(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 January 2014 (09.01.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/005655 A1

(51) International Patent Classification:
G03G 15/10 (2006.01)

(21) International Application Number:
PCT/EP2012/063337

(22) International Filing Date:
6 July 2012 (06.07.2012)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **Hewlett-Packard Indigo B.V.** [NL/NL]; Limburglaan, NL-6221 SH Maastricht (NL).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **PELEG, Eyal** [IL/IL]; Einstein 10, Kiryat Weizmann, 76101 Nes Ziona (IL). **SCHLUMM, Doron** [IL/IL]; Einstein 10, Kiryat Weizmann, 76101 Nes Ziona (IL). **BELINKOV, Haim** [IL/IL]; Einstein 20, 76101 Nes Ziona (IL).

(74) Agent: **BLASEBY, Matthew**; Eip, Fairfax House, 15 Fulwood Place, London Greater London WC1V 6HU (GB).

(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, QA, RO, RS, RU, RW, 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, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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).

Published:

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

(54) **Title**: PRINTING SYSTEM

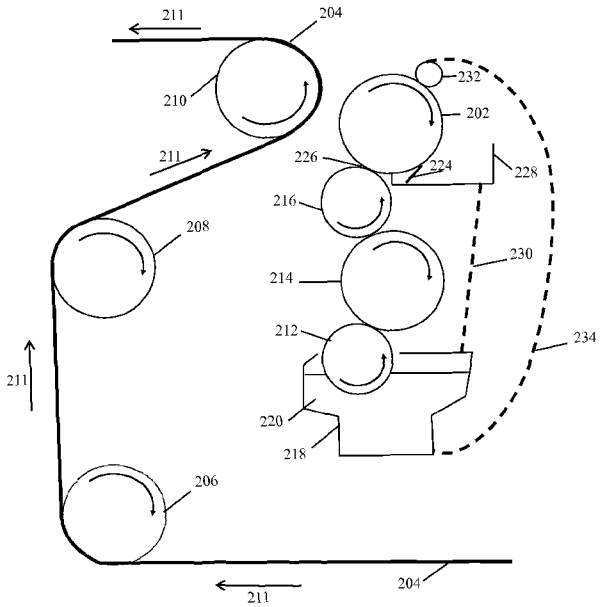

Fig. 2b

(57) **Abstract**: A printing system comprising: • a) a feeding system (206, 208, 210) for feeding print media; • b) a first roller (202) for applying a printing fluid to a print medium fed to the first roller by the feeding system; and • c) a supply system (212, 214, 216) for supplying the first roller with a printing fluid, the printing system having a first mode and a second mode, wherein • in the first mode the first roller is positioned relative to the feeding system such that the first roller can apply a printing fluid to a print medium fed to the first roller by the feeding system, and • in the second mode the first roller is positioned relative to the feeding system such that the first roller cannot apply a printing fluid to a print medium fed by the feeding system, wherein the printing system is adapted to control a quantity of a printing fluid on the first roller when the printing system is in the second mode.

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PRINTING SYSTEM

BACKGROUND

[0001] The Hewlett Packard (HP) Indigo line of digital printing presses is based on digital offset color technology, which combines ink-on-paper quality with multi-color printing on a wide range of paper, foil and plastic substrates, i.e. print media. These digital printing presses offer cost-effective short-run printing, on-demand service and on-the-fly color switching.

[0002] Details of an illustrative example of a digital offset printing system are given below. A detailed description of the operation of a typical digital offset printer is also described in Hewlett-Packard (HP) White Paper Publication, "Digital Offset Color vs. Xerography and Lithography", for example. An example of a digital offset printer is HP's digital printing press Indigo Press.TM. 1000, 2000, 4000, or newer, presses, manufactured by and commercially available from Hewlett-Packard Company of Palo Alto, California, USA.

[0003] It is known in printing systems, for example a digital offset printing system, to prime a print medium before printing an image. Such priming can increase the color gamut printable on a print medium, improve fixing of a printed image on a print medium, i.e. the durability of the ink(s) when printed, and/or enable adding additional degrees of freedom to the ink and printing process design.

