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(54) MAINTENANCE SYSTEM FOR LARGE-FORMAT INKJET PRINTING MACHINES

(57) The invention refers to a maintenance system for large-format inkjet printing machines. The underside of the base (6) of the supporting plate (1) of the injectors (7), whereon the print heads (5) are mounted, is provided with a thin plate (2) at the bottom, preferably made of ferromagnetic stainless steel, and positioned at a short distance from the base (6) of the supporting plate (1), of between 0.1 mm and 2 mm, whereby said thin plate can slide in the plane thereof and is joined to the supporting plate (1) under the action of magnets (4).

The thin plate (2) includes grooves (3) which are aligned with the injectors (7) in one end position. In the other end position, the aforementioned grooves are closed by the supporting plate (1).

The ink that flows into the space between the thin plate (2) and the base (6) is absorbed by channels (8) and conveyed by the thin plate (2) as it moves, owing to the combination of the surface tension of the ink and the surface energy of both.

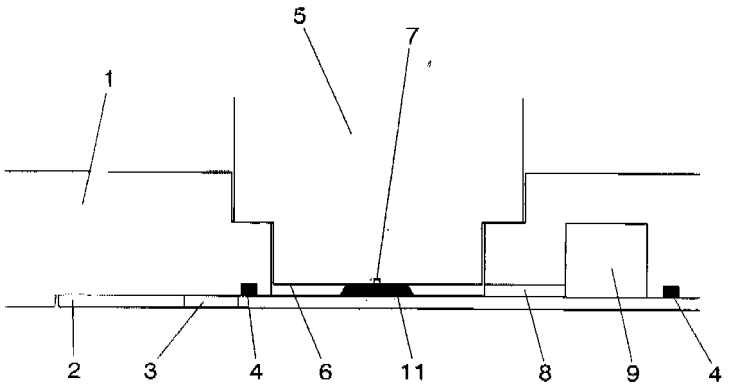

FIG. 5

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Description

Object of the invention

[0001] The present invention refers to a maintenance system for large format inkjet printing machines that allows carrying out all the cleaning operations of the print heads in order to maintain the lower base of the supporting plate of the print heads, whereon the injecting holes are mounted, under optimal conditions and so that their complexity does not make it prohibitive.

[0002] For the construction of the inkjet printing machines, different print heads are assembled until achieving the print width and the number of colors desired.

[0003] Typically, the number of injectors of each head is usually a power of two (1, 2, 4, 8, 16, 32, 64, 128, 256, 512, etc.), these are further aligned and uniformly distributed in a plane defined as the base of the supporting plate, commonly called "injector platc".

[0004] When it is desired to print on each pass a width greater than the separation between the first and last injector, more heads are placed together so as to cover the required width. Since, in the injector plate, before the first injector and after the last one there is a non useful area (without injectors), the heads can not be placed side by side with the injectors aligned and it will be needed to use staggered or overlapping arrangements in inclined position, as discussed later.

[0005] These structures must be repeated for each of the different inks (colors) used, so that the heads are arranged in different rows. Examples of these arrangements are shown in Figure 2 and are discussed later.

[0006] Each one of the mentioned heads needs a system that maintains the plate, wherein the injector holes are housed, in optimal cleaning state so that the print quality is not affected.

[0007] Typically, these maintenance systems perform three basic functions:

· **Maintaining the injector plate clean.**

[0008] During the normal operation of the print heads, ink spills littering the injector plate occur. During the priming and purging processes, ink spills that flood the injector plate occur. Furthermore, the external environment to which the injector plate is exposed also makes this to get dirty with dust, fibers, etc.

[0009] Mainly, two systems are used for cleaning: spatuling and/or blowing, always after an intentional flooding with fresh ink in order to prevent the erosion of the injector plate.

