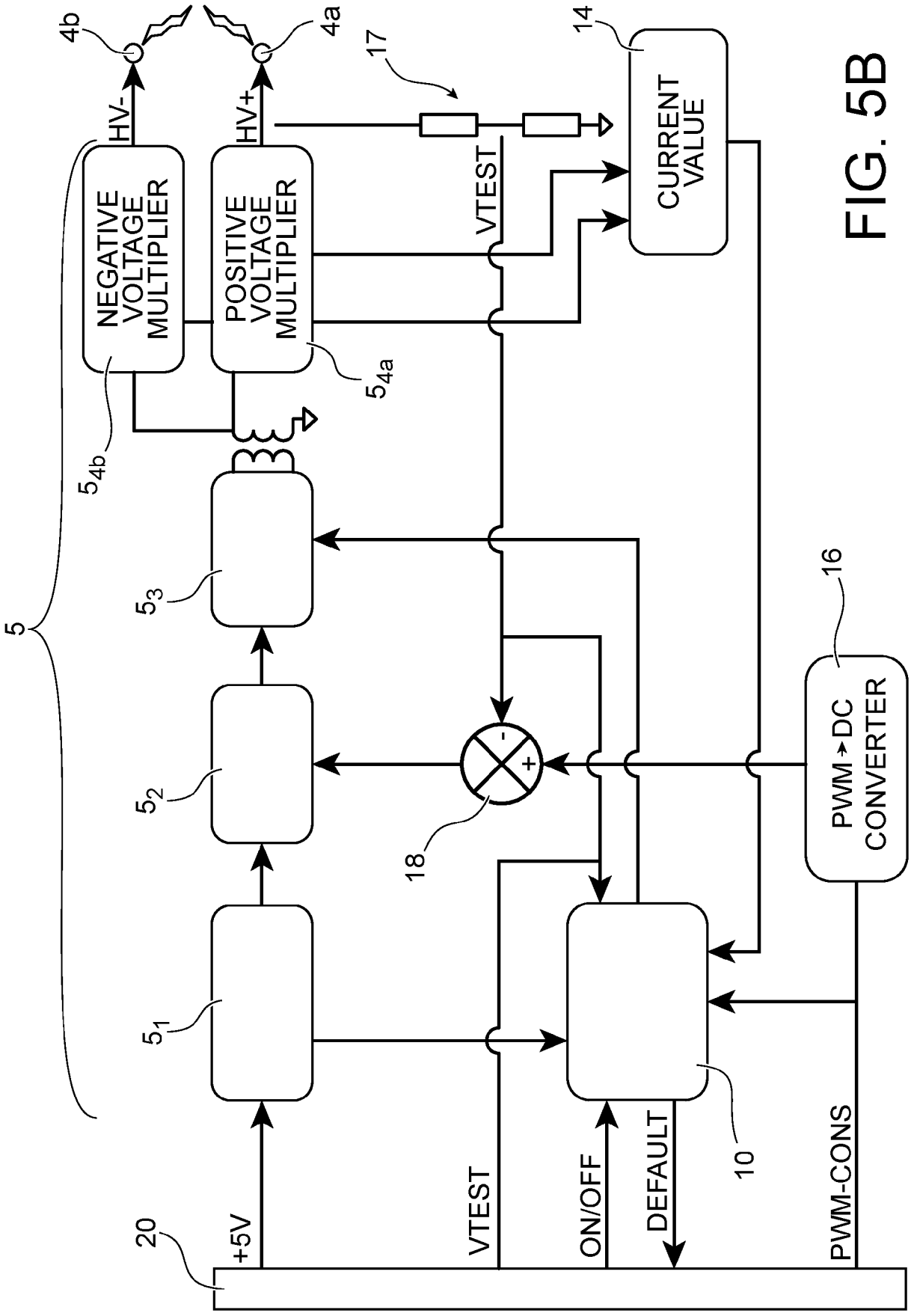
4b
4a
17
14
HV-
HV+
CURRENT VALUE
NEGATIVE VOLTAGE MULTIPLIER
POSITIVE VOLTAGE MULTIPLIER
VTEST
5_{4a}
5_{4b}
5
5_3
5_2
5_1
16
PWM→DC CONVERTER
18
20
+5V
VTEST
ON/OFF
DEFAULT
10
PWM-CONS

