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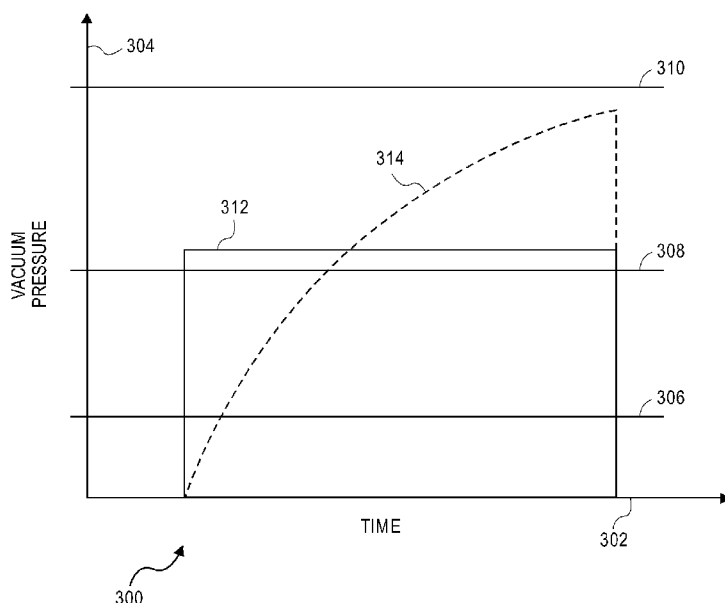
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[Continued on next page]

(54) Title: SQUARE WAVE VACUUM PRESSURE PROFILE FOR PRIMING FLUID-JET PRECISION-DISPENSING MECHANISM

FIG. 3



(57) Abstract: A fluid-jet precision-dispensing mechanism is primed to remove any gaseous bubbles from a supply of fluid contained by the fluid-jet precision-dispensing mechanism. One or more nozzles of the fluid-jet precision-dispensing mechanism are capped with a cap such that the cap seals around the nozzles. A vacuum pressure is created within the cap to suction the gaseous bubbles and a portion of the fluid from within the fluid-jet precision-dispensing mechanism through the nozzles. The profile of the vacuum pressure created within the cap over time is substantially square wave shaped.

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SQUARE WAVE VACUUM PRESSURE PROFILE FOR PRIMING FLUID-JET PRECISION-DISPENSING MECHANISM

BACKGROUND

A common way to form images on media, such as paper, is to use a fluid-ejection device, such as an inkjet-printing device. An inkjet-printing device has a number of inkjet-printing mechanisms, such as inkjet printhead assemblies. Each inkjet printhead assembly has a printhead die having a number of inkjet nozzles that eject ink, such as differently colored ink, in such a way as to form a desired image on the media.

Occasionally air bubbles can form within the supplies of ink used to form images on media. If these air bubbles are not removed from the ink before the ink is used to form an image on media, the air bubbles can cause degradation of the resulting image quality. Therefore, the inkjet-printing mechanisms are commonly periodically primed to remove such air bubbles from the ink.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram of a representative inkjet-printing device, according to an embodiment of the present disclosure.

FIGs. 2A and 2B are diagrams of a representative inkjet-printing mechanism, according to an embodiment of the present disclosure.

FIG. 3 is a graph of an idealized square wave vacuum pressure profile used in an embodiment of the present disclosure during priming, as compared to an idealized shark fin vacuum pressure profile used within the prior art during priming.

FIG. 4 is a diagram of priming an inkjet-printing device, according to an embodiment of the present disclosure.

FIG. 5 is a flowchart of a method for priming the inkjet-printing device in FIG. 4, according to an embodiment of the present disclosure.

FIG. 6 is a diagram of priming an inkjet-printing device, according to another embodiment of the present disclosure.

FIG. 7 is a flowchart of a method for priming the inkjet-printing device in FIG. 6, according to an embodiment of the present disclosure.

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DETAILED DESCRIPTION

FIG. 1 shows a representative inkjet-printing device 100, according to an embodiment of the present disclosure. The inkjet-printing device 100 is a device, such as a printer, that ejects ink onto media, such as paper, to form images, which can include text, on the media. The inkjet-printing device 100 is more
10 generally a fluid-jet precision-dispensing device that precisely dispenses fluid, such as ink, as is described in more detail later in the detailed description. The inkjet-printing device 100 may eject pigment-based ink, dye-based ink, or another type of ink. Differences between pigment-based inks and dye-based inks include that the former is generally more viscous than the latter, among other
15 differences.

While the detailed description is at least substantially presented herein to inkjet-printing devices that eject ink onto media, those of ordinary skill within the art can appreciate that embodiments of the present disclosure are more generally not so limited. In general, embodiments of the present disclosure
20 pertain to any type of fluid-jet precision-dispensing device that dispenses a substantially liquid fluid. A fluid-jet precision-dispensing device is a drop-on-demand device in which printing, or dispensing, of the substantially liquid fluid in question is achieved by precisely printing or dispensing in accurately specified locations, with or without making a particular image on that which is being printed
25 or dispensed on. As such, a fluid-jet precision-dispensing device is in comparison to a continuous precision-dispensing device, in which a substantially liquid fluid is continuously dispensed therefrom. An example of a continuous precision-dispensing device is a continuous inkjet-printing device, for instance.

The fluid-jet precision-dispensing device precisely prints or dispenses a
30 substantially liquid fluid in that the latter is not substantially or primarily composed

of gases such as air. Examples of such substantially liquid fluids include inks in the case of inkjet-printing devices. Other examples of substantially liquid fluids include drugs, cellular products, organisms, fuel, and so on, which are not substantially or primarily composed of gases such as air and other types of gases, as can be appreciated by those of ordinary skill within the art. Therefore, while the following detailed description is described in relation to an inkjet-printing device that ejects ink onto media, those of ordinary skill within the art will appreciate that embodiments of the present disclosure more generally pertain to any type of fluid-jet precision-dispensing device that dispenses a substantially liquid fluid as has been described in this paragraph and the preceding paragraph.

FIGs. 2A and 2B show a representative inkjet-printing mechanism 200, according to an embodiment of the present disclosure. FIG. 2A specifically shows the inkjet-printing mechanism 200 in total, while FIG. 2B shows a portion of the inkjet-printing mechanism 200 in detail, as well as a cap 202 attached to the bottom of the mechanism 200. The portion of the inkjet-printing mechanism 200 depicted in detail FIG. 2B is the portion below the dotted line 209 in FIG. 2A.

The inkjet-printing mechanism 200 is inserted into and/or is part of the inkjet-printing device 100, and may more generally be considered a fluid-jet precision-dispensing mechanism that is inserted into and/or is part of a fluid-jet precision-dispensing device. In FIGs. 2A and 2B, the inkjet-printing mechanism 200 is in the form of a cartridge that includes a supply of ink 204. However, in another embodiment, the inkjet-printing mechanism 200 may take a different form, and/or may not actually include a supply of ink 204, which may instead be located external to the mechanism 200 and fluidically coupled to the mechanism 200.