· **Priming unprimed injectors.**

[0010] Typically, inkjet print heads operate maintaining the ink under a pressure below the ambient pressure, the ink being maintained in the injectors by the action of the meniscus formed by the surface tension of the ink. Frequently occurs that the meniscus of one or a few injectors is broken by sharp mechanical and/or hydraulic oscillations. This makes that the affected injector(s), take air and get unprimed.

[0011] In order to restore the damaged meniscus, the ink pressure is usually made to be higher than that outside, so that a small amount of ink to fill all the way up to the injector hole flows. This pressure increase is performed by increasing the pressure of the ink and/or decreasing the external pressure by vacuum.

After performing the repriming described, the injector plate is pooled and must be cleaned as already mentioned in the previous section.

· **Preventing the ink from drying.**

[0012] During normal operation of a inkjet print head, the ink flows through the injector holes so that the ink remaining in the injectors is always renewed and maintains its properties even in the event that this contain a highly volatile component, evaporation of which can cause a change in its properties. The main problem that can arise is that the evaporation of some volatile component, and therefore the increase of the concentration of other components, which increases the viscosity of the ink so much as to block the injectors.

[0013] This is normally prevented by tightly closing and/or maintaining the area surrounding the injectors flooded with ink.

[0014] In the event that, due to the instability of the ink, it is necessary to maintain it in continuous circulation, the maintenance system could also be responsible for recirculating the ink during the downtime periods of the machine. In this case the system must be able to move a higher ink amount.

[0015] In some cases, the maintenance system can automatically change the fluid flowing through the print head, by having various circuits that are switched using solenoid valves. This can be useful to clean ink residues in the internal circuit of the heads and even for automatically changing the ink used.

Background of the invention

[0016] Currently, there are a lot of proprietary systems on the market that perform the functions described above. Most of them are, per head used, a concave piece made of soft elastomer that is used as a cover to prevent evaporation, to collect the remains of ink and to suck when the pressure is desired to be reduced in the area near the injector plate. Moreover these systems usually include a soft elastomer spatula used to remove the remaining of fresh ink that has been deposited on the injector plate after an ink bleeding.

[0017] When inkjet printing machines are construed for printing large formats in a single pass and/or with numerous inks, the number of heads to be mounted increases to the point that conventional solutions described

above are difficult to build and operate. The patent of the invention P200603033 of the same applicant firm of the present invention, shows a solution that leads to other former ones, located in the structure of the print heads, in which an autonomous module of inkjet printing is claimed. It has a maintenance, pressurization and thermal conditioning system for the ink used. It includes a specific mechanism that covers the injector plate and collects the ink poured at each bleeding, cleaning said injector plates and preventing the ink from drying. It has an inverted "T"-shaped profile on wings of which the print heads are mounted and in soul of which there are channels for circulating a heater liquid. At the top of the soul there is another horizontal hole that acts as a distributor for the ink that passes to the print heads through the vertical holes.

[0018] This arrangement is significantly improved in the present invention, as discussed below.

Description of the invention

[0019] Overall, the maintenance system for large format inkjet machines object of the present invention has the print heads housed in a supporting plate and the injectors are protected by a thin plate, preferably made of ferromagnetic stainless steel, which is located in a recess on the lower face of said supporting plate. It acquires an arrangement parallel to the base or flat of the injectors and slides between two limiting positions. It is separated from said base between 0.1 mm and 2 mm.

[0020] The thin plate is kept attached to the supporting plate by the action of some magnets, so that the thin plate can not be separated from the supporting plate although it can move over the plane on which it is, by actuating some external mechanism.

[0021] In addition, the thin plate has grooves made therein, which are aligned in one of its end positions with the injectors, so that the print heads can perform their work without interference. At the other end position of the thin plate, the groove is completely blocked against the supporting plate.

[0022] The supporting plate has one or more ducts that communicate with the housing of the heads through channels. In this way the ink spilled in the gap between the thin plate and the supporting plate can be collected.

[0023] The ink spilled in said gap by the injectors is carried by the thin plate when this is moved due to the combination of surface tension of the ink and the surface energy of the thin plate and base, which make the ink to "wet" the thin plate but not the base.

