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(54) **PRINTER DEVICE AND METHOD FOR POSITIONING A PRINT HEAD ASSEMBLY IN A PRINTER DEVICE**

(57) The present invention relates to a method for positioning a print head assembly in a printer device. The invention also relates to a printer device configured for applying such method.

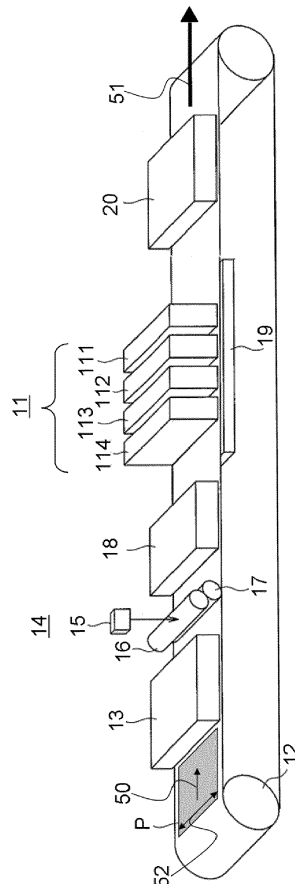


Fig. 1

EP 3 587 131 A1

Description

[0001] The present invention relates to a method for positioning a print head assembly in a printer device. The invention also relates to a printer device configured for applying such method.

Background of the invention

[0002] Inkjet printers are known in the art. Ink jet printers apply an image onto a recording medium by applying a predetermined pattern of droplets onto the recording medium. The droplets are generally ejected by one or more print heads. The one or more print heads may be mounted together on a print head assembly. Optionally, an inkjet printer device may comprise more than one print head assembly.

The droplets ejected by an inkjet print head typically have a volume of a few picoliters. These droplets are thus very small. Therefore, it is very important that the droplets are positioned accurately with regard to one another. Therefore, it is necessary that the print head assemblies carrying the print heads are positioned accurately with regard to the printer device.

After replacement or servicing of the print head assembly, the print head assembly may need to be positioned wrt the printer device. Methods for positioning a print head assembly wrt a printer device are known in the art. US 6,249,300 describes a two-step method for positioning a print head assembly in a printer, wherein the first step is a linear homing step and the second step is a rotary homing step.

With regard to accuracy, there is room for improvement.

[0003] It is therefore an object of the present invention to provide a method for positioning a print head assembly in printer device with improved accuracy. Preferably, such method does not require relative positioning of different sensors.

Summary of the invention

[0004] The object of the present invention is achieved in a method for positioning a print head assembly in a printer device, the print head assembly comprising:

- a lever for moving the print head assembly in the printer device;
- a course sensor configured to detect a position of the print head assembly;
- a lead screw mechanism for moving the print head assembly along the lead screw path;
- a fine sensor configured to detect a rotational position of the lead screw mechanism,

the method comprising the steps of:

- a) Moving the print head assembly to a first position by moving the lever, the first position being the po-

sition were the coarse sensor detects the lever;

b) Moving the print head assembly to a second position by moving the lead screw mechanism in a first direction, the second position being the position were the fine sensor detects a first signal;

c) Moving the print head assembly to a third position by moving the lead screw mechanism in a second direction, the second direction being opposite the first direction until a second signal is detected, the third position being the position were the fine sensor detects a second signal;

d) Based on the detected first, second and third position, determining the first distance, the first distance being the distance between the first and second signal and determining the second distance, the second distance being the distance between the first and third signal;

e) Determining a first difference between the first distance and the predetermined distance and determining a second difference between the second distance and the predetermined distance;

f) Determining which of the first difference and second difference is smallest;

g) Selecting a reference signal from the group consisting of the first and second signal;

h) Moving the print head assembly to a final position, the final position being in between the second and third position, the final position being positioned at the predetermined distance from the reference signal.

[0005] The print head assembly may comprise at least one print head. The print head assembly may comprise a print head array, for example a page wide array for use in a single pass inkjet printer device. Alternatively, the at least one print head may be mounted on a carriage configured to move in reciprocation in a scanning direction. The print head assembly may further comprise means for positioning the print head assembly with regard to the inkjet printer device. These means may comprise a lever, a course sensor, a lead screw mechanism and a fine sensor.

[0006] The lever may be pivotably connected to the inkjet printer device. The print head assembly may be connected to the lever. When moving the lever, the print head assembly is also moved. The lever may be provided with a marker detectable by a sensor. Examples of markers are visible markers or protrusions.

The print head assembly may further comprise a coarse sensor. The coarse sensor may be configured to detect proximity of the marker provided on the lever. The coarse sensor may be an inexpensive sensor. For example, the coarse sensor may be a slotted optical switch. When the marker on the lever approaches the coarse sensor, the coarse sensor may generate a signal.