During formation of an image on media, the ink 204 is moved through a low-capillarity media 201 and a high-capillarity media 203 to a wick 207. A supply vent 222 exposes the interior of the inkjet-printing mechanism 200 externally, such as to outside ambient air or other gas. From the wick 207, the ink 204 travels through a filter 206 and into a first passage 208, from which the ink is moved into a channel 210. From the channel 210, the ink 204 is moved

through a second passage 212 to a plenum 214 that ends at a printhead die 216. The printhead die 216 includes a number of nozzles 218A, 218B, . . . , 218N, collectively referred to as the nozzles 218. The nozzles 218 may be considered inkjet nozzles, or more generally fluid-ejection nozzles. The nozzles 218 are
5 selectively controlled to eject droplets of the ink 204 from the plenum 214.

Air bubbles, which are more generally gaseous bubbles, may undesirably form within the ink within the inkjet-printing mechanism 200, at any point from the initially supply of ink 204, to the media 201 and 203, the wick 207, the filter 206, the passage 208, the channel 210, the passage 212, and plenum 214. Such air
10 bubbles can result in degradation of image quality. For instance, when one of the nozzles 218 is controlled to eject a droplet of ink, an air bubble may interfere with or completely block proper ink ejection. To remove the air bubbles from the inkjet-printing mechanism 200, and thus from the inkjet-printing device 100 of which the mechanism 200 is a part, a cap 202 is positioned over the nozzles 218.

The cap 202 can be movably positioned over the nozzles 218 to cap the nozzles 218, such the cap 202 seals around the nozzles 218. A vacuum is created within the cap 202, via for instance fluidically coupling a pump at an opening 220 of the cap 202. The resulting vacuum pressure suctions the air bubbles, as well as a portion of the ink 204, from the inkjet-printing mechanism
15 200. This process is referred to more generally as priming. By priming the inkjet-printing mechanism 200, any air bubbles within the ink 204 are removed, so that image quality degradation does not result when the mechanism 200 is employed to form images on media.

When ink is ejected from the nozzles 218 during image formation, or when
25 ink is moved through the nozzles 218 during priming, air or other gas is drawn through the vent 222 of the inkjet-printing mechanism 200 to replace the ink that has been depleted. This ensures that an undesirable negative pressure is not created within the inkjet-printing-mechanism 200 itself. When all the ink 204 has been depleted from the inkjet-printing mechanism 200, air has substituted this ink
30 within the mechanism 200 to substantial degree.

It is noted that the vacuum pressure created within the cap 202 has to be sufficiently large to cause the air bubbles and a portion of the ink 204 to be moved through the nozzles 218. That is, the pressure differential between the cap 202 and the channel 210, for instance, has to be sufficiently large so that the air bubbles and a portion of the ink 204 are moved through the nozzles 218. However, if the vacuum pressure created within the cap 202 is too large, then additional air (or other gas) can be suctioned into the ink 204 remaining within the inkjet-printing mechanism 200. More specifically, during priming, the wick 207 may be pushed up into the high-capillarity media 203. This can result in a small gap between the filter 206 and the wick 207. Therefore, air (or other gas) can be suctioned through the filter 206 at this gap.

FIG. 3 shows a graph 300 depicting an idealized square wave vacuum pressure profile 312 used in an embodiment of the present disclosure during priming, as compared to an idealized shark fan vacuum pressure profile 314 used within the prior art during priming. The x-axis 302 denotes time, while the y-axis 304 denotes the vacuum pressure created within the cap 202. There are three pressure thresholds of interest in FIG. 3: a pressure threshold 306, a pressure threshold 308, and a pressure threshold 310.

The pressure threshold 306 corresponds to the vacuum pressure at which ink begins to be moved through the nozzles 218 during priming, but before which any air bubbles within the ink are also moved through the nozzles 218. The higher pressure threshold 308 corresponds to the vacuum pressure at which both ink and any air bubbles within the ink are moved through the nozzles 218. Greater vacuum pressures between the pressure thresholds 306 and 308 result in greater amounts of ink being moved through the nozzles 218 – due to higher ink flow rates – while still not resulting in air bubbles moving through the nozzles 218. Similarly, as the vacuum pressure is increased over the pressure threshold 308, greater amounts of ink are moved through the nozzles 218, again due to higher ink flow rates. The pressure threshold 310 corresponds to the vacuum pressure at which air begins to be suctioned through the vent 222, and then through the filter 206 at a gap between the filter 206 and the wick 207.

The square wave vacuum pressure profile 312 is designed to minimize the amount of ink that is depleted when priming the inkjet-printing mechanism 200, and also to ensure that air is not undesirably suctioned through the vent 222, and then through the filter 206, during priming. Ideally, the vacuum pressure that is created within the cap 202 during priming at least substantially instantaneously reaches a pressure level at least equal to the pressure threshold 308. Thus, there is little or no time when the vacuum pressure is between the pressure thresholds 306 and 308, such that there is little or no time when ink is being moved through the nozzles 218 without the air bubbles also being moved through the nozzles 218.

Furthermore, the vacuum pressure that is created within the cap 202 in accordance with the square wave vacuum pressure profile 312 is a minimum margin above the pressure threshold 308 that can be afforded by various manufacturing, operational, and design tolerances and constraints. Because the air bubbles are moved through the nozzles 218 once the vacuum pressure reaches the pressure threshold 308, no greater vacuum pressure is desirably created within the cap 202, to minimize the amount of ink that is used during priming. The square wave vacuum pressure profile 312 having a predetermined margin over the pressure threshold 308 thus minimizes ink usage during priming, while compensating for any tolerances and constraints that may prevent the profile from otherwise having a vacuum pressure being exactly equal to the threshold 308.

It is further noted that the square wave vacuum pressure profile 312 is well below the pressure threshold 310 at which air is undesirably suctioned and introduced into the supply of ink 204 within the inkjet-printing mechanism 200. Additionally, ideally, once priming has been completed, the vacuum pressure that has been created within the cap 202 at least substantially instantaneously drops below the pressure threshold 306 towards zero pressure. Here, too, then, there is little or no time when the vacuum pressure is above the pressure threshold 306 upon completion of priming, such that there is little or no time when ink is being

moved through the nozzles 218 after priming has been completed, which would otherwise result in wasted ink.

Embodiments of present disclosure as to how such a square wave vacuum pressure profile 312 can be achieving during priming are described later in the detailed description. By comparison, the shark fin vacuum pressure profile 314 used during priming within the prior art is typically achieved by connecting a pump to the cap 202 at the opening 220. The pump is then turned on at a constant speed for the duration of the priming process to remove any air bubbles that are contained within the supply of ink 204.

When the pump is first turned on, the vacuum pressure begins to increase in accordance with the shark fin vacuum pressure profile 314. At some point in time, the vacuum pressure reaches the pressure threshold 306. From this point in time until the vacuum pressure reaches the pressure threshold 308, ink is therefore undesirably moved through the nozzles 218 without resulting in the air bubbles contained within the ink also moving through the nozzles 218. In this way, the shark fin vacuum pressure profile 314 results in the priming process wasting ink.