[0004] A roller may be used to apply a primer to a print medium. It is desirable to apply a layer of primer evenly on the print medium, with a desired thickness, so a high quality image can then be printed on the primed print medium. However, it can be difficult to apply on demand a layer of primer with these properties. For example, if a roller for applying a primer to a print medium is disengaged from the print medium, a length of print medium may be wasted after re-engaging the roller with the print medium, before a satisfactory layer of primer is applied by the roller. In addition to the costs of wasting print medium, valuable time for performing a printing job can be lost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The accompanying drawing illustrates an example of the principles described herein and are a part of the specification. The illustrated example is merely an example and does not limit the scope of the claims.

[0006] Fig.1 is a diagram of part of an illustrative digital offset printing system; and

[0007] Figs. 2a and 2b are diagrams of features of an illustrative printing system in accordance with an example of the invention.

DETAILED DESCRIPTION

[0008] In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present systems and methods. It will be apparent, however, to one skilled in the art that the present apparatus, systems and methods may be practised without these specific details. Reference in the specification to “an example” or similar language means that a particular feature, structure, or characteristic described in connection with the example is included in at least that one example, but not necessarily in other examples.

[0009] In accordance with examples of the present invention, a printing system is provided. Part of the printing system may comprise a digital offset printing system, or may comprise an alternative printing system for printing an image on a print medium. An example of such a digital offset printing system will first be described, followed by a description of features of the printing system in accordance with the present invention.

[0010] Fig. 1 is a diagram of an illustrative digital offset printing system (100), which in this example is a digital Liquid Electro Photographic (LEP) printing system and which may be part of a printing system according to an example of the present invention. The term "Liquid Electro Photographic" or “LEP” refers to a process of printing in which a liquid toner is applied onto a

surface having a pattern of electrostatic charge, to form a pattern of liquid toner corresponding with the electrostatic charge pattern. This pattern of liquid toner is then transferred to at least one intermediate surface, and then to a print medium. During the operation of a digital LEP system, ink images are formed on the surface of a photo-imaging cylinder. These ink images are transferred to a heated blanket cylinder, which heating evaporates a liquid carrier, and then to a print medium. The photo-imaging cylinder continues to rotate, passing through various stations to form the next image.

[0011] In the illustrative digital LEP system (100), the desired image is communicated to the printing system (100) in digital form. The desired image may include any combination of text, graphics and images. The desired image is initially formed on the photo-imaging cylinder (105), transferred to a blanket (122) on the outside of the blanket cylinder (120), and then transferred to the print medium (140). The blanket (122) may otherwise be referred to as an intermediate transfer member (ITM).

[0012] According to one illustrative example, an image is formed on the photo-imaging cylinder (105) by rotating a clean, bare segment of the photo-imaging cylinder (105) under the photo charging unit (110). The photo charging unit (110) includes a charging device such as corona wire, charge roller, or other charging device and a laser imaging portion. A uniform static charge is deposited on the photo-imaging cylinder (105) by the photo charging unit (110). As the photo-imaging cylinder (105) continues to rotate, it passes the laser imaging portion of the photo charging unit (110) that dissipates the static charges in selected portions of the image area to leave an invisible electrostatic charge pattern that represents the image to be printed.

[0013] Ink is transferred onto the photo-imaging cylinder (105) by Binary Ink Developer (BID) units (115). There is one BID unit (115) for each ink color. During printing, the appropriate BID unit is engaged with the photo-imaging cylinder (105). The engaged BID unit presents a uniform film of ink to the photo-imaging cylinder (105). The ink contains electrically charged pigment particles which are attracted to the opposing electrical fields on the image areas of the photo-imaging cylinder (105). The ink is repelled from the

uncharged, non-image areas. The photo-imaging cylinder (105) now has a single color ink image on its surface.

[0014] The photo-imaging cylinder (105) continues to rotate and transfers the ink image to the ITM (122) of the blanket cylinder (120) which is heatable. The blanket cylinder transfers the image from the ITM to a sheet of media wrapped around the impression cylinder (130). In other examples the media may be web fed. As will be further described below, this process may be repeated for each of the colored ink layers to be included in the final image.