The lead screw mechanism may be a mechanism for providing a linear movement of the print head assembly along a lead screw. The movement may be effected by

operation of a stepper motor. The lead screw may be provided with a vane configured to rotate around the screw. The vane may be provided with one or more markers for detecting a rotational position of the vane. The marker provided on the vane may be detected by a fine sensor. The marker should be selected such that it can be detected by the fine sensor. For example, the marker may be a protrusion, a magnetic element, or an optical marker.

In the method according to the present invention, in step a), print head assembly is moved to a first position by moving the lever, the first position being the position where the coarse sensor detects the lever. The lever may comprise and/or be operatively connected to suitable moving means. When the coarse level detects the lever, the print head is approximately at the right position. However, because of inaccuracy of the coarse sensor, the print head assembly may not be at the exact right position.

[0007] In the method according to the present invention, in step b), the print head assembly is moved to a second position by moving the lead screw mechanism in a first direction, the second position being the position where the fine sensor detects a first signal. The lead screw mechanism provides a slower, but more accurate positioning system than the lever and the coarse sensor. The marker provided on the vane provides a regular signal upon rotation, corresponding to a fixed rotational movement of the vane around the lead screw. For example, if the vane comprises one marker, then a signal is detected by the fine sensor one for a full rotation of the vane. The first direction may be opposite the direction of the lever in step a). Alternatively, the first direction and the direction of the lever in step a) may be the same. The lead screw mechanism is moved in the first direction until the fine sensor detects a first signal.

[0008] Subsequently, in step c), print head assembly is moved to a third position by moving the lead screw mechanism in a second direction, the second direction being opposite the first direction until a second signal is detected, the third position being the position where the fine sensor detects a second signal.

Now, three positions have been determined by the system: the first position, corresponding to the signal detected by the coarse sensor and the second and third position, corresponding to the first and second signal, respectively, detected by the fine sensor. It is now known in between which positions, corresponding to the fine sensor signals, the desired position is. Because of the inaccuracy of the coarse sensor, the print head assembly cannot yet be placed in the desired position. To obtain the desired position, the following steps are taken.

Based on the detected first, second and third position, determining the first distance, the first distance being the distance between the first and second signal and determining the second distance, the second distance being the distance between the first and third signal.

In step d), the first distance, the first distance being the distance between the first and second signal and the sec-

ond distance, the second distance being the distance between the first and third signal are determined based on the detected first, second and third position. In step e), a first difference between the first distance and a predetermined distance is determined, as well as a second difference between the second distance and the predetermined distance. The predetermined distance may be determined in a calibration procedure. The predetermined distance may be stored on suitable storing means. The predetermined distance may be the distance between a previously measured position corresponding to a signal of the coarse sensor and the closest position, corresponding to a signal detected by the fine sensor.

In step f), it is determined which of the first difference and second difference is smallest. Now it is known which of these distances closest resembles the predetermined distance. In step g), a reference signal is selected from the group consisting of the first and second signal. The reference signal is the fine sensor signal corresponding to the distance closest resembling the predetermined distance.

In step h), the print head assembly is moved to a final position, the final position being in between the second and third position, the final position being positioned at the predetermined distance from the reference signal. The final position is the desired position of the print head assembly. Preferably, the final position is the position where the print head assembly is properly positioned with regard to the printer frame and the paper path.

By using the method according to the invention, the accuracy of positioning a print head assembly can be improved. Accurate positioning is important to obtain good print quality.

[0009] In an embodiment, the method further comprises the steps of:

a' storing the position where the coarse sensor detects the lever.

Over time, the signal of the coarse sensor may show drift. By storing the detected coarse signal, it can be compared to other signals of the coarse sensor (previously measured signals as well as signals to be measured in future). By storing the measured signal and comparing it to previously measured signals of the coarse sensor it can be determined whether drift has occurred. This drift can then be compensated for when determining the reference signal.

Preferably, the maximum drift of the sensor is less than half the distance between two subsequent signals of the fine sensor. If the drift approaches the maximum drift, then a warning may be issued, based on which the user may take measures, such as cleaning the sensors. Alternatively, cleaning of the sensors may be done in an automated way.

[0010] In an aspect of the invention, a printer apparatus is provided, the printer apparatus comprising a print head assembly in a printer device, the print head assembly

comprising:

- a lever for moving the print head assembly in the printer device;
- a course sensor configured to detect a position of the print head assembly;
- a lead screw mechanism for moving the print head assembly along the lead screw path;
- a fine sensor configured to detect a rotational position of the lead screw mechanism,

wherein the printer apparatus further comprises a control unit configured to control the printer apparatus to perform a method according to the present invention.

The printer apparatus is thus configured to perform the method according to the present invention.

[0011] In an embodiment, the printer apparatus is an inkjet printer apparatus

Brief Description of the Drawings

[0012] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying schematical drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

Fig. 1 shows a schematic representation of an inkjet printing system.