At some point in time, the vacuum pressure in accordance with the shark fin vacuum pressure profile 314 reaches the pressure threshold 308, at which time the air bubbles begin to be moved through the nozzles 218. However, the vacuum pressure still continues to increase, resulting in more ink than necessary being used during the priming process. Furthermore, by the time the priming process has finished, at which point the pump is turned off after having run at a constant speed, the vacuum pressure in accordance with the shark fin vacuum pressure profile 314 can be dangerously close to the pressure threshold 310. This means that there is a heightened potential that air will be undesirably suctioned into the supply of ink 204 through the vent 222, and then through the filter 206, while performing the priming process in accordance with the prior art.

Thus, embodiments of the present disclosure that achieve priming in accordance with the square wave vacuum pressure profile 312 are advantageous in comparison to the prior art's achievement of priming in

accordance with the shark fin pressure profile 314. Less ink is wasted during the priming process, and the likelihood that the pressure threshold 310 is undesirably reached is significantly reduced if not eliminated. Furthermore, the priming process may be able to be conducted in a shorter period of time, because the pressure threshold 308 is reached within the square wave vacuum pressure profile 312 before it is reached within the shark fin pressure profile 314.

FIG. 4 shows a portion of the inkjet-printing device 100, and how the square wave vacuum pressure profile 312 can be attained during priming, according to an embodiment of the present disclosure. The inkjet-printing device 100 is depicted in FIG. 4 as including the nozzles 202, the vent 222, a pump 402, and a controller 404. The controller 404 controls the pump 402 and may be implemented in software, hardware, or a combination of software and hardware. The inkjet-printing device 100 further contains the supply of ink 204. The inkjet-printing device 100 may also include other components and mechanisms, such as the other parts of the inkjet-printing mechanism 200 depicted in FIGs. 2A and 2B.

FIG. 5 shows a method 500 depicting how priming is performed in the inkjet-printing device 100 of FIG. 4, according to an embodiment of the present disclosure. The method 500 may be implemented at least in part by one or more computer programs stored on a computer-readable medium, and executed by one or more processors, for instance. The method 500 may be performed by the controller 404 appropriately directing other components and mechanisms of the inkjet-printing device 100.

The nozzles 218 are capped by the cap 202 (502), such that the cap 202 forms a seal around the nozzles 218. Thereafter, the vacuum pressure is created within the cap 202, by the pump 402, to suction any air bubbles from the ink 204 through the nozzles 218 (504), which also results in a portion of the ink 204 being suctioned through the nozzles 218 as well. The profile of the vacuum pressure created within the cap 202 is at least substantially the square wave vacuum pressure profile 312 that has been described.

To achieve the square wave vacuum pressure profile 312 in this embodiment, the pump 402 is run at a relatively high first speed for a first length of time (506), so that the vacuum pressure created within the cap 202 very quickly – such as nearly instantaneously – reaches a desired level of vacuum pressure. The desired level of vacuum pressure is at least equal to the pressure threshold 308 that has been described. For instance, as has been described, the desired level of vacuum pressure may exceed the pressure threshold 308 by a predetermined margin.

Thereafter, once the first length of time has elapsed, the pump 402 is run at a relatively slow second speed for a second length of time (508), to maintain the desired level of vacuum pressure within the cap 202. The second speed is thus less than the first speed. The second speed is sufficient to maintain, but desirably not to increase, the level of vacuum pressure that has already been created within the cap 202 due to earlier running the pump 402 at the first speed for the first length of time. As such, substantially the minimum amount of ink needed to be moved through the nozzles 218 to also move any air bubbles through the nozzles 218 is used.

Once the second length of time has elapsed, corresponding to the length of time in which it can be at least substantially guaranteed that most if not all of the air bubbles within the ink 204 have been removed therefrom, the pump is turned off (510), and does not run at any speed. This can result in the vacuum pressure within the cap 202 quickly – such as nearly instantaneously – dropped back to zero. During the priming process of FIG. 4, then, the vacuum pressure does not reach the pressure threshold 310 at which air is undesirably introduced into the ink 204 contained within the inkjet-printing device 100.

For example, in one embodiment, the vacuum pressure within the cap 202 can quickly decrease to zero as follows. The cap 202 may have two channels, one for one color of ink, such as pigment black ink, and one for all the other colors of ink, such as dye non-black inks. For the non-black channel, a corresponding valve may be opened to vent the cap 202 to atmospheric pressure. For the black channel, a roller within the pump 402, where the pump is

a peristaltic pump, may be disengaged, resulting in the cap 202 being vented to atmospheric pressure.

FIG. 6 shows a portion of the inkjet-printing device 100, and how the square wave vacuum pressure profile 312 can be attained during priming, according to another embodiment of the present disclosure. The inkjet-printing device 100 is depicted in FIG. 6 as including the nozzles 218, the cap 202, the vent 222, the pump 402, the controller 404, a first valve 602, a second valve 604, and a pressure accumulator vessel 606. The inkjet-printing device 100 further contains the supply of ink 204. The inkjet-printing device 100 may also include other components and mechanisms, such as the other parts of the inkjet-printing mechanism 200 depicted in FIGs. 2A and 2B.

The controller 404 as before may be implemented in software, hardware, or a combination of software and hardware. The controller 404 controls the valves 602 and 604, in addition to controlling the pump 402. The valve 602 is employed to fluidically vent the cap 202. When the valve 602 is opened, any pressure within the cap 202 is externally released. The valve 604 is employed to fluidically connect the pressure accumulator vessel 606 to the cap 202. When the valve 604 is opened, the vessel 606 is fluidically connected to the cap 202. The pressure accumulator vessel 606 is in the most general, non-limiting, and non-restrictive sense considered a vessel. The vessel 606 acts to contain, or accumulate, vacuum pressure created by the pump 402 before the cap 202 is exposed to the vacuum pressure. As such, the pressure accumulator vessel 606 is fluidically coupled to the pump 402.

FIG. 7 shows the method 500 depicting how priming is performed in the inkjet-printing device 100 of FIG. 6, according to an embodiment of the present disclosure. As before, the nozzles 218 are capped by the cap 202 (502), such that the cap 202 forms a seal around the nozzles 218. Thereafter the vacuum pressure is created within the cap 202, by the pump 402, to suction any air bubbles from the ink 204 through the nozzles 218 (504), which also results in a portion of the ink 204 being suctioned through the nozzles 218 as well. The

profile of the vacuum pressure created within the cap 202 is at least substantially the square wave vacuum pressure profile 312 that has been described.

To achieve the square wave vacuum pressure profile 312 in this embodiment, both the valves 604 and 602 are closed (706), and the pump 402 is run to initially create the vacuum pressure within the pressure accumulator vessel 606 (708) – and not within the cap 202 – due to the valve 604 being closed. Therefore, the length of time it takes for the vacuum pressure to reach the desired level does not matter, since the cap 202 has not yet been exposed to this vacuum pressure. As before, the desired level of vacuum pressure is at least equal to the pressure threshold 308 that has been described. For instance, as has been described, the desired level of vacuum pressure may exceed the pressure threshold 308 by a predetermined margin.

At some point, the vacuum pressure thus reaches the desired level within the pressure accumulator vessel 606. For instance, the pressure may be measured or detected, or a length of time may be waited for, such that it is known that running the pump 402 for this length of time corresponds to the desired level of vacuum pressure being created. At that time, the pump 402 is turned off, and the valve 604 is opened (710), to create the desired level of vacuum pressure within the cap 202 (i.e., to expose the cap 202 to the vacuum pressure that has been created within the vessel 606). The cap 202 is thus subjected to the desired level of vacuum pressure at least substantially instantaneously, such that it can be said that the vacuum pressure within the cap 202 reaches this desired level at least substantially instantaneously.