[0015] The print medium (140) enters the printing system (100) from the right, passes over a feed tray (125), and is wrapped onto the impression cylinder (130). The print medium may have been pre-printed with a primer, for example, as will be described later using Figs. 2a and 2b. As the print medium (140) contacts the ITM (122) of the blanket cylinder (120), the single color ink image is transferred to the print medium (140). The creation, transfer, and cleaning of the photo-imaging cylinder (105) is a continuous process, with hundreds of images being created and transferred per minute.

[0016] To form a single color image (such as a black and white image), one pass of the print medium (140) through the impression cylinder (130) and the blanket cylinder (120) completes the desired image. For a color image, the print medium (140) is retained on the impression cylinder (130) and makes multiple contacts with the blanket cylinder (120) as it passes through the nip (127). At each contact, an additional color plane may be placed on the print medium (140). The term nip refers to a region between two rollers where the rollers are in closest proximity. When a media sheet or other material passes through the nip, the distance between the two rollers can be adjusted to produce pressure on the media.

[0017] For example, to generate a four color image, the photo charging unit (110) forms a second pattern on the photo-imaging cylinder (105) which receives the second ink color from a second BID unit (115). As described above, this second ink pattern is transferred to the ITM (122) and impressed onto the print medium (140) as it continues to rotate with the

impression cylinder (130). This continues until the desired image with all four color planes is formed on the print medium. Following the complete formation of the desired image on the print medium (140), the print medium (140) can exit the machine or be duplexed to create a second image on the opposite surface of the print medium (140). In other examples, where the print medium is web fed, all colours of an image may be provided onto the ITM and transferred to the print medium in one rotation of the ITM. Because the printing system is digital, the operator can change the image being printed at any time and without manual reconfiguration.

[0018] Figs. 2a and 2b are diagrams of an illustrative printing system in accordance with the present invention. In this example the printing system is used to print a primer on a print medium before printing an image on the print medium using for example the digital offset printing system described above. The digital offset printing system may be part of a larger printing system comprising the features of Figs. 2a and 2b to be described, or may be a separate printing system.

[0019] Referring to Fig. 2a, the printing system comprises a first roller (202) for applying a printing fluid to a print medium (204) fed to the first roller by a feeding system of the printing system. Thus, a print medium may be coated with the printing fluid, for example as a pattern or as a continuous layer of printing fluid. The printing fluid may be a liquid. The print medium may for example be a flexible paper, plastic or foil substrate in sheet form. In other examples, the print medium may be any substrate to be coated, which may not be flexible. The feeding system in this example comprises a plurality of rollers, in this case three rollers (206),(208), (210), in series for feeding a print medium in a feeding direction (211). The printing system further comprises a supply system for supplying the first roller with a printing fluid. The supply system may comprise at least one roller for supplying a printing fluid to the first roller (202), for example a series of touching rollers, in this example three rollers (212), (214), (216). The supply system in this example supplies the printing fluid from a reservoir (218) of printing fluid (220) in which the first

(212) of the series of rollers of the supply system is at least partially immersed.

[0020] The printing system has a first mode and a second mode. Fig. 2a illustrates the first mode and Fig. 2b illustrates the second mode.

[0021] In the first mode the first roller (202) is positioned relative to the feeding system such that the first roller can apply a printing fluid to a print medium fed to the first roller by the feeding system. Thus, as illustrated in Fig. 2a, the first roller is engaged with a roller (210) of the feeding system to form a nip (222) at which the printing fluid is applied to the print medium.

[0022] In the second mode the first roller (202) is positioned relative to the feeding system such that the first roller cannot apply a printing fluid to a print medium fed to the print medium by the feeding system. Thus, as illustrated in Fig. 2b, the first roller is disengeged from the roller (210) of the feeding system. The second mode may be used when printing the print medium is to be paused, for example to allow maintenance to be performed on the printing system. The printing system may be switched between the first and second modes using for example pneumatic pistons to move rollers of the supply system and/or the feeding system towards or away from each other.