Fig. 2 shows a schematic representation of an inkjet marking device: A) and B) assembly of inkjet heads; C) detailed view of a part of the assembly of inkjet heads.

Fig 3A - E show a schematic representation of a first embodiment of the method according to the present invention.

Fig. 4 shows a first example of a mechanism for positioning a print head assembly

Fig. 5A-B show a second example of a mechanism for positioning a print head assembly.

[0013] In the drawings, same reference numerals refer to same elements.

Detailed description of the Drawings

[0014] The present invention will now be described with reference to the accompanying drawings, wherein the same reference numerals have been used to identify the same or similar elements throughout the several views.

[0015] A printing process in which the inks according to the present invention may be suitably used is described with reference to the appended drawings shown in Fig. 1 and Fig. 2A -C. Figs. 1 and 2A-C show schematic representations of an inkjet printing system and an inkjet marking device, respectively.

[0016] Fig. 1 shows a sheet of a receiving medium P.

The image receiving medium P may be composed of e.g. paper, cardboard, label stock, coated paper, plastic, machine coated paper or textile. Alternatively, the receiving medium may be a medium in web form (not shown). The medium, P, is transported in a direction for conveyance as indicated by arrows 50 and 51 and with the aid of transportation mechanism 12. Transportation mechanism 12 may be a driven belt system comprising one (as shown in Fig. 1) or more belts. Alternatively, one or more of these belts may be exchanged for one or more drums. A transportation mechanism may be suitably configured depending on the requirements (e.g. sheet registration accuracy) of the sheet transportation in each step of the printing process and may hence comprise one or more driven belts and/or one or more drums. For a proper conveyance of the sheets of receiving medium, the sheets need to be fixed to the transportation mechanism. The way of fixation is not particularly limited and may be selected from electrostatic fixation, mechanical fixation (e.g. clamping) and vacuum fixation. Of these, vacuum fixation is preferred.

The printing process as described below comprises of the following steps: media pre-treatment, image formation, drying and fixing and optionally post treatment.

[0017] Fig. 1 shows that the sheet of receiving medium P may be conveyed to and passed through a first pre-treatment module 13, which module may comprise a pre-heater, for example a radiation heater, a corona/plasma treatment unit, a gaseous acid treatment unit or a combination of any of the above. Optionally and subsequently, a predetermined quantity of the pre-treatment liquid is applied on the surface of the receiving medium P at pre-treatment liquid applying member 14. Specifically, the pre-treatment liquid is provided from storage tank 15 of the pre-treatment liquid to the pre-treatment liquid applying member 14 composed of double rolls 16 and 17. Each surface of the double rolls may be covered with a porous resin material such as sponge. After providing the pre-treatment liquid to auxiliary roll 16 first, the pre-treatment liquid is transferred to main roll 17, and a predetermined quantity is applied on the surface of the receiving medium P. Subsequently, the image receiving medium P on which the pre-treatment liquid was supplied may optionally be heated and dried by drying member 18 which is composed of a drying heater installed at the downstream position of the pre-treatment liquid applying member 14 in order to decrease the quantity of the water content in the pre-treatment liquid to a predetermined range. It is preferable to decrease the water content in an amount of 1.0 weight% to 30 weight% based on the total water content in the provided pre-treatment liquid provided on the receiving medium P.

To prevent the transportation mechanism 12 being contaminated with pre-treatment liquid, a cleaning unit (not shown) may be installed and/or the transportation mechanism may be comprised of multiple belts or drums as described above. The latter measure prevents contamination of the upstream parts of the transportation mech-

anism, in particular of the transportation mechanism in the printing region.

Image formation

[0018] Image formation is performed in such a manner that, employing an inkjet printer loaded with inkjet inks, ink droplets are ejected from the inkjet heads based on the digital signals onto a print medium. The inkjet inks may be inkjet inks according to the present invention. Although both single pass inkjet printing and multi pass (i.e. scanning) inkjet printing may be used for image formation, single pass inkjet printing is preferably used since it is effective to perform high-speed printing. Single pass inkjet printing is an inkjet recording method with which ink droplets are deposited onto the receiving medium to form all pixels of the image by a single passage of a receiving medium underneath an inkjet marking module. In Fig. 1, 11 represents an inkjet marking module comprising four inkjet marking devices, indicated with 111, 112, 113 and 114, each arranged to eject an ink of a different color (e.g. Cyan, Magenta, Yellow and black). The nozzle pitch of each head is e.g. about 360 dpi. In the present invention, "dpi" indicates a dot number per 2.54 cm.