[0024] To facilitate the understanding of the characteristics of the invention and being part of this specification, some sheets of drawings are attached, in figures of which, in an illustrative and not limitative manner, the following has been represented:

Brief description of the drawings

[0025]

Figure 1a.- Shows a solution wherein the print width is increased while maintaining the original resolution of the head.

Figure 1b.- Shows a configuration wherein the print width has been increased while increasing the print resolution (by a factor equal to 1/sin a).

Figure 2a.- Shows the structure of the heads of Figure 1a, repeated for each of the different inks (colors) used.

Figure 2b.- Shows the structure of the heads of Figure 1b, repeated for each of the different inks (colors) used.

Figure 3.- Is a schematic view of a head injector of which is protected with the thin cleaning plate, in an end position of inactivity.

Figure 4.- Is a view similar to Figure 3, with the thin plate at the other end position, during printing.

Figure 5.- Is a view similar to Figure 3 including the flooding of ink produced by cleaning the area surrounding the injector.

Figure 6.- Is a view similar to Figure 5, when the ink dragging is carried out by sliding the thin plate.

Description of the preferred embodiment

[0026] Referring to the numbering adopted in the figures and particularly in relation to Figures 1a and 1b, it can be seen how the system maintenance for large format inkjet printing machines, proposed by the invention includes, as others of its type, different plates 1 for supporting the injectors 7 arranged in respective two different ways in order to print on each pass a larger width, i.e., a large format, leaving some overlapping areas between the supporting platens 1 so that injectors 7 make a uniform sweep.

[0027] Figure 1a maintains the original resolution and Figure 1b increases since the sweep lines are closer together, with a factor equal to the inverse of the sine of "alpha".

[0028] In Figures 2a and 2b these same structures are repeated for each of the printing inks, in this case four in number, separated by dashed lines.

[0029] The maintenance system proposed by the present invention, schematically shown in Figures 3 and 4, consists or a thin plate 2 made of ferromagnetic stainless steel, has as many grooves 3 practiced therein as print heads 5 are installed in the module. The thin plate 2 can be moved between two end positions (shown respectively in Figures 3 and 4) and is held against the supporting plate 1 by the action of various magnets 4. These magnets 4 hold the thin plate 2 attached to the supporting plate 1 but allowing its displacement.

[0030] The end position shown in Figure 3, is that corresponding to the inactivity phase, in which the thin plate

2 protects the print head 5 with the groove 3 blocked against the supporting plate 1.

[0031] The other end position, shown in Figure 4, corresponds to the printing phase, in which the thin plate 2 has been moved so that the grooves 3 are aligned with the injectors 7 of the print heads 5 allowing the injectors 7 to project the droplets 10 through the grooves 3.

[0032] As mentioned before, if necessary, in the inactivity phase recirculating the ink, by increasing the pressure of the ink inside the head 5, would cause a flooding of ink 11 in the gap formed between the plane defined by the base 6 of the supporting plate 1 of the injectors 7 and the thin plate 2, as shown in Figure 5. During this ink recirculation, a vacuum is applied to channel 9 that communicates through two separate channels 8 with the housings of all print heads 5, so that the ink flowing through the channels 8 is collected in the channel 9 and taken to a deposit for being reused.

[0033] When it is intended to pass from the inactivity to printing phase, there must be ensured that the base 6 of the supporting plate 1 containing the injectors 7 is perfectly cleaned in the area surrounding thereof so as not to disturb the path of the generated droplets 10. For achieving this purpose, there is a small flooding of ink 11 in a manner similar to the case of recirculation, but forming only a small ink bead along the row of injectors 7 having contact with the thin plate 2 and the base 6 of the supporting plate 1 of injectors 7. By the surface tension of the ink and surface energies of materials, the ink "wets" the thin plate 2 for being made of stainless steel and does not "wet" the surface of the injector plate by carrying a special coating. This phenomenon is outlined in the form given to the flooding of ink 11 in Figure 5.