[0023] In operation, with the printing system in the first mode, the rollers of the supply system are rotated, for example by motorising at least one roller of the supply system. In this way, printing fluid is transferred via the supply system rollers from the reservoir to the first roller (202) for application to a print medium (222) fed by the feeding system. The first roller (202) may also be motorised, to match the speed at which the print medium is fed to the first roller (202).

[0024] When the printing system is in the second mode, the supply system may continue to supply a printing fluid to the first roller (202), despite the printing fluid not being applied to a print medium. Therefore, as the first roller (202) is not in contact with the print medium, excess printing fluid can collect on the first roller (202). The inventors have identified that this excess printing fluid can dry on the first roller (202), which can cause problems printing the printing fluid on the print medium when the printing

system is switched to the first mode from the second mode. For example, flakes of dried printing fluid can contaminate wet printing fluid on the first roller, causing an uneven layer of printing fluid to be applied on the print medium. Where the printing fluid is a primer, this uneven application can cause poor durability of ink subsequently printed on the primed print medium. One way to deal with this problem is to apply the printing fluid to the printing medium until any debris of dried printing fluid is removed, and an even layer of printing fluid is achieved. This however wastes printing medium and printing fluid. To curb such waste, a rate of feeding print medium to the first roller may be limited, which limits the speed of performing of a print job.

[0025] The printing system is adapted to control a quantity of a printing fluid on the first roller when the printing system is in the second mode. This control may also be provided in the first mode. In this example the printing system comprises an element, for example a wiper (224), arranged to provide such control of a quantity of a printing fluid on the first roller. The quantity of the printing fluid on the first roller which is controlled may be a quantity of a printing fluid which has been supplied to the first roller by the supply system. The control may be provided at a location on the first roller ahead of a location on the first roller where the supply system is arranged to supply a printing fluid to the first roller (202). Therefore, the element, in this example the wiper (224), may be positioned as close to, and ahead of, the nip (226) between the supply system roller (216) and the first roller (202); this minimises the opportunity for the printing fluid to dry before the nip (226). In alternative examples of the present invention, the wiper may be positioned at a different circumferential location on the roller than previously described.

[0026] By controlling the quantity of printing fluid on the first roller, excess printing fluid on the first roller can be removed. Thus an outer surface of printing fluid on the first roller, which may have begun to dry, can be removed. In removing this excess fluid, the thickness of the fluid layer on the first roller is reduced, for example to a thickness of less than 200 nanometres.. The removed excess printing fluid may be collected in a container (228), which in this example drains into the printing fluid reservoir (218) via a

drainage hose (230) which is schematically illustrated herein with a dashed line. Removed excess printing fluid may therefore be resupplied to the first roller (202) by the supply system.

[0027] Further, when the printing system is in the second mode, the wiper may be used to clean the first roller by removing the excess fluid supplied to the first roller.

[0028] The control of the quantity of printing fluid on the first roller may be configured in accordance with a rate of drying of the printing fluid. For example, a rate of drying may be influenced by the chemical composition of the printing fluid, a temperature of the printing system,a speed of rotation of the first roller, relative velocities of rollers of the supply system, and the relative humidity of the printing system. The quantity of the printing fluid on the first roller may be controlled accordingly, to minimise drying of the printing fluid.

[0029] In this example, the supply system supplies printing fluid to the first roller at a first circumferential location of the first roller, namely the nip (226) between the first roller and the supply system. In this example, the supply system further supplies a printing fluid at a different second circumferential location of the first roller; for example, a further roller (232) may supply printing fluid to the first roller. Thus, by further wetting the first roller (202) with printing fluid at this second location, the time for printing fluid to dry on the first roller is reduced further. Also, the further roller may be used to clean the first roller by supplying further printing fluid when the printing system is in the second mode.

[0030] The second circumferential location may be as close to, and after, the nip (222) between the feeding system and the first roller (202). The further roller is for example supplied with printing fluid via a pipe (234), schematically illustrated herein by a dashed line, from the printing fluid reservoir. The printing system may be configured such that the further roller (232) comes into contact with the first roller when the printing system is switched into the second mode, and is removed from contact with the first roller upon switching to the first mode. In alternative examples, the supply

system may not include the further roller, and supply printing fluid to the first roller only at one circumferential location.