[0019] An inkjet marking device for use in single pass inkjet printing, 111, 112, 113, 114, has a length, L, of at least the width of the desired printing range, indicated with double arrow 52, the printing range being perpendicular to the media transport direction, indicated with arrows 50 and 51. The inkjet marking device may comprise a single print head having a length of at least the width of said desired printing range. The inkjet marking device may also be constructed by combining two or more inkjet heads, such that the combined lengths of the individual inkjet heads cover the entire width of the printing range. Such a constructed inkjet marking device is also termed a page wide array (PWA) of print heads. Fig. 2A shows an inkjet marking device 111 (112, 113, 114 may be identical) comprising 7 individual inkjet heads (201, 202, 203, 204, 205, 206, 207) which are arranged in two parallel rows, a first row comprising four inkjet heads (201 - 204) and a second row comprising three inkjet heads (205 - 207) which are arranged in a staggered configuration with respect to the inkjet heads of the first row. The staggered arrangement provides a page wide array of nozzles which are substantially equidistant in the length direction of the inkjet marking device. The staggered configuration may also provide a redundancy of nozzles in the area where the inkjet heads of the first row and the second row overlap, see 70 in Fig. 2B. Staggering may further be used to decrease the nozzle pitch (hence increasing the print resolution) in the length direction of the inkjet marking device, e.g. by arranging the second row of inkjet heads such that the positions of the nozzles of the inkjet heads of the second row are shifted in the length direction of the inkjet marking device by half the nozzle pitch, the nozzle pitch being the distance be-

tween adjacent nozzles in an inkjet head, d_{nozzle} (see Fig. 2C, which represents a detailed view of 80 in Fig. 2B). The resolution may be further increased by using more rows of inkjet heads, each of which are arranged such that the positions of the nozzles of each row are shifted in the length direction with respect to the positions of the nozzles of all other rows.

[0020] In image formation by ejecting an ink, an inkjet head (i.e. print head) employed may be either an on-demand type or a continuous type inkjet head. As an ink ejection system, there may be usable either the electric-mechanical conversion system (e.g., a single-cavity type, a double-cavity type, a bender type, a piston type, a shear mode type, or a shared wall type), or an electric-thermal conversion system (e.g., a thermal inkjet type, or a Bubble Jet type (registered trade name)). Among them, it is preferable to use a piezo type inkjet recording head which has nozzles of a diameter of 30 μm or less in the current image forming method.

Fig. 1 shows that after pre-treatment, the receiving medium P is conveyed to upstream part of the inkjet marking module 11. Then, image formation is carried out by each color ink ejecting from each inkjet marking device 111, 112, 113 and 114 arranged so that the whole width of the image receiving medium P is covered.

Optionally, the image formation may be carried out while the receiving medium is temperature controlled. For this purpose a temperature control device 19 may be arranged to control the temperature of the surface of the transportation mechanism (e.g. belt or drum) underneath the inkjet marking module 11. The temperature control device 19 may be used to control the surface temperature of the receiving medium P, for example in the range of 10°C to 100°C. The temperature control device 19 may comprise heaters, such as radiation heaters, and a cooling means, for example a cold blast, in order to control the surface temperature of the receiving medium within said range. Subsequently and while printing, the receiving medium P is conveyed to the downstream part of the inkjet marking module 11.

Drying and fixing

[0021] After an image has been formed on the receiving medium, the prints have to be dried and the image has to be fixed onto the receiving medium. Drying comprises the evaporation of solvents, in particular those solvents that have poor absorption characteristics with respect to the selected receiving medium.

[0022] Fig. 1 schematically shows a drying and fixing unit 20, which may comprise a heater, for example a radiation heater. After an image has been formed, the print is conveyed to and passed through the drying and fixing unit 20. The print is heated such that solvents present in the printed image, such as water and/or organic co-solvents, evaporate. The speed of evaporation and hence drying may be enhanced by increasing the air refresh rate in the drying and fixing unit 20. Simultaneously, film

formation of the ink occurs, because the prints are heated to a temperature above the minimum film formation temperature (MFFT). The residence time of the print in the drying and fixing unit 20 and the temperature at which the drying and fixing unit 20 operates are optimized, such that when the print leaves the drying and fixing unit 20 a dry and robust print has been obtained. As described above, the transportation mechanism 12 in the fixing and drying unit 20 may be separated from the transportation mechanism of the pre-treatment and printing section of the printing apparatus and may comprise a belt or a drum.

Post treatment

[0023] To increase the print robustness or other properties of a print, such as gloss level, the print may be post treated, which is an optional step in the printing process. For example, the prints may be post treated by laminating the prints. Alternatively, the post-treatment step comprises a step of applying (e.g. by jetting) a post-treatment liquid onto the surface of the coating layer, onto which the inkjet ink has been applied, so as to form a transparent protective layer on the printed recording medium.