[0034] Then, the thin plate 2 slides as indicated by the arrow in Figure 6, dragging the ink 11 therewith. This makes the surface of the base 6 surrounding the injectors 7 to be cleaned, the ink bead 11 taking therewith all traces of ink and impurities deposited in the base 6 thus leaving it ready for the printing phase.

[0035] During the displacement of the thin plate 2, the vacuum system sucks through the duct 9, so that when the ink reaches the channels 8 is absorbed and taken to the collection deposit. At the end of this cleaning process, the system would be in the situation shown in Figure 4.

Claims

1. Maintenance system for large format inkjet printing machines, said machines having assembled the print heads and a device for cleaning the injection holes, **characterized by** having the print heads (5) housed within a supporting plate (1) of the injectors (7), so that said injectors (7) are protected by a thin plate (2), preferably made of ferromagnetic stainless steel and which can slide in a recess of the supporting plate (1), providing a separation between the thin plate (2) and the base (6) of said supporting plate (1), of between 0.1 mm and 2 mm.

2. Maintenance system for large format inkjet printing machines, according to claim 1, **characterized in that** the thin plate (2) is joined to the supporting plate (1) under the action of some magnets (4), so that the thin plate (2) can not be separated from the supporting plate (1), but it can be moved over the plane whereon it is located, by actuating some external mechanism.

3. Maintenance system for large format inkjet printing machines, according to claims 1 and 2, **characterized in that** the thin plate (2) has some grooves (3) that are aligned, in one of its end positions, with the injectors (7), so that the print heads (5) can carry out their work without any interference, while in the other end position of thin plate (2), the groove (3) is completely closed against the supporting plate (1).

4. Maintenance system for large format inkjet printing machines, according to any one of the preceding claims, **characterized in that** the supporting plate (1) has one or more ducts (9) that communicate with the housing of the print heads (5) through two separate channels (8), so that the ink spined in the gap existing between the thin plate (2) and the base (6) of the supporting plate (1) wherein the injectors (7) are housed can be collected.

5. Maintenance system for large format inkjet printing machines, according to any one of the preceding claims, **characterized in that** the ink (11) spilled in the gap existing between the thin plate (2) and the base (6) of the supporting plate (1) of the injectors (7), is dragged by the thin plate (2) when said thin plate (2) is moved due to the combination of surface tension of the ink and the surface energy of thin plate (2) and the base (6), which makes the ink to wet the thin plate (2) but not the base (6).