[0031] In examples of the present invention, the printing fluid may be a primer, for example Digiprime® supplied by Michelman, Inc., 9080 Shell Road, Cincinnati, Ohio, 45236-1299, United States of America. In such a case, the drying referred to above may occur due to evaporation, polymerisation, or drying of an emulsification ingredient in the primer. In alternative examples of the present invention, the printing fluid may not be a primer but a different printing fluid. For example, the printing fluid may be any coating for a substrate. In one example, the printing fluid may be a coating for applying to a print medium after an image has been printed thereon; i.e. the printing fluid may be a post printing treatment, such as a varnish.

[0032] By controlling the quantity of printing fluid on the first roller, the present invention eliminates, or at least notably reduces, drying of printing fluid on the first roller. Therefore, after switching the printing system from the second mode to the first mode, an even layer of primer applied to the print medium can be quickly obtained, for example immediately after the first roller is engaged with the feeding system. Thus waste of print medium and printing fluid which would otherwise occur whilst waiting for an even layer to be obtained may be eliminated or at least significantly reduced. A print job can therefore be started more quickly after switching to the first mode, thus improving the efficiency of performing a print job. Running costs of the printing system may therefore also be reduced. Further, the footprint of the printing system may be reduced, as a buffer unit for delaying image printing until an even layer of printing fluid has first been obtained is not necessary, or can be reduced in size. Moreover, since waste of print medium is reduced, a rate of feeding a print medium to the first roller may also be increased, for example to greater than 2 metres per minute, thus increasing the speed that the printing system can perform a print job. Further, where the printing fluid is a primer, a high quality primer layer may be applied to the print medium, thus allowing a high quality and durable image to be subsequently printed on the print medium.

[0033] The preceding description has been presented to illustrate and describe examples of the principles described. This description is not intended to be exhaustive or to limit these principles to any precise form disclosed. Many modifications and variations are possible in light of the above teaching, within the scope of the appended claims.

CLAIMS

1. A printing system comprising:

a) a feeding system for feeding print media;

b) a first roller for applying a printing fluid to a print medium fed to the first roller by the feeding system; and

c) a supply system for supplying the first roller with a printing fluid,

the printing system having a first mode and a second mode, wherein

in the first mode the first roller is positioned relative to the feeding system such that the first roller can apply a printing fluid to a print medium fed to the first roller by the feeding system, and

in the second mode the first roller is positioned relative to the feeding system such that the first roller cannot apply a printing fluid to a print medium fed by the feeding system,

wherein the printing system is adapted to control a quantity of a printing fluid on the first roller when the printing system is in the second mode.

2. A printing system according to claim 1, wherein the quantity of a printing fluid which the printing system is adapted to control is a quantity of a printing fluid which has been supplied to the first roller by the supply system.

3. A printing system according to claim 1, adapted to control the quantity of a printing fluid at a location on the first roller ahead of a location on the first roller where the supply system is arranged to supply a printing fluid to the first roller.

4. A printing system according to claim 1, wherein the supply system comprises at least one roller for supplying a printing fluid to the first roller.

5. A printing system according to claim 4, wherein the at least one roller comprises a series of rollers.

6. A printing system according to claim 1, wherein the supply system is arranged to supply a printing fluid from a printing fluid reservoir to the first roller.

7. A printing system according to claim 1, wherein the printing fluid is a primer.

8. A printing system according to claim 1, wherein the printing system comprises an element arranged to provide said control of a quantity of a printing fluid on the first roller.

9. A printing system according to claim 8, wherein the element comprises a wiper.

10. A printing system according to claim 1, wherein said printing system is arranged to control the quantity of a printing fluid on the first roller in accordance with a rate of drying of the printing fluid.

11. A printing system according to claim 1, wherein the supply system is arranged to supply the first roller with a printing fluid when the printing system is in the second mode.

12. A printing system according to claim 1, wherein said adaptation of the printing system for controlling the quantity of a printing fluid on the first roller is configured to remove excess printing fluid from the first roller.

13. A printing system according to claim 12, wherein said supply system is arranged to resupply said removed excess printing fluid to the first roller.