A length of time is then elapsed sufficient for any air bubbles within the ink 204 to be removed through the nozzles 218. During this length of time, the vacuum pressure at least substantially remains at the desired level within the cap 202, because the valve 602 is closed. After this length of time has elapsed, the valve 604 is closed and the valve 602 is opened (712). This results in the removal of the vacuum pressure created within the cap 202, due to external exposure of the cap 202 through the valve 602. As such, the vacuum pressure within the cap 202 quickly – such as nearly instantaneously – drops to zero.

During the priming process of FIG. 7, then, the vacuum pressure also does not reach the pressure threshold 310 at which air is undesirably introduced into the ink 204 contained within the inkjet-printing device 100.

We claim:

1. A method for priming a fluid-jet precision-dispensing mechanism to remove any gaseous bubbles from a supply of fluid contained by the fluid-jet precision-dispensing mechanism, comprising:

- 5 capping one or more nozzles of the fluid-jet precision-dispensing mechanism with a cap such that the cap seals around the nozzles; and,
creating a vacuum pressure within the cap to suction the gaseous bubbles and a portion of the fluid from within the fluid-jet precision-dispensing mechanism through the nozzles,
10 such that a profile of the vacuum pressure created within the cap over time is substantially square wave shaped.

2. The method of claim 1, wherein creating the vacuum pressure within the cap, such that the profile of the vacuum pressure over time is substantially square wave shaped, comprises:

- 15 running a pump at a first speed for a first length of time to reach a desired level of the vacuum pressure; and,
thereafter, running the pump at a second speed for a second length of time to at least substantially maintain the desired level of the vacuum pressure during the second length of time,
20 wherein the second speed is less than the first speed.

3. The method of claim 2, wherein creating the vacuum pressure within the cap, such that the profile of the vacuum pressure over time is substantially square wave shaped, further comprises turning off the pump after the second length of time has elapsed.

- 25 4. The method of claim 2, wherein the desired level of the vacuum pressure is at least equal to a first pressure threshold at which the fluid and the gaseous bubbles are moved through the nozzles.

5. The method of claim 4, wherein the desired level of the vacuum pressure is greater than the first pressure threshold by at least a predetermined margin.

6. The method of claim 4, wherein the desired level of the vacuum pressure is less than a second pressure threshold at which gas is introduced into the fluid
5 contained within the fluid-jet precision-dispensing mechanism from a vent.

7. The method of claim 1, wherein creating the vacuum pressure within the cap, such that the profile of the vacuum pressure over time is substantially square wave shaped, comprises:

closing a first valve fluidically coupled between a pressure accumulator
10 vessel and the cap;

closing a second valve fluidically venting the cap;

running a pump fluidically coupled to the pressure accumulator vessel, such that the vacuum pressure is created within the pressure accumulator vessel due to the first valve being closed;

15 upon the vacuum pressure reaching a desired level within the pressure accumulator vessel,

turning off the pump; and,

opening the first valve so that the desired level of the vacuum pressure is created within the cap.

20 8. The method of claim 7, wherein creating the vacuum pressure within the cap, such that the profile of the vacuum pressure over time is substantially square wave shaped, further comprises, after a length of time has elapsed during which time the desired level of the vacuum pressure has been created within the cap,

25 closing the first valve;

opening the second valve to remove the vacuum pressure created within the cap.

9. The method of claim 7, wherein the desired level of vacuum pressure is at least equal to a first pressure threshold at which the fluid and the gaseous bubbles are moved through the nozzles,

5 wherein the desired level of the vacuum pressure is greater than the first pressure threshold by at least a predetermined margin, and

wherein the desired level of the vacuum pressure is less than a second pressure threshold at which gas is introduced into the fluid contained within the fluid-jet precision-dispensing mechanism from a vent.

10. A fluid-jet precision-dispensing device comprising:

10 a supply of fluid;

one or more nozzles through which the fluid is selectively ejected from the fluid-ejection device;

a cap movably positionable over the nozzles to seal around the nozzles; and,

15 a pump to create a vacuum pressure within the cap to suction a portion of the fluid, and any gaseous bubbles within the fluid, through the nozzles,

wherein a profile of the vacuum pressure created within the cap over time is substantially square wave shaped.

11. The fluid-jet precision-dispensing device of claim 10, further comprising a controller to control the pump to create the vacuum pressure within the cap, such that the profile of the vacuum pressure over time is substantially square wave shaped, by:

running the pump at a first speed for a first length of time to reach a desired level of the vacuum pressure;

25 thereafter, running the pump at a second speed for a second length of time to at least substantially maintain the desired level of the vacuum pressure during the second length of time; and,

turning off the pump after the second length of time has elapsed,

wherein the second speed is less than the first speed.

12. The fluid-jet precision-dispensing device of claim 11, further comprising a vent externally exposing the supply of fluid,

wherein the desired level of the vacuum pressure is at least equal to a first pressure threshold at which the fluid and the gaseous bubbles are moved

5 through the nozzles, and is less than a second pressure threshold at which gas is introduced into the supply of fluid through the vent.

13. The fluid-jet precision-dispensing device of claim 10, further comprising:

a pressure accumulator vessel fluidically coupled to the pump;

a first valve fluidically coupled between the pressure accumulator vessel

10 and the cap;

a second valve fluidically venting the cap; and,

a controller to control the pump, the pressure accumulator, the first valve, and the second valve, to create the vacuum pressure within the cap, such that the profile of the vacuum pressure over time is substantially square wave

15 shaped, by:

closing the first valve;

closing the second valve;

running the pump to initially create the vacuum pressure within the pressure accumulator vessel due to the first valve being closed;

20 upon the vacuum pressure reaching a desired level within the pressure accumulator vessel,

turning off the pump;

opening the first valve so that the desired level of the vacuum pressure is created within the cap;

25 after a length of time has elapsed during which time the desired level of the vacuum pressure has been created within the cap,

closing the first valve;

opening the second valve to remove the vacuum pressure created within the cap.

14. The fluid-jet precision-dispensing device of claim 13, further comprising a vent externally exposing the supply of fluid,

wherein the desired level of the vacuum pressure is at least equal to a first pressure threshold at which the fluid and the gaseous bubbles are moved

5 through the nozzles, and is less than a second pressure threshold at which gas is introduced into the supply of fluid through the vent.