[0024] Hitherto, the printing process was described such that the image formation step was performed in-line with the pre-treatment step (e.g. application of an (aqueous) pre-treatment liquid) and a drying and fixing step, all performed by the same apparatus (see Fig. 1). However, the printing process is not restricted to the above-mentioned embodiment. A method in which two or more machines are connected through a belt conveyor, drum conveyor or a roller, and the step of applying a pre-treatment liquid, the (optional) step of drying a coating solution, the step of ejecting an inkjet ink to form an image and the step of drying and fixing the printed image are performed. It is, however, preferable to carry out image formation with the above defined in-line image forming method.

[0025] Fig. 3A shows the first position 401, corresponding to the position where the coarse sensor detected the lever. The (first) position may also be referred to as (first) signal. Fig. 3B shows the position of the second position 402.

Fig. 3C shows the position of the third position 403, as well as the second position 402. Each signal provided by the fine sensor, corresponding to a certain rotation of the vane. The signals are provided at regular intervals; the distance between two subsequent signals of the fine sensors is constant. Positions in between the second position 402 and the third position 403 may be expressed e.g. in a number of steps performed by a stepper motor. Alternatively, positions in between the second position 402 and the third position 403 may be expressed e.g. in degrees rotation of the vane.

Fig. 3D shows first distance 411, the first distance being the distance between the first signal 401 and the second signal 402. Fig. 3D further shows second distance 412, the second distance being the distance between the first

signal 401 and the third signal 403. In the example shown, the first distance is 1120 steps, whereas the second distance is - 480 steps. The sign (positive/negative) corresponds to the relative position of the second position, third position, respectively wrt to the first position.

Fig. 3E shows a predetermined distance 413, based on a predetermined position 404. In the example shown, the predetermined distance is + 400. The difference between the first distance 411 and the predetermined distance 413 is 720 (1120 - 400), the difference between the second distance 412 and the predetermined distance 413 is 880(400- -480). Thus, the difference between the first distance and the predetermined distance is smaller than the difference between the second distance and the predetermined distance.

Thus, the second position 402, corresponding to the first signal provided by the fine sensor is used as reference position.

[0026] Fig. 4 shows a first example of a mechanism 300 for positioning a print head assembly. The mechanism 300 comprises lever 304 pivotably positioned around pivot 305. The lever 304 is operatively connected to coarse sensor 301. The lever can be further moved by lead screw arrangement 308. The lead screw arrangement 308 comprises vane 303, which is operatively connected to induce a signal in fine sensor 302. Part 307 is part of the print frame. A print head (not shown) is operatively connected to the part 307. The positioning part 306 can be placed against the media belt of the printer.

[0027] Fig. 5A shows a second example of a mechanism 300 for positioning a print head assembly. Fig. 5B shows, the same example, but viewed at from a different perspective. In the mechanism shown in figs 5A-5B, the vane is embodied as a rotatable protrusion 303. The rotatable protrusion 303 may be magnetic. The fine sensor 302 may provide a signal when the sensor 302 detects the rotatable protrusion 303.

[0028] While detailed embodiments of the present invention are disclosed herein, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. In particular, features presented and described in separate dependent claims may be applied in combination and any advantageous combination of such claims are herewith disclosed.

[0029] Further, the terms and phrases used herein are not intended to be limiting; but rather, to provide an understandable description of the invention. The terms "a" or "an", as used herein, are defined as one or as more than one. The term plurality, as used herein, is defined as two or more than two. The term another, as used herein, is defined as at least a second or more. The terms including and/or having, as used herein, are defined as

comprising (i.e., open language).

[0030] It will be evident that the described embodiments may be varied in many ways. All such modifications as would be evident to one skilled in the art starting from what is explicitly described are intended to be included.

Claims

1. Method for positioning a print head assembly in a printer device, the print head assembly comprising:

- a lever for moving the print head assembly in the printer device;
- a course sensor configured to detect a position of the print head assembly;
- a lead screw mechanism for moving the print head assembly along the lead screw path;
- a fine sensor configured to detect a rotational position of the lead screw mechanism,

the method comprising the steps of:

- a) moving the print head assembly to a first position by moving the lever, the first position being the position where the coarse sensor detects the lever;
- b) moving the print head assembly to a second position by moving the lead screw mechanism in a first direction, the second position being the position where the fine sensor detects a first signal;
- c) moving the print head assembly to a third position by moving the lead screw mechanism in a second direction, the second direction being opposite the first direction until a second signal is detected, the third position being the position where the fine sensor detects a second signal;
- d) based on the detected first, second and third position, determining the first distance, the first distance being the distance between the first and second signal and determining the second distance, the second distance being the distance between the first and third signal;
- e) determining a first difference between the first distance and a predetermined distance and determining a second difference between the second distance and the predetermined distance;
- f) determining which of the first difference and second difference is smallest;
- g) selecting a reference signal from the group consisting of the first and second signal;
- h) moving the print head assembly to a final position, the final position being in between the second and third position, the final position being positioned at the predetermined distance from the reference signal.