14. A printing system according to claim 13, wherein the supply system is arranged to supply a printing fluid to a first circumferential location and to a different second circumferential location of the first roller.

15. A printing system according to claim 1, wherein the printing system comprises a digital offset printing system.

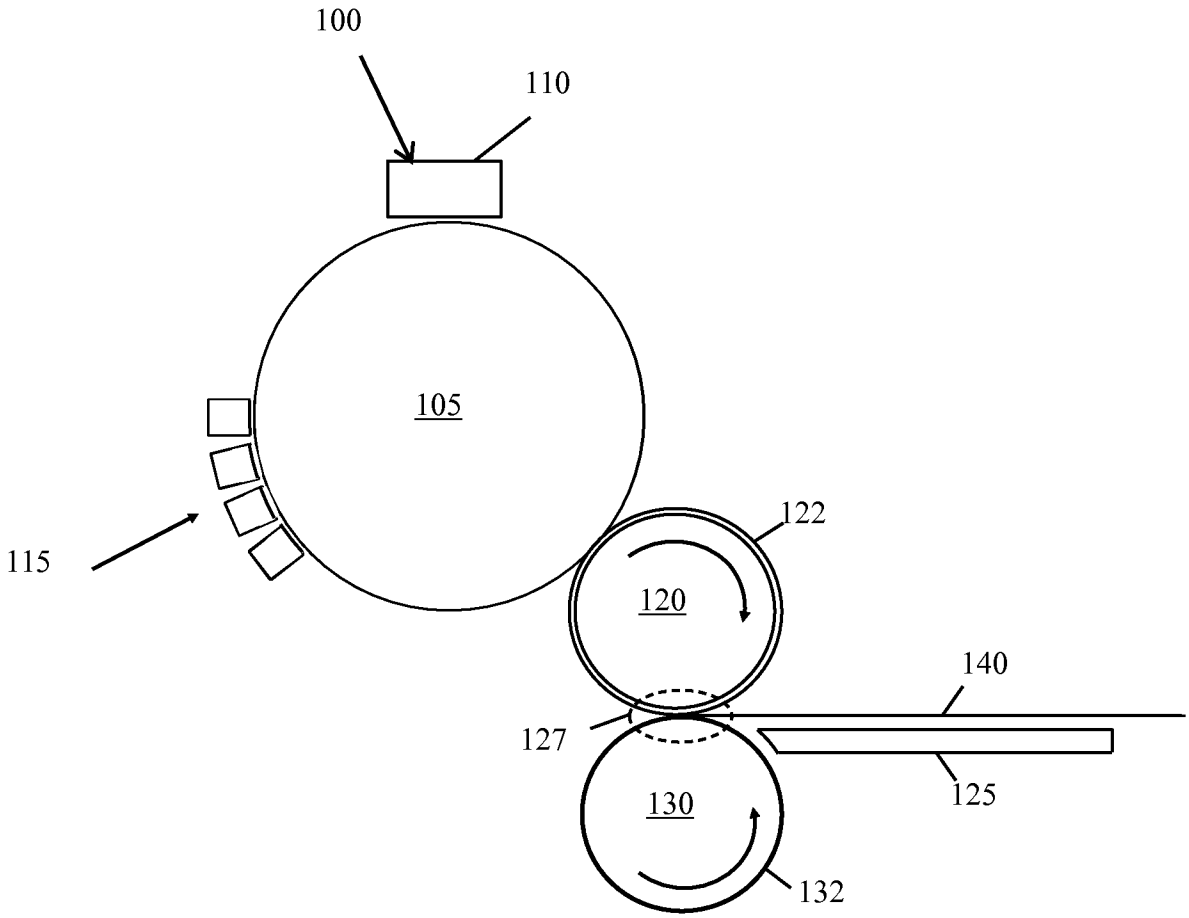

Fig. 1

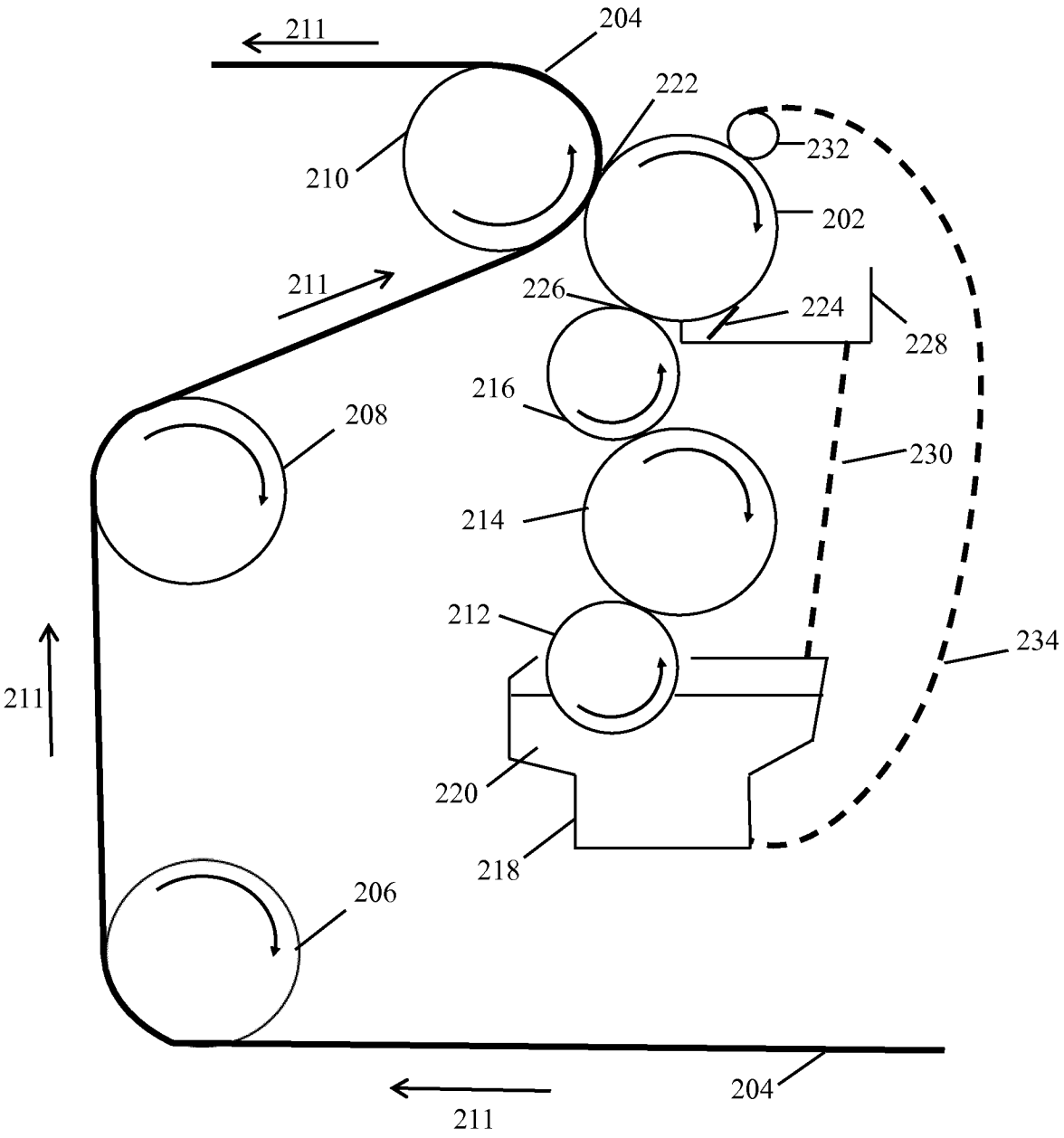
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Fig. 2a