15. A computer-readable medium having one or more computer programs stored thereon to perform a method for priming a fluid-jet precision-dispensing mechanism to remove any gaseous bubbles from a supply of fluid contained by
10 the fluid-jet precision-dispensing mechanism, the method comprising:

capping one or more nozzles of the fluid-jet precision-dispensing mechanism with a cap such that the cap seals around the nozzles; and,

creating a vacuum pressure within the cap to suction the gaseous bubbles and a portion of the fluid from within the fluid-jet precision-dispensing mechanism
15 through the nozzles,

such that a profile of the vacuum pressure created within the cap over time is substantially square wave shaped,

wherein creating the vacuum pressure within the cap, such that the profile of the vacuum pressure over time is substantially square wave shaped,

20 comprises:

running a pump at a first speed for a first length of time to reach a desired level of the vacuum pressure;

thereafter, running the pump at a second speed for a second length of time to at least substantially maintain the desired level of the vacuum pressure
25 during the second length of time; and,

turning off the pump after the second length of time has elapsed,

wherein the second speed is less than the first speed, and

wherein the desired level of vacuum pressure is at least equal to a first pressure threshold at which the fluid and the gaseous bubbles are moved

30 through the nozzles, and is less than a second pressure threshold at which gas is

introduced into the fluid contained within the fluid-jet precision-dispensing mechanism from a vent.