2. Method according to claim 1, wherein the method further comprises the steps of:

- a' storing the position where the coarse sensor detects the lever.

3. Printer apparatus comprising a print head assembly in a printer device, the print head assembly comprising:

- a lever for moving the print head assembly in the printer device;
- a course sensor configured to detect a position of the print head assembly;
- a lead screw mechanism for moving the print head assembly along the lead screw path;
- a fine sensor configured to detect a rotational position of the lead screw mechanism,

wherein the printer apparatus further comprises a control unit configured to control the printer apparatus to perform a method according to any of the claims 1 - 2.

4. Printer apparatus according to claim 3, wherein the printer apparatus is an inkjet printer apparatus.

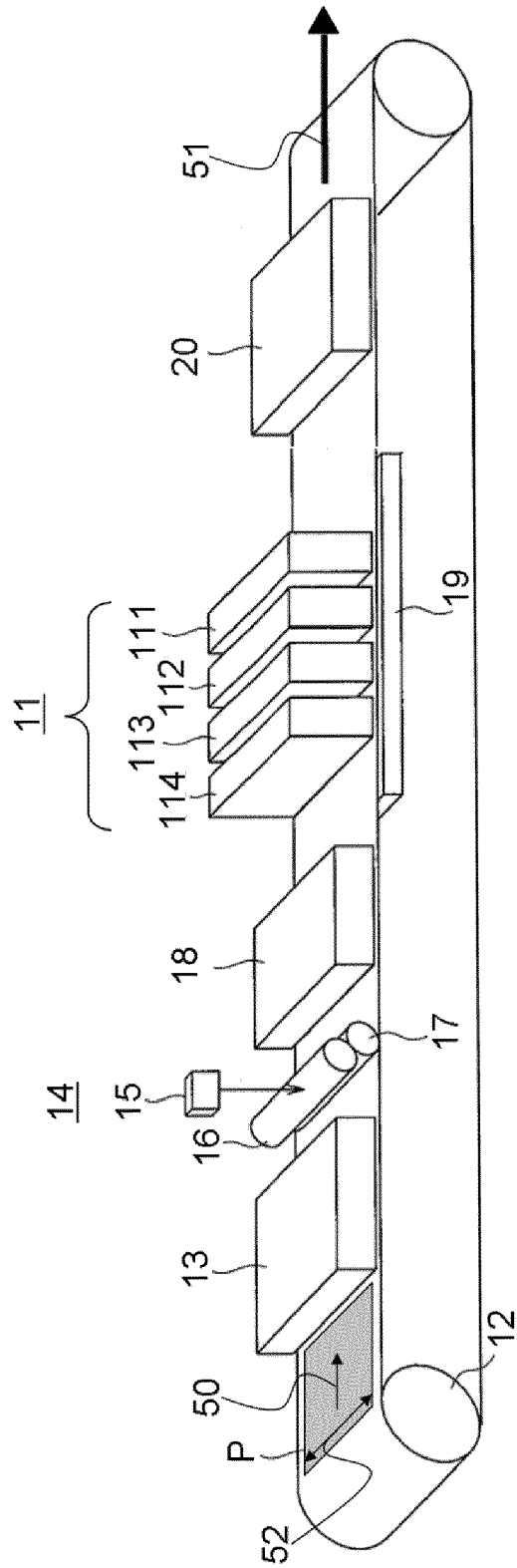


Fig. 1

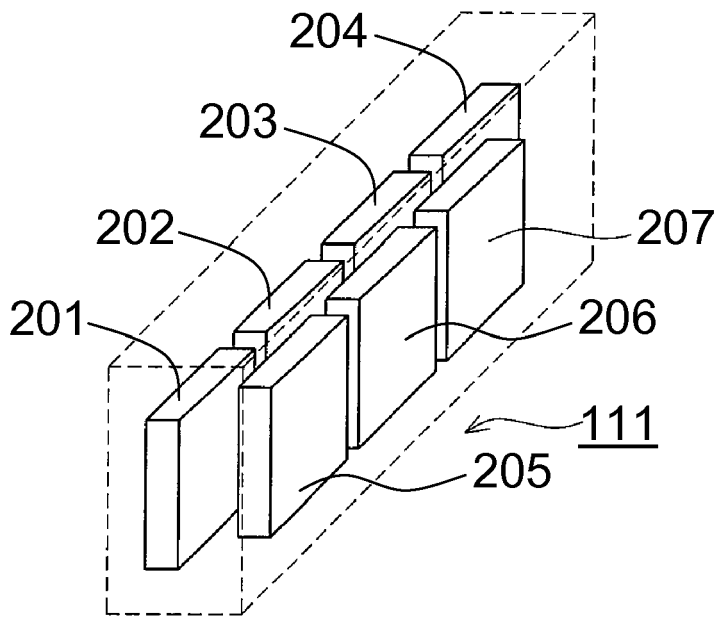