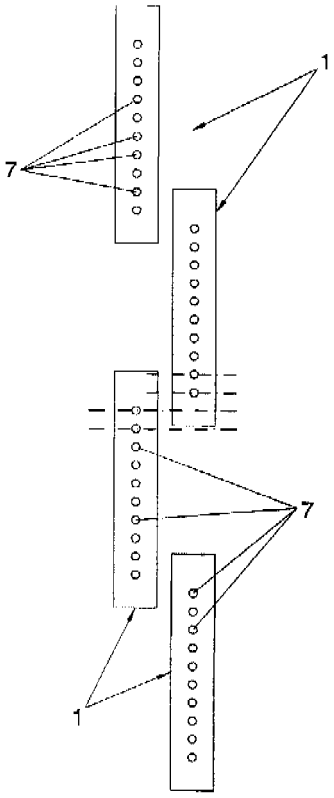

FIG. 1a

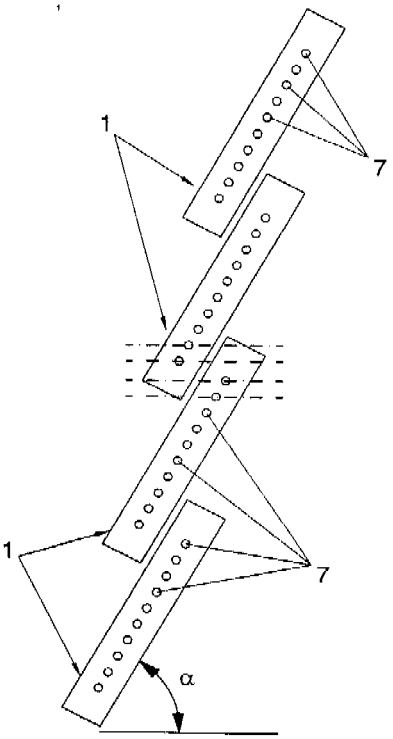

FIG. 1b

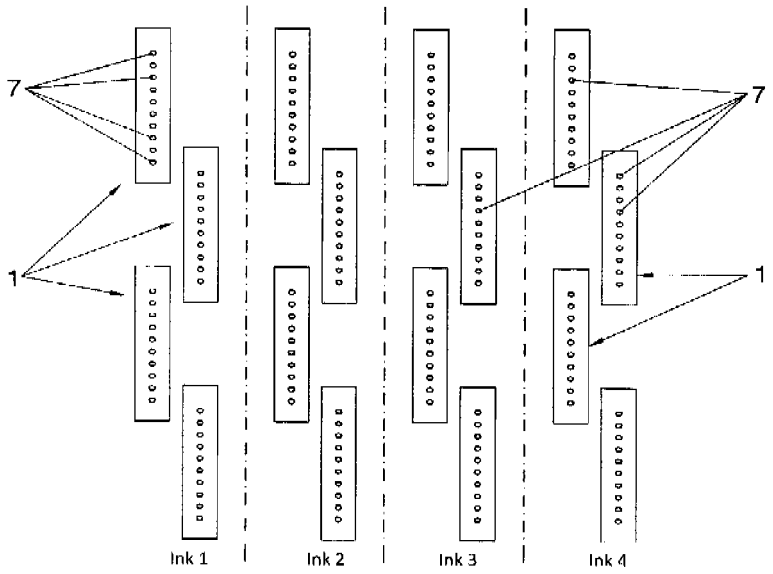

FIG. 2a

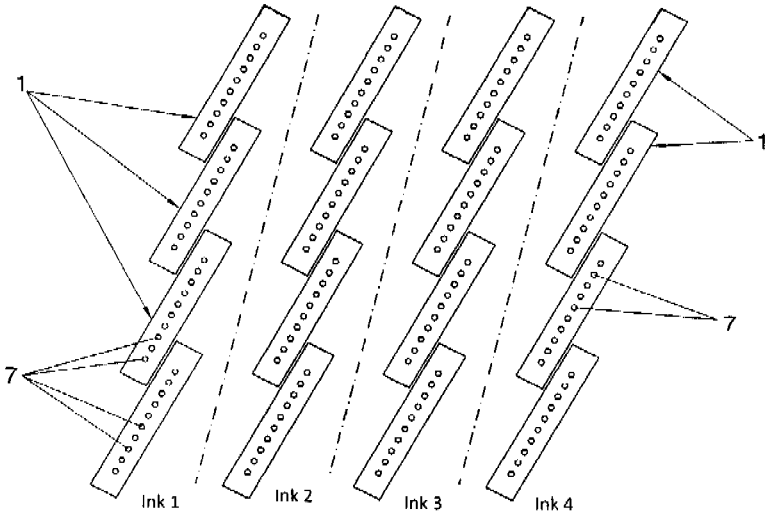

FIG. 2b

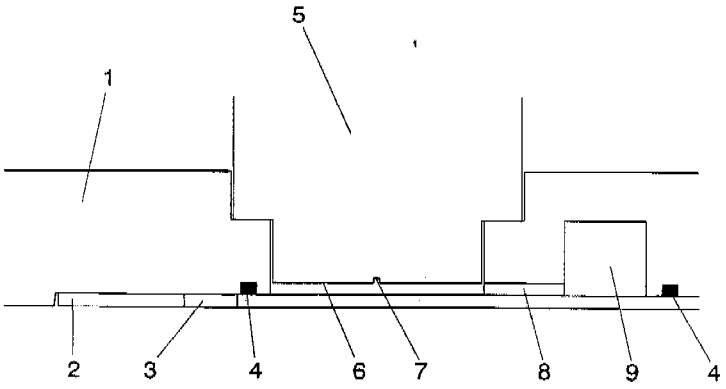

FIG. 3

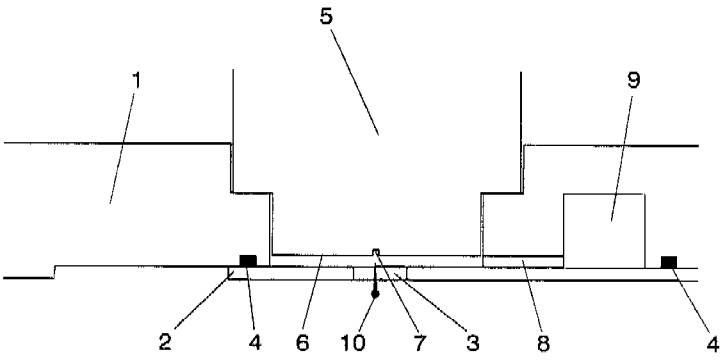

FIG. 4

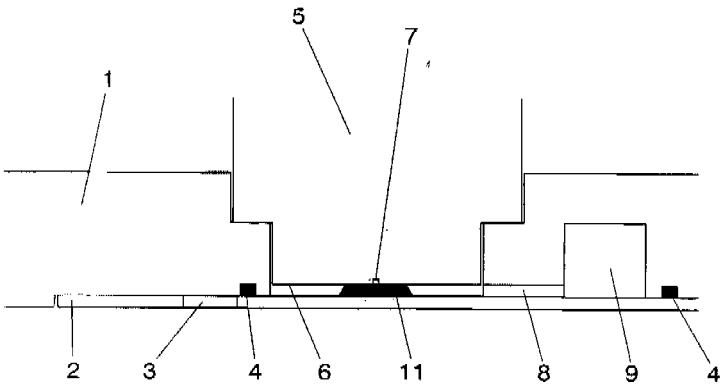

FIG. 5

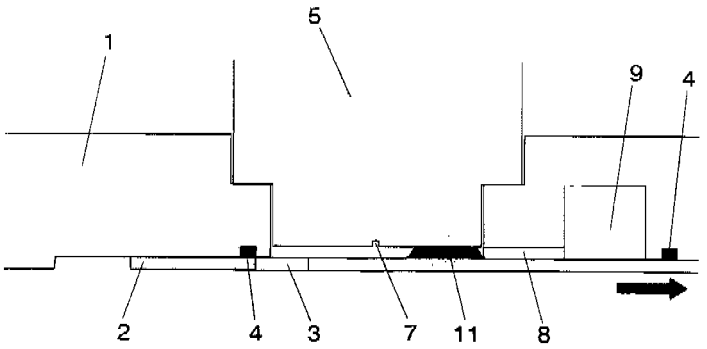

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES 2009/070503

A. CLASSIFICATION OF SUBJECT MATTER

B41J 2/165 (2006.01)
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)
B41J

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)

INVENES,EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	JP 9216354 A (CANON KK) 19.08.1997, figures and Abstract from DataBase EPODOC. Recuperado de EPOQUE.	1-5
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Date of the actual completion of the international search	Date of mailing of the international search report
01.March.2010 (01.03.2010)	**(03/03/2010)**
Name and mailing address of the ISA/ O.E.P.M. Paseo de la Castellana, 75 28071 Madrid, España. Facsimile No. 34 91 3495304	Authorized officer G. Villarroel Alvaro Telephone No. +34 91 349 85 71

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International application No.
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C (continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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