FIG. 1

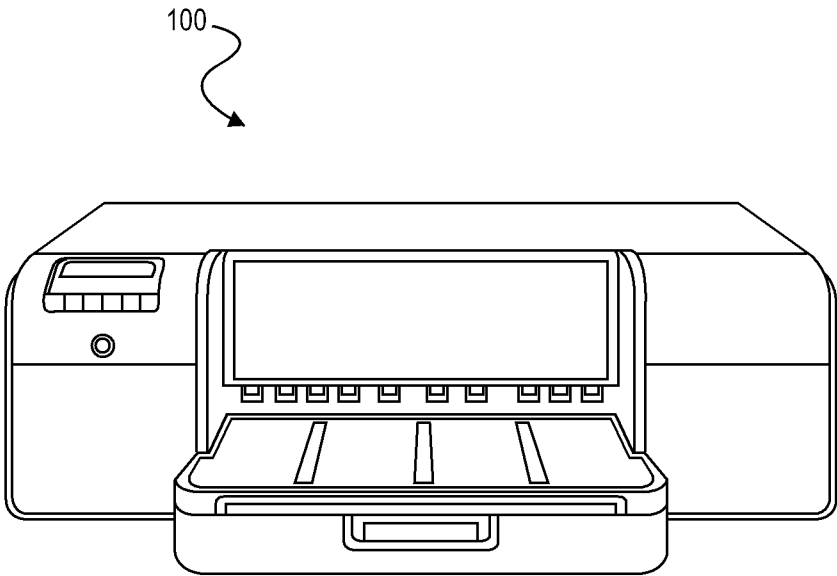


FIG. 2A

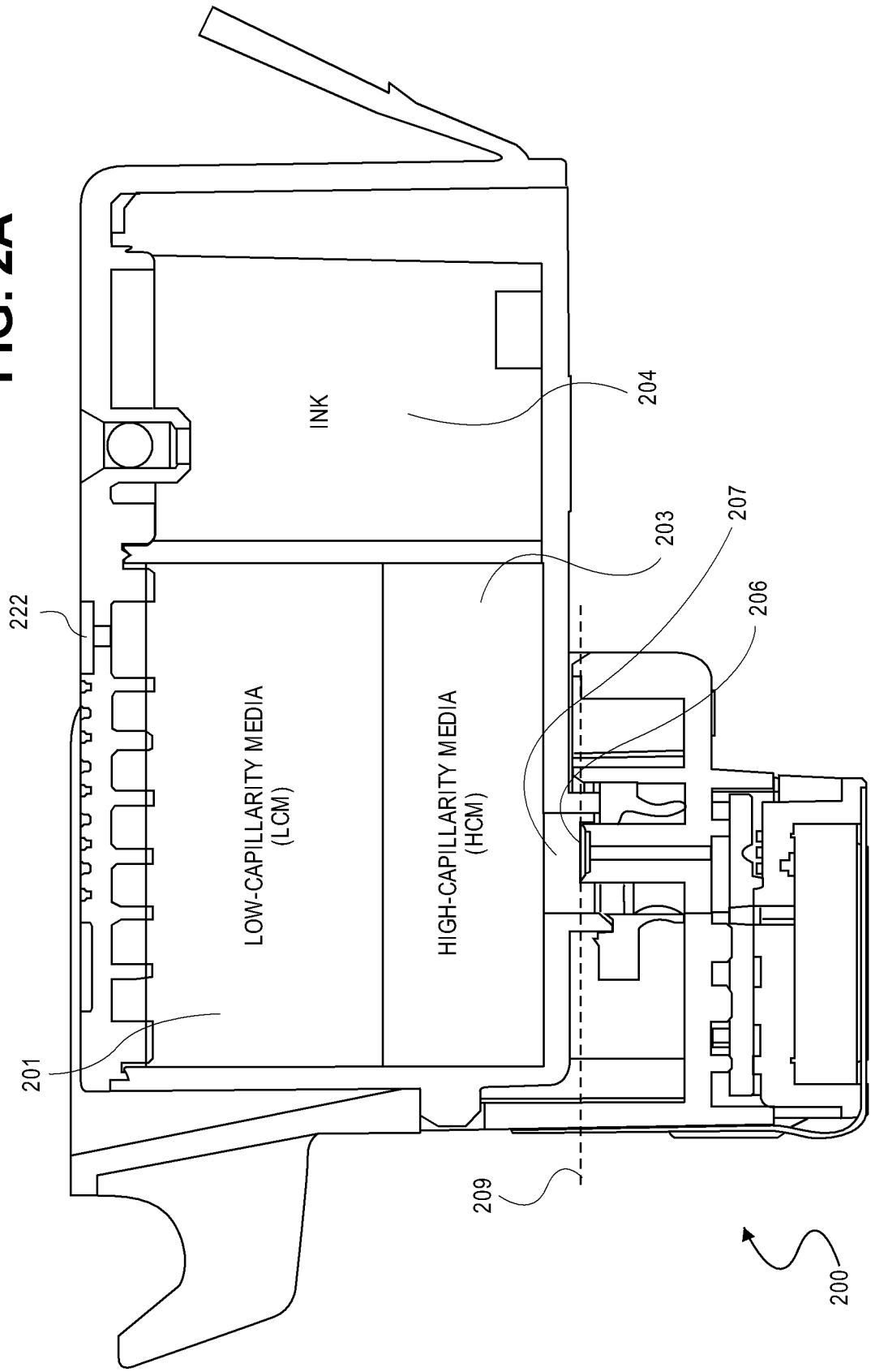


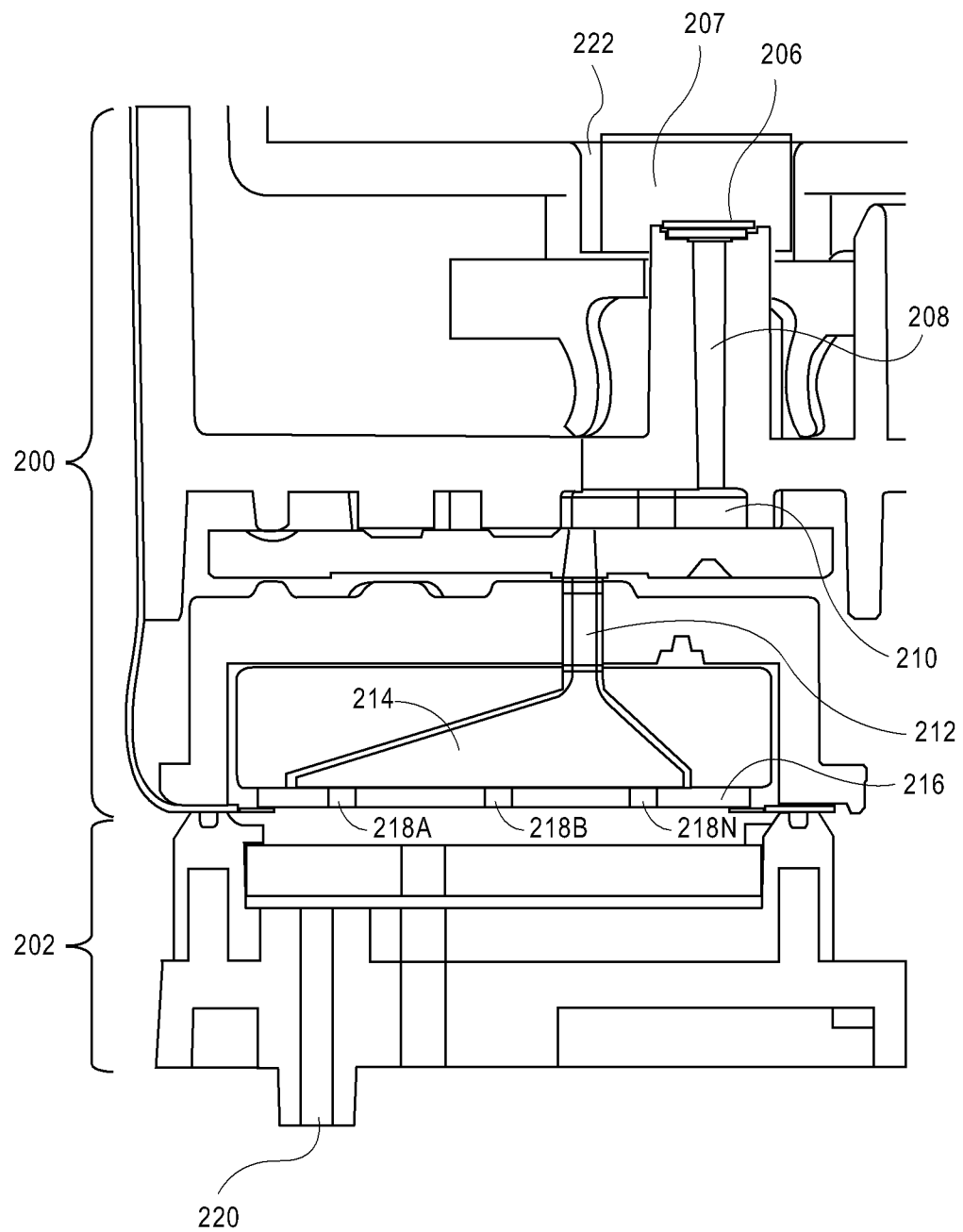
FIG. 2B

FIG. 3

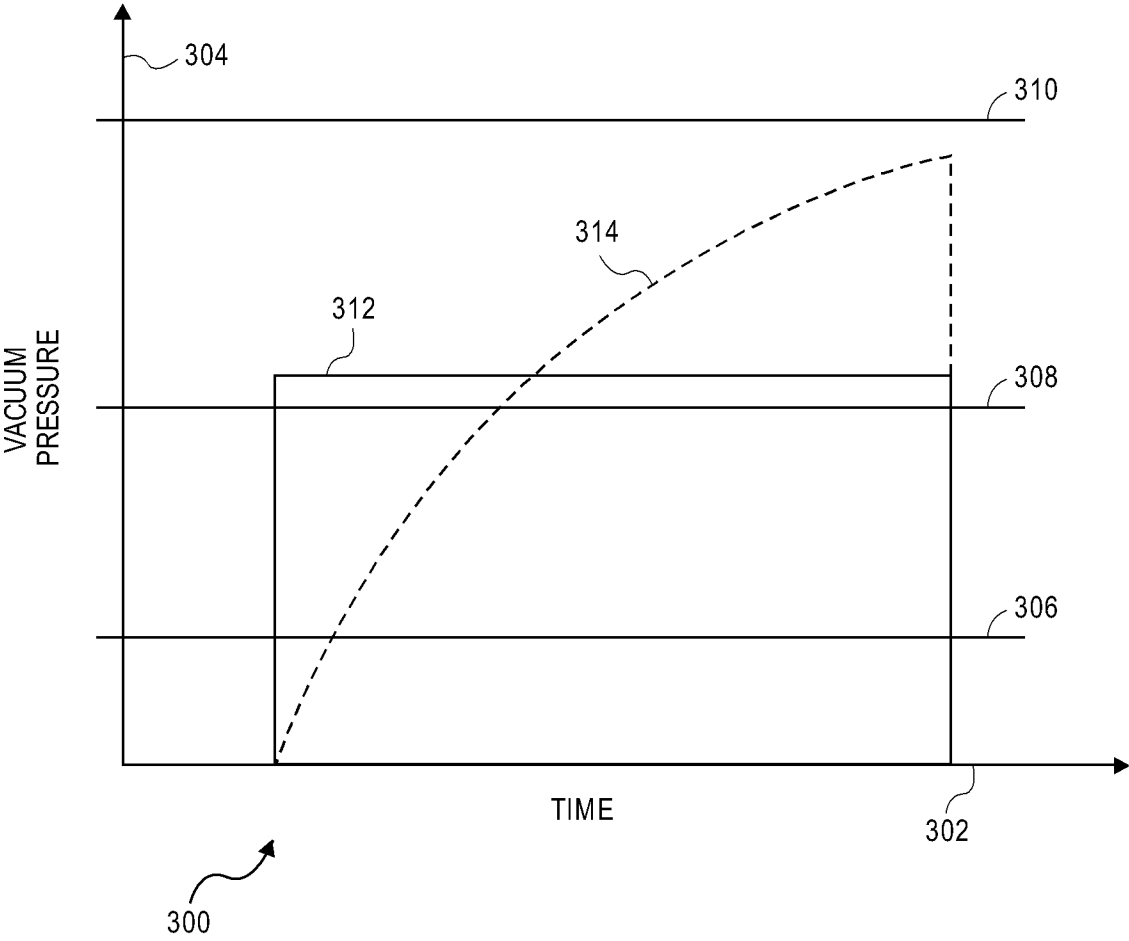


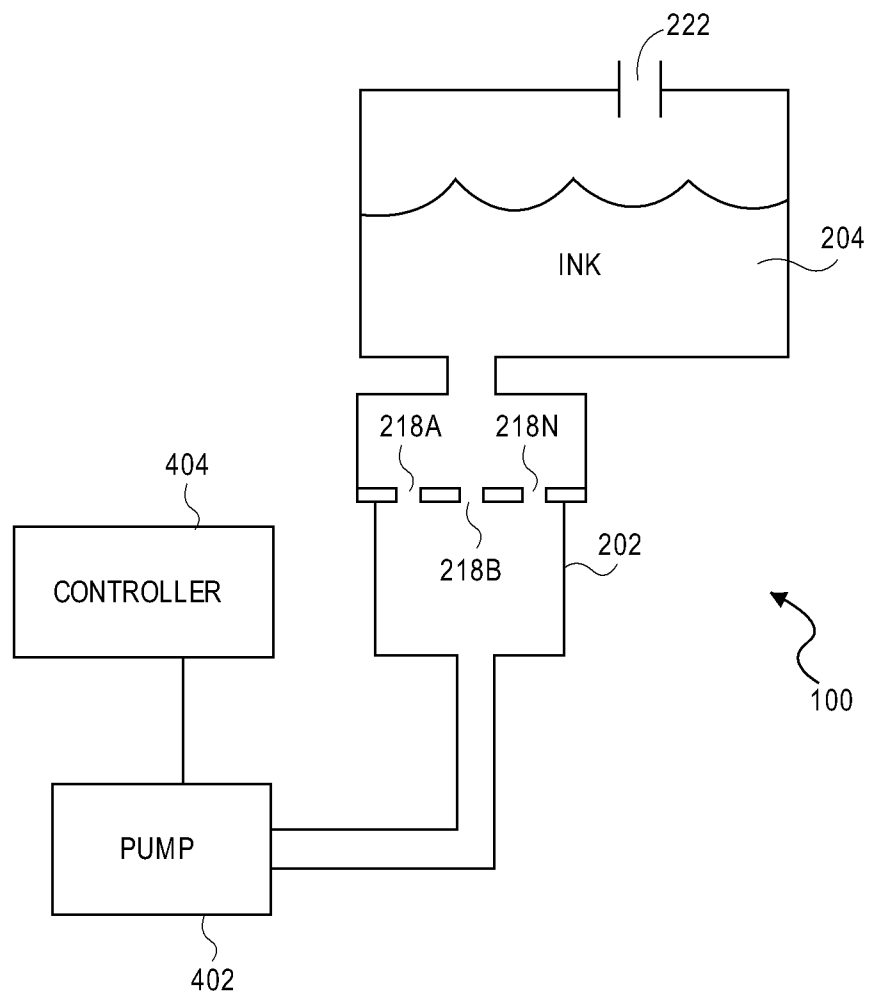
FIG. 4

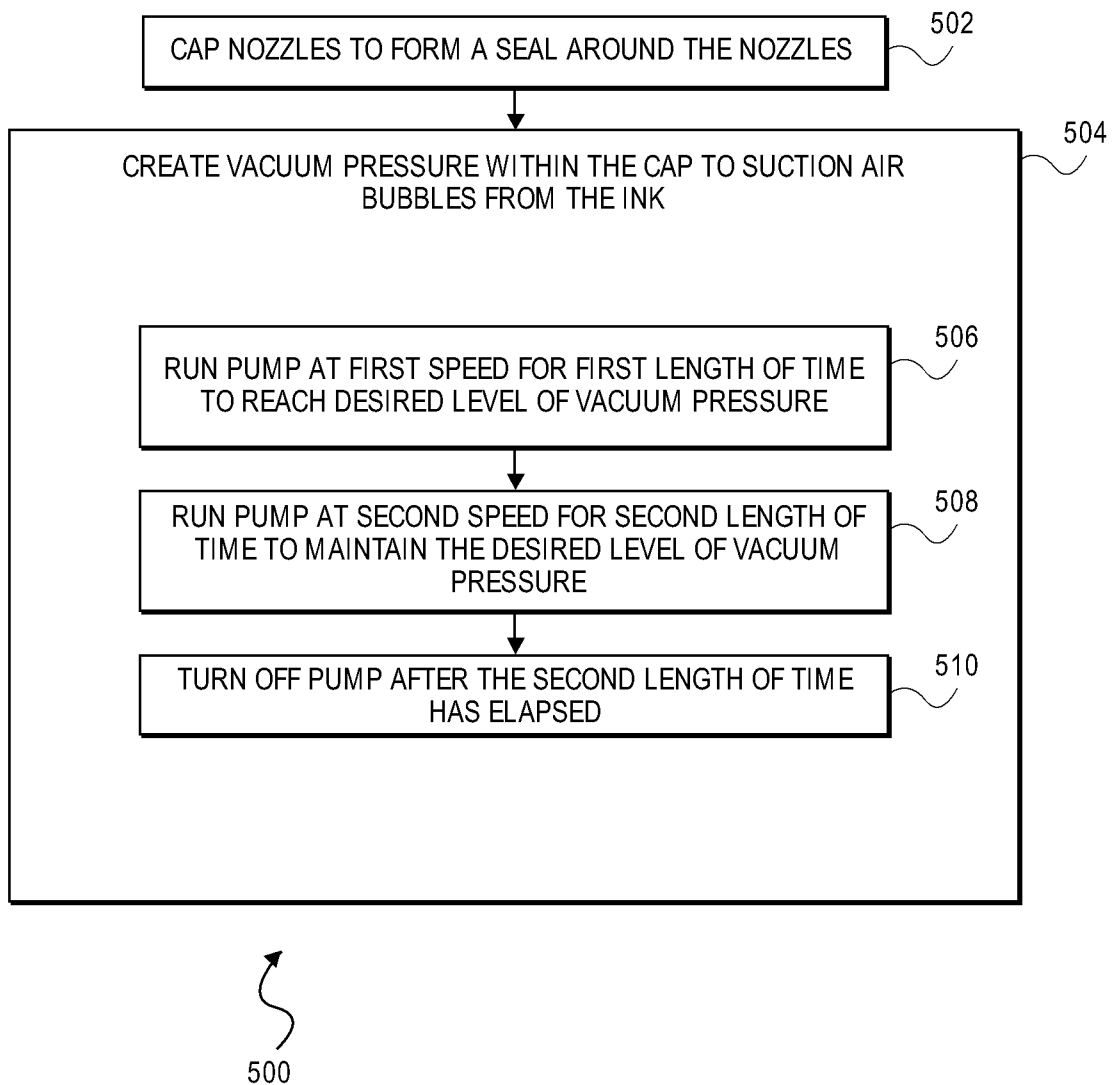
FIG. 5

FIG. 6

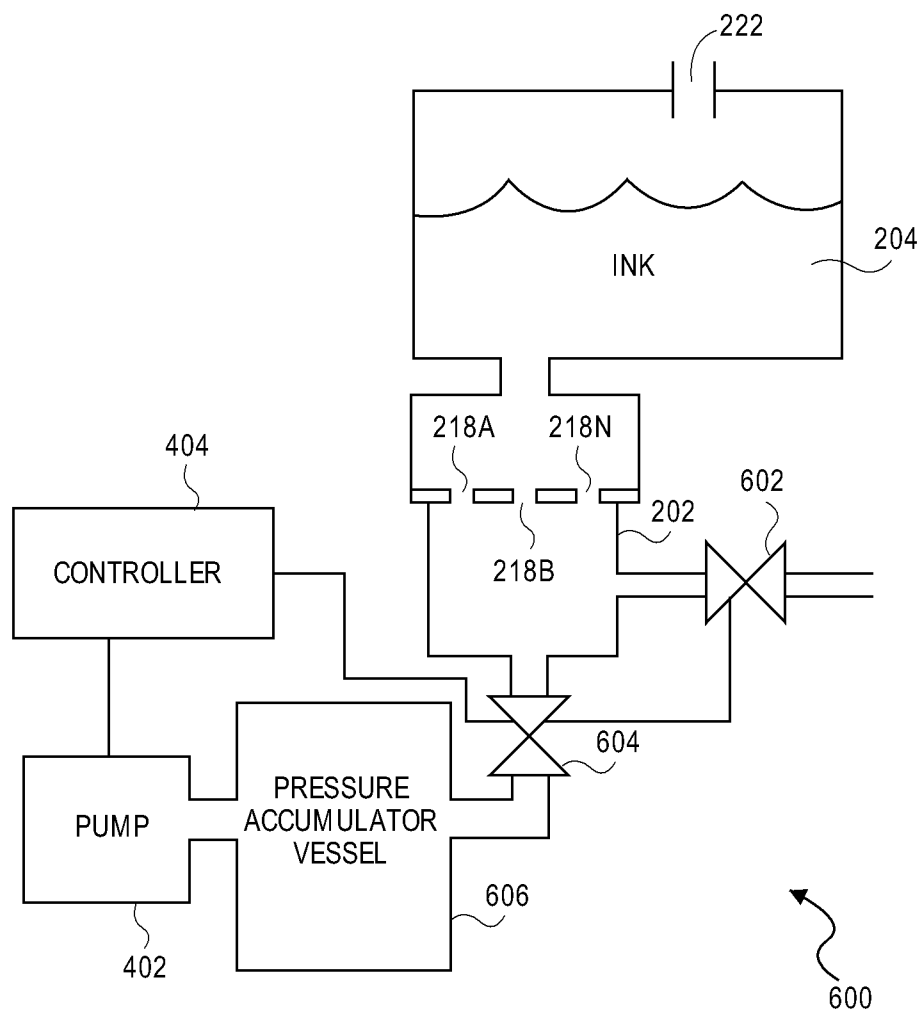
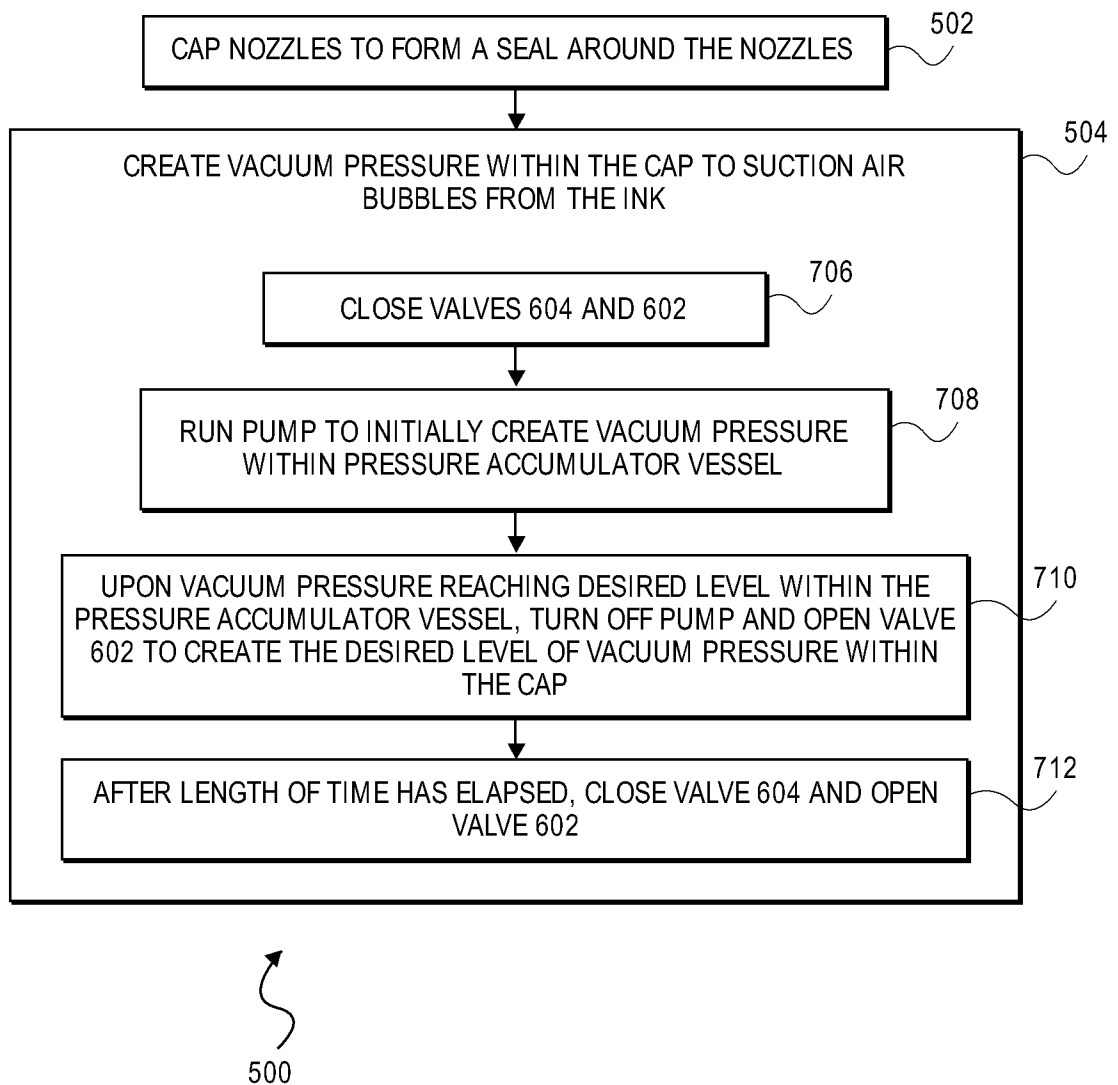


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/064811**A. CLASSIFICATION OF SUBJECT MATTER*****B41J 2/175(2006.01)i, B41J 2/325(2006.01)i***

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)

IPC B41J 2/175, 2/325