Fig. 2A

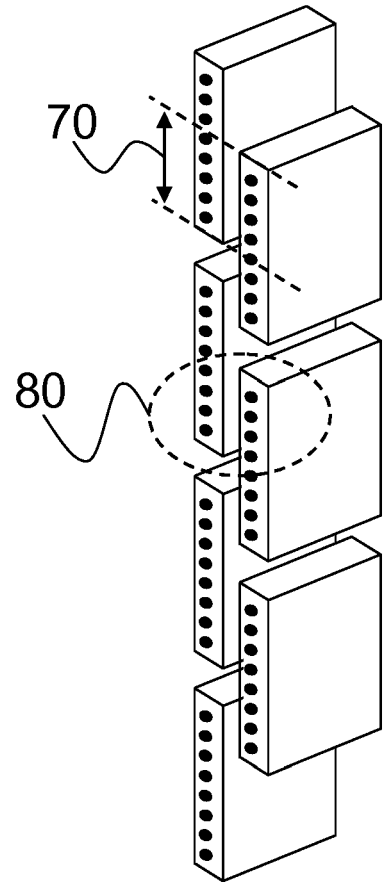


Fig. 2B

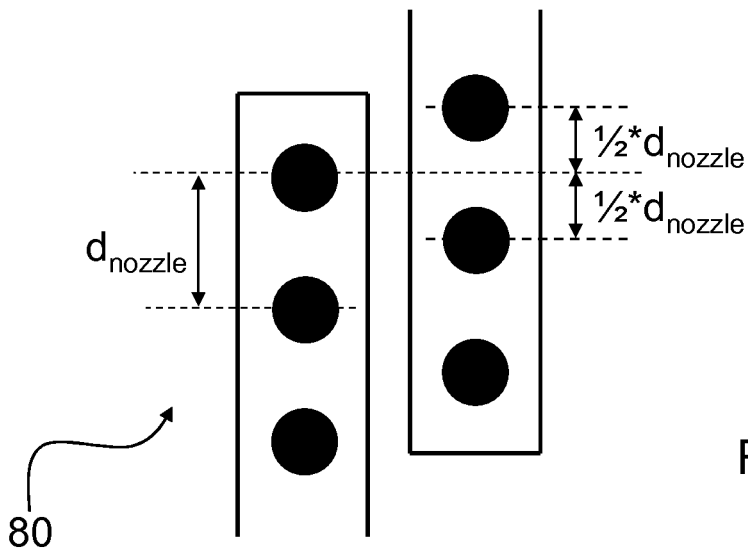


Fig. 2C

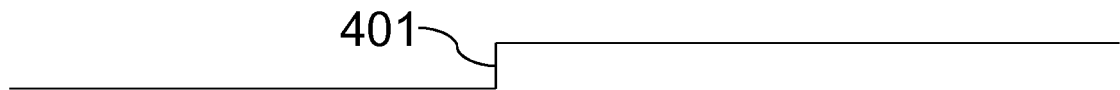


Fig. 3A



Fig. 3B



Fig. 3C

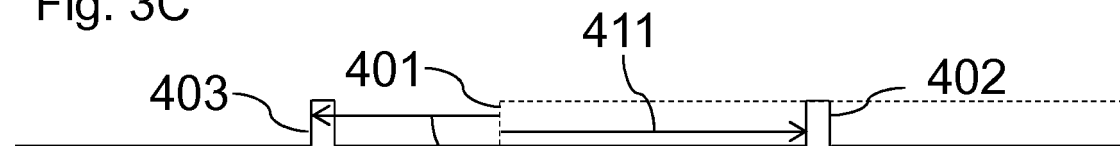


Fig. 3D

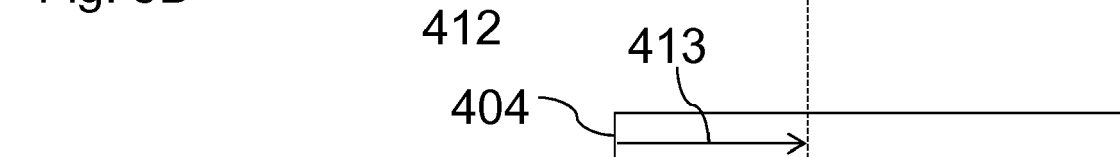


Fig. 3E

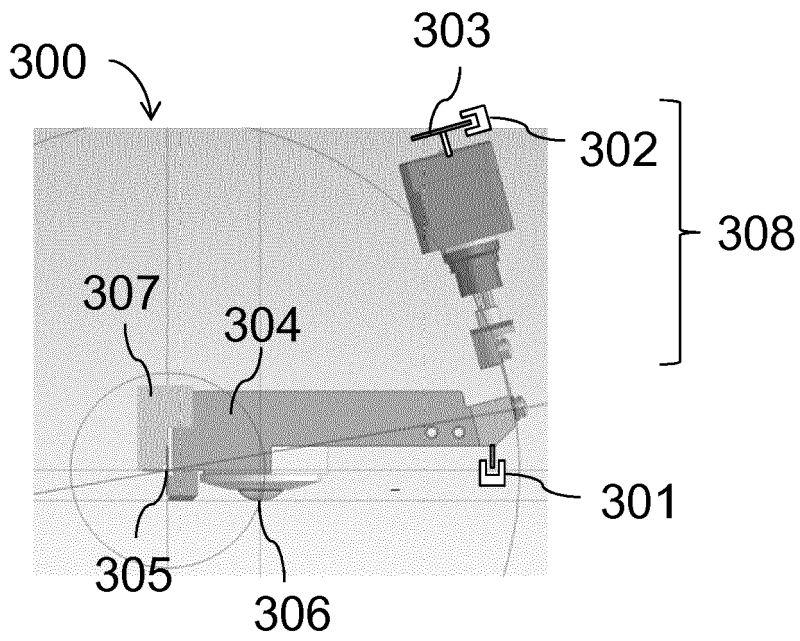


Fig. 4

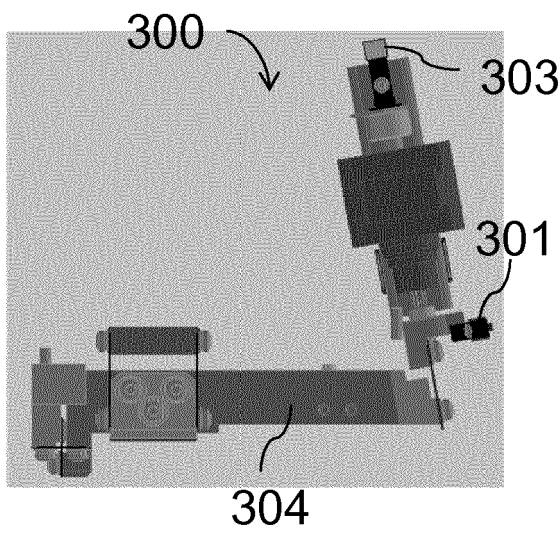


Fig. 5A

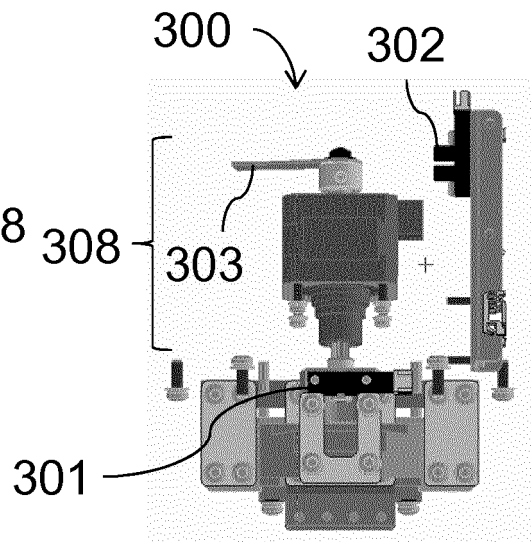


Fig. 5B



EUROPEAN SEARCH REPORT

Application Number
EP 18 17 9222

5

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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	KR 2003 0088241 A (SAMSUNG ELECTRONICS CO LTD [KR]) 19 November 2003 (2003-11-19) * the whole document * -----	1-4	INV. B41J19/20 B41J25/316 TECHNICAL FIELDS SEARCHED (IPC) B41J
A	EP 0 351 854 A2 (CANON KK [JP]) 24 January 1990 (1990-01-24) * column 7, line 41 - column 15, line 10; figures 1-20 * -----	1-4	
A	EP 1 790 487 A1 (RICOH KK [JP]) 30 May 2007 (2007-05-30) * paragraph [0009] - paragraph [0080]; figures 1-20B * -----	1-4	
A	JP 2005 212147 A (KONICA MINOLTA HOLDINGS INC) 11 August 2005 (2005-08-11) * the whole document * -----	1-4	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 13 December 2018	Examiner Dewaele, Karl
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/02 (P04/C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 18 17 9222

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

13-12-2018

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 20030088241 A	19-11-2003	NONE	
EP 0351854 A2	24-01-1990	DE 68918898 D1 DE 68918898 T2 EP 0351854 A2 US 5402161 A	24-11-1994 16-03-1995 24-01-1990 28-03-1995
EP 1790487 A1	30-05-2007	EP 1790487 A1 JP 4668044 B2 JP 2007144633 A	30-05-2007 13-04-2011 14-06-2007
JP 2005212147 A	11-08-2005	NONE	

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20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6249300 B [0002]