FIG. 5B

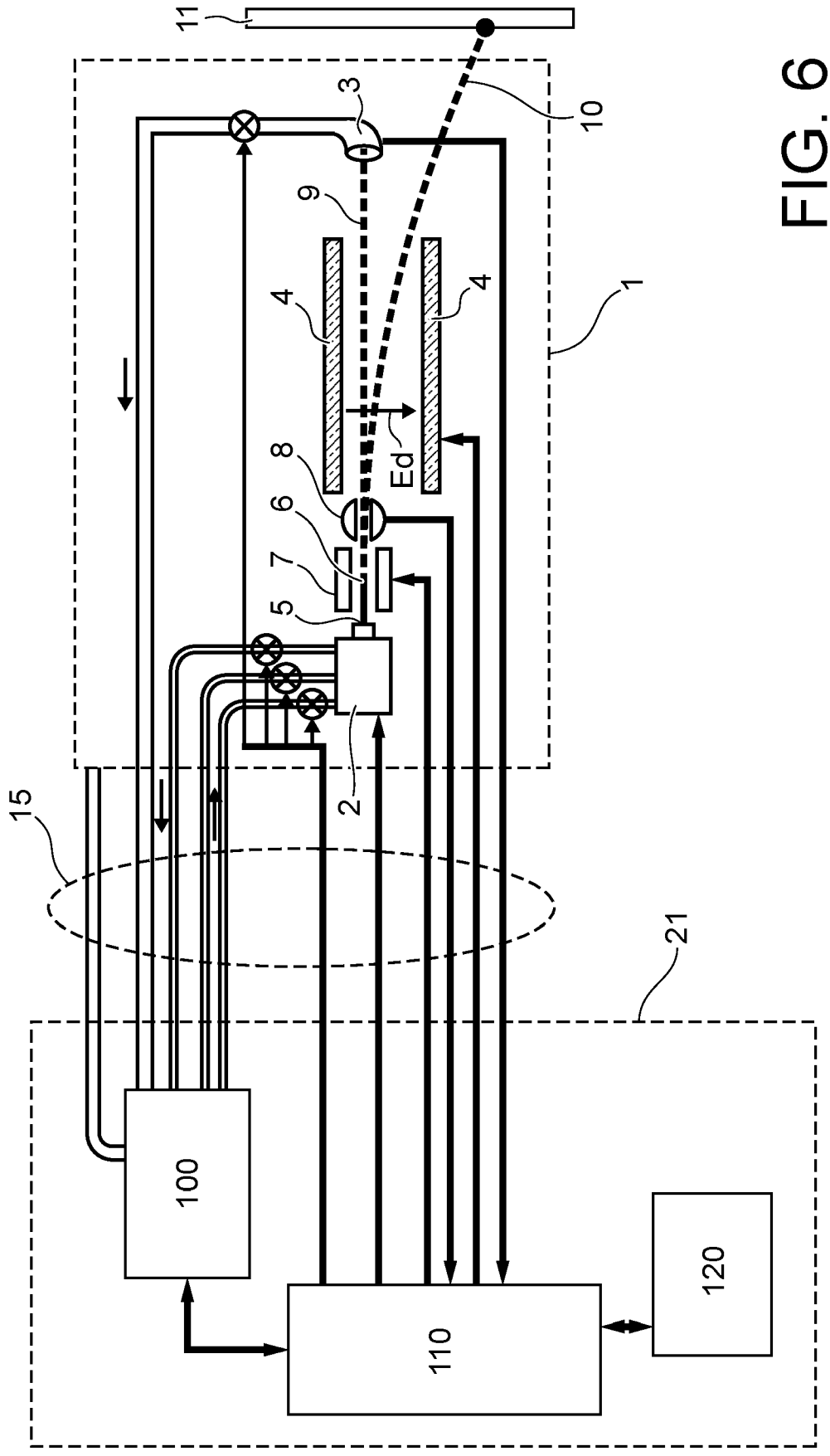

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 9493

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 771 655 A2 (SCITEX DIGITAL PRINTING INC [US]) 7 May 1997 (1997-05-07) * column 1, line 5 - column 2, line 40 * * column 3, line 9 - column 4, line 5 * * claims 1-11; figures 1-4 * -----	1-15	INV. B41J2/09 B41J2/125
			TECHNICAL FIELDS SEARCHED (IPC) B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 March 2024	Bacon, Alan

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04-03-2024

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