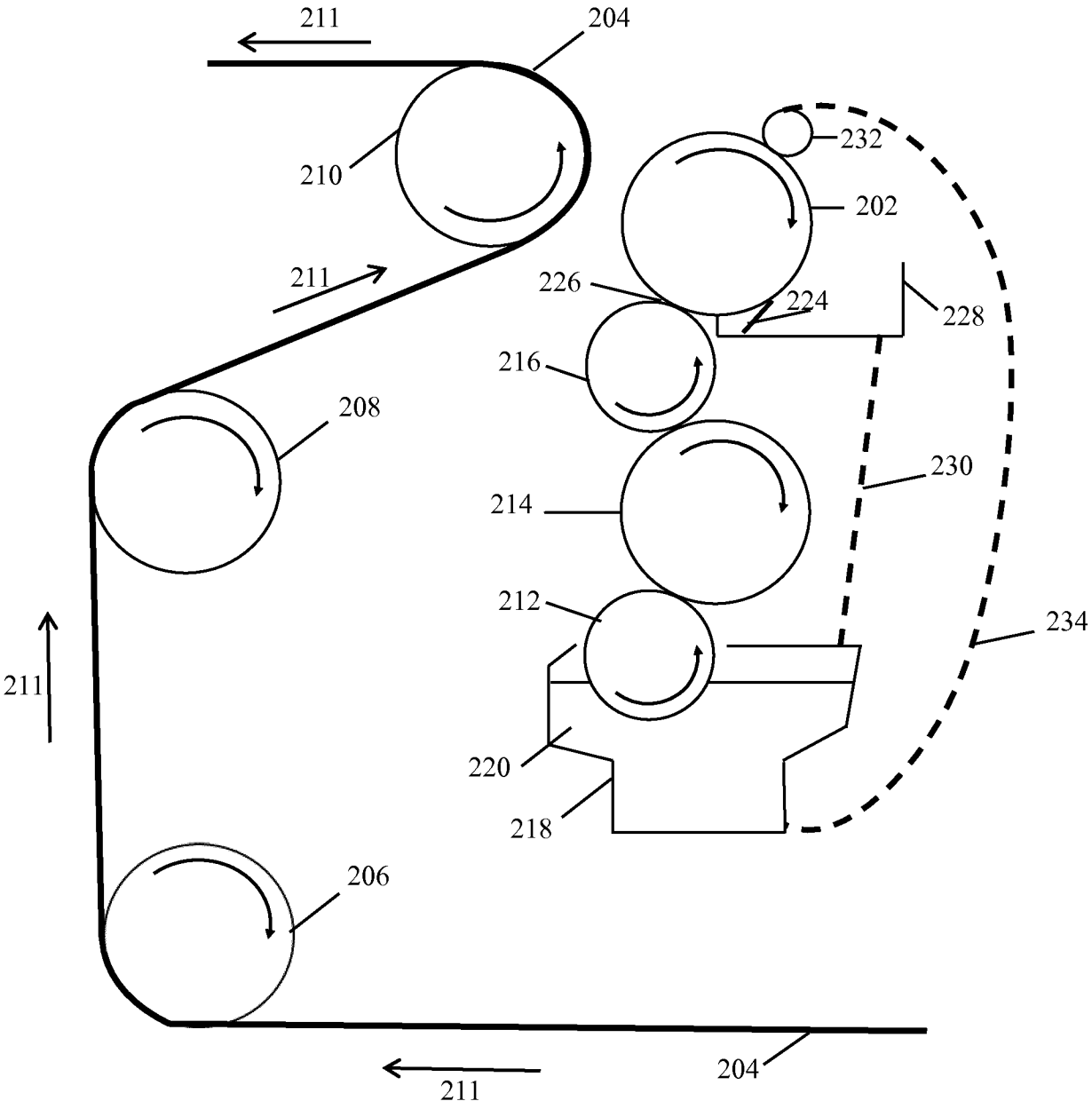
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Fig. 2b

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/063337

A. CLASSIFICATION OF SUBJECT MATTER
INV. G03G15/10
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)
G03G

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 practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 981 576 A (INOUE SHOZO) 21 September 1976 (1976-09-21) column 32, line 43 - column 4, line 9 -----	1-15
A	US 2008/252680 A1 (SCHMID CHRISTIAN [US] ET AL ALMOG YAACOV [IL] ET AL) 16 October 2008 (2008-10-16) the whole document -----	1-15

☐ 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

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"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

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Date of the actual completion of the international search	Date of mailing of the international search report
5 March 2013	12/03/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Götsch, Stefan

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2012/063337

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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