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KOREAN UTILITY MODELS AND APPLICATIONS FOR UTILITY MODELS SINCE 1975

JAPANESE UTILITY MODELS AND APPLICATIONS FOR UTILITY MODELS SINCE 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS(KIPO internal) & keyword : pump, priming, vacuum, suction, inkjet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2002-109747 A1(KARAI P. PREMNATH; WILLIAM L. KING) 15 August 2002 See Abstract; Paragraph [0022] - Paragraph [0026] and Figures 2, 3	1-6, 10-12, 15 7-9, 13, 14
Y	JP 2000-052568 A(SEIKO EPSON CORP) 22 February 2000 See Paragraphs [0039], [0042], [0046], [0055], [0056], [0067], [0069], [0071] and Figures 2, 4-7	7-9, 13, 14
A	JP 2006-076130 A(FUJI XEROX CO., LTD.) 23 March 2006 See Paragraphs [0025], [0030], [0035], [0036], [0038], [0041] and Figures 2, 7	1-15
A	JP 62-077939 A(CANON INC) 10 April 1987 See Page 2, Left Column, Line 22 - Right Column, Line 29 and Figures 3, 4	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search

24 FEBRUARY 2009 (24.02.2009)

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2008/064811

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JP 2006-076130 A	23.03.2006	None	
JP 62-077939 A	10.04.1987	None	