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October 2021

INK DELIVERY SYSTEM WITH INTERMEDIATE TANK INK MIXING FEATURE

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Recommended Citation

INC, HP, "INK DELIVERY SYSTEM WITH INTERMEDIATE TANK INK MIXING FEATURE", Technical Disclosure Commons, (October 04, 2021)
https://www.tdcommons.org/dpubs_series/4638



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Ink Delivery System with Intermediate Tank Ink Mixing Feature

Abstract

More and more, **Large Format** and **3D printers** include **more difficult inks/agents** to maintain them healthy (due to pigment settling, ink aging, etc.) and Ink Delivery Systems have tried to overcome this challenge with **complex recirculation systems** that recirculate ink through the tubes, cartridges, tanks and even through the printhead.

However, such systems are very complex, with a lot of hardware components, complicated algorithms and overall, too expensive for some printer segments.

Some printers with a high printing usage do not need to recirculate through all the system, and only **ink mixing in the Intermediate Tank would be required**, as this is the largest volume of ink that is stored in the printer.

This new disclosure presents a **new Ink Delivery System that includes a method to keep the ink pigment mixed in the Intermediate Tank**. The Intermediate Tank is an internal buffer of ink in the printer, and it is where most of pigment settling occurs.

The invention relies on having two intermediate tanks per color and moving ink between the two to mix completely the ink. The solution is based on pressurizing only one intermediate tank through its air pressure system and swapping between the two by a 3-way valve.

This system offers several advantages, as the only additional hardware added is in the air side and does not require any sensors or other valves in contact with the ink.

Invention

The **Ink Delivery System** described in this disclosure has the following elements:

- In the ink side, it has an Ink cartridge and an Ink Pump per color/agent, which is in charge to recharge the Intermediate Tanks where needed.
- It includes two Intermediate Tanks connected in parallel per color. These are the ones that provide ink pressure / flowrate to the printheads. Such Intermediate Tanks have one differential pressure each to detect when the Intermediate Tank is full or empty.
- The Air Pressure System includes an Air Pump and Relief Valve. The main novelty of this disclosure relies on the **Air Pressure System Control**. A **4-port 3-way valve** is included in the system to be able to select between three different pressurization modes:

- **Printing/Refill/Idle: Pressurization Mode A** In this configuration, the Air Pump pressurizes both Intermediate Tanks at the same time and enables either the printing or an Intermediate Tank Refill (it will refill both at the same time).
- **Ink Mixing in the Intermediate Tank: Pressurization Mode B and Mode C.** When an ink Mixing is needed (based on a Timeout since the previous cycle), the valve will commute to the position B to move the ink from one tank to the other. Once the donor tank is empty (detected by the Pressure Sensor), the valve will commute to position C to perform the opposite cycle.

The following figure shows the basic schematic of this invention in the electro-valves **Position A**:

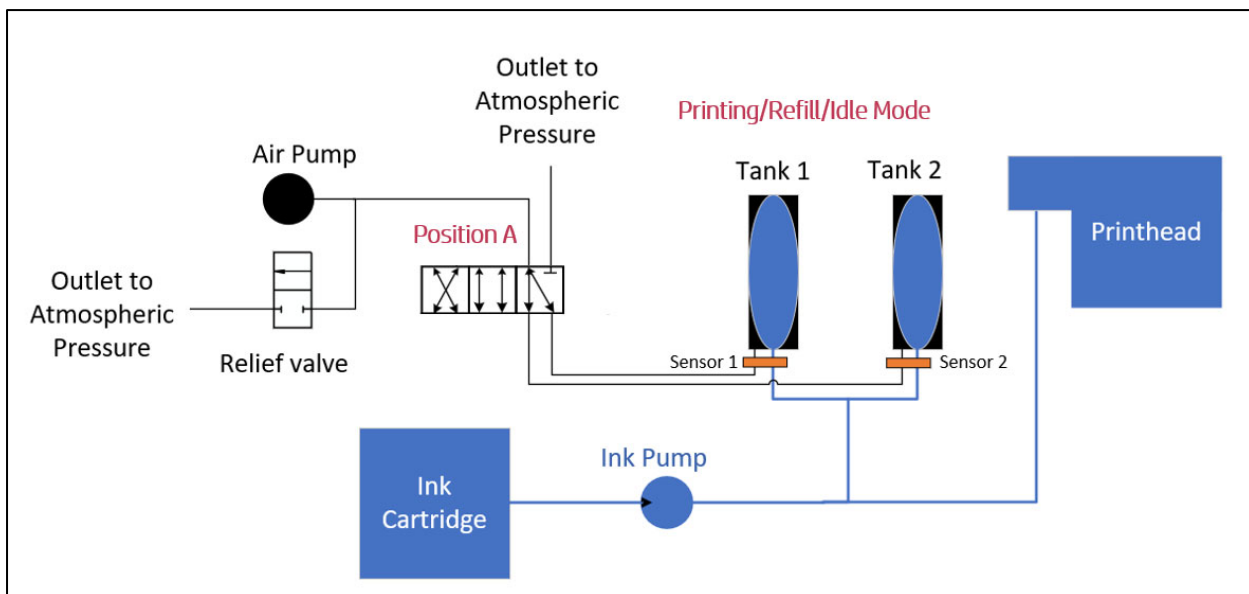


Figure 1 Ink Delivery Schematic with electro-valve in Position A

The following figure shows the basic schematic of this invention in the electro-valves **Position B**:

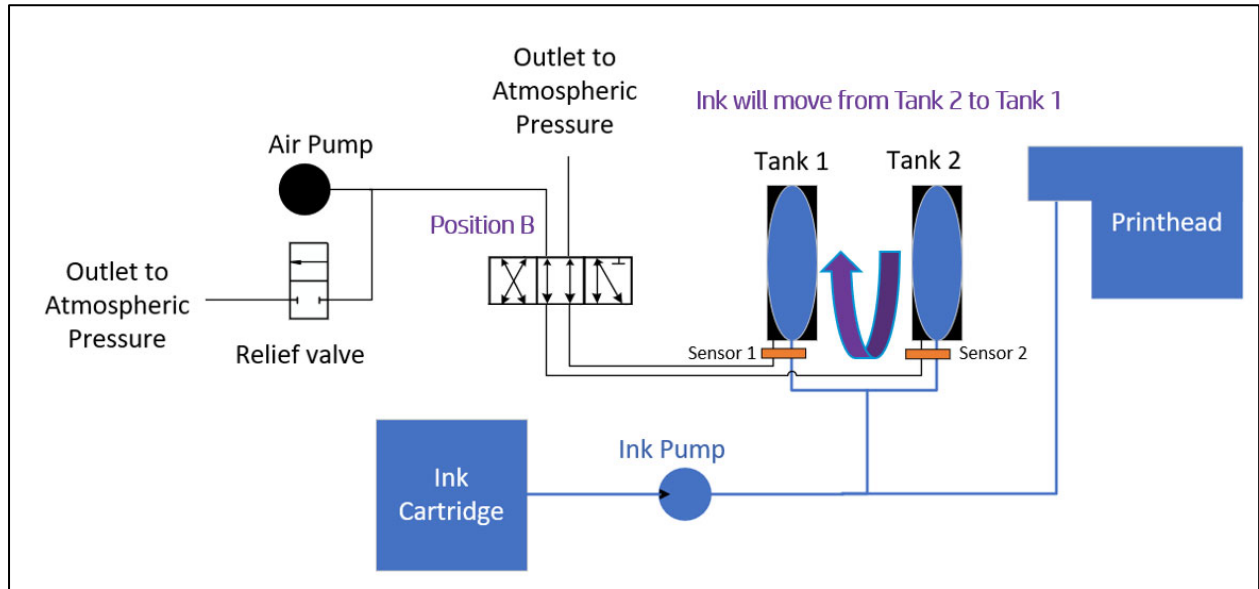


Figure 2 Ink Delivery Schematic with electro-valve in Position B

Finally, the following figure shows the basic schematic of this invention in the electro-valves **Position C**:

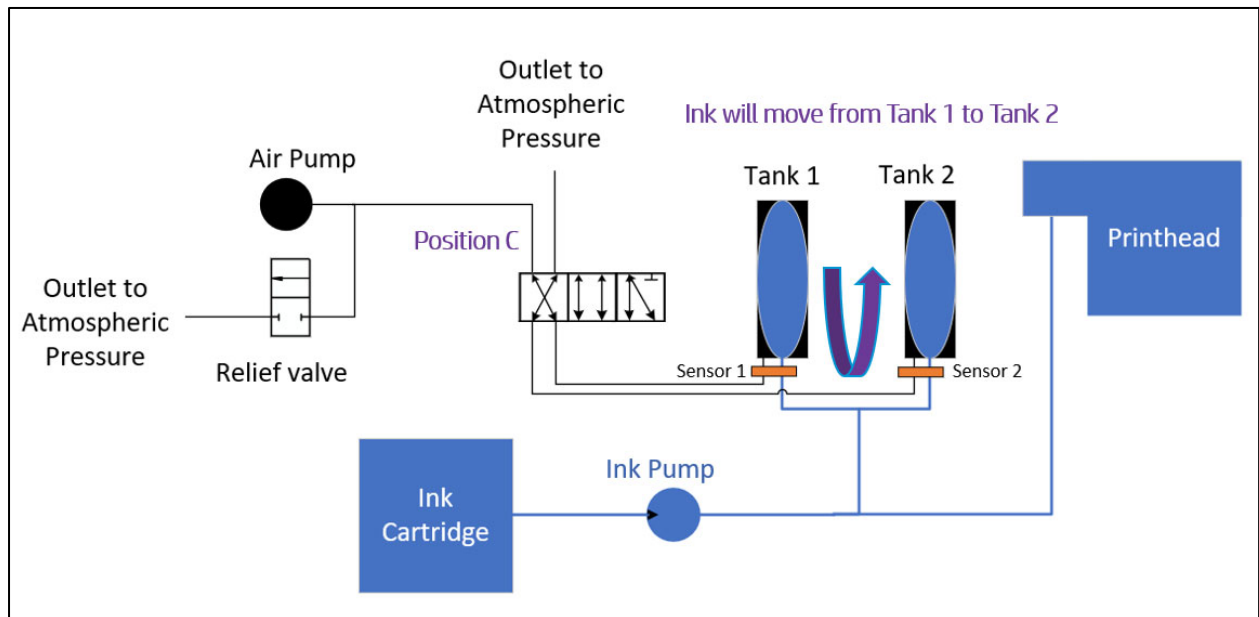


Figure 3 Ink Delivery Schematic with electro-valve in Position C

The problems solved with this new Ink Delivery System are several:

- It offers a solution to keep the ink mixed in the Ink Delivery System without having to include a complex Recirculation System, which is expensive, less reliable and more difficult to manufacture and support.
- It does not require to recirculate through the Printhead, which is the most challenging of the recirculation modes and it requires a specific printhead (with a recirculation path enabled) and more electronics in the carriage.

Prior solutions to this invention include the following:

- Typically, the Recirculation IDS consist of an Intermediate Tank (pressurized by the APS) and two external bags. When the recirculation occurs, the ink from one bag moves to the other by using an ink pump, also the Intermediate Tank is emptied by the APS to that destination bag. Finally, the Intermediate Tank is refilled from the destination supply. This solution requires a complex IDS composed by several electro-valves that allow to configure different circuits depending on the recirculation direction.
- Other solutions could consist of requiring the customer to manually shake the Intermediate Tank with a certain frequency. However, this implies an extra action done by the customer, manipulating the hardware and furthermore, designing the IDS to allow the access to the customer to the Intermediate Tank.

This new Ink/Agent Ink Delivery System offers several advantages. Among them:

- Automatic process: ink mixing process is done automatically when the printer is in idle.
- Image Quality: the ink stored on the Intermediate Tank is properly mixed, ensuring the best Image Quality of the printed jobs.
- Agent settling on the Intermediate Tank: no agent settling on the dead volume of the Intermediate Tank, which could imply the premature replacement of the Intermediate Tank due to the agent settling.
- Flexibility: the solution does not depend on the supply type, printhead architecture or relative position between the different IDS components.

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