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CONTINUOUS IMPULSION INK DELIVERY SYSTEM FOR PRINTERS

HP INC

Continuous Impulsion Ink Delivery System for printers

1. ABSTRACT

The invention disclosure presented here describes a new architecture of an Ink Delivery System (IDS) based on moving the ink permanently during printing without using an ink buffer, also known as Intermediate Tank. This solution provides enough ink flow and pressure to ensure a correct printing operation of the Print Head. Moreover, it presents great advantages in terms of system performance, printing speed and reliability.

2. PROBLEMS SOLVED BY THIS INVENTION

Previous Ink Delivery Systems used for industrial and high production printers have very short Hot Swap times. Hot Swap is the concept of being able to replace a Supply when it is finished without stopping printing. In current printers this functionality needs the presence of an Intermediate Tank. This component acts as an ink buffer between the Ink Supply and the Print Head, allowing to continue printing during the replacement of an Ink Supply since the ink is moved from the Intermediate Tank to the Print Head while there is no Supply connected. However, this concept has the inherent limitation of the low volume of the Intermediate Tank, which is much smaller than the Supply. This can lead to the necessity of replacing a Supply within few minutes since the Supply is finished. Otherwise the current job being printed is cancelled.

The invention presented here does not use any Intermediate Tank, instead it works with two Supplies for each fluid. This means that the second Supply behaves as an ink buffer while the other is being replaced, providing much more time to do the operation due to its high volume.

Besides, it is common that the Intermediate Tank and the components associated with it have reliability and robustness issues. The Intermediate Tank is filled and emptied thousands of times during the printer life, which can lead to failures due to fatigue. Since the Continuous Impulsion IDS does not require Intermediate Tanks these problems are solved.

Finally, it is also common to have difficulties to diagnose the Ink Delivery System of a printer. This system is very complex and in previous concepts it depended on many components and algorithms, all interconnected. The new solution improves greatly the printer's ability to self-diagnose because it reduces the number of components and the algorithms related to them.

3. PRIOR SOLUTIONS AND THEIR DISADVANTAGES

There are two main types of Ink Delivery Systems that have been used in up to now. The first one is based on pressurizing with air the Ink Supply and use this pressure to push the ink to the Print Head. The main disadvantages of this concept are that it can provide very low ink flowrates and it does not allow Hot Swap, in other words, if an Ink Supply is removed during printing, that job is stopped and lost. For these reasons this type of Ink Delivery System is only used in Low Volume Printers

The second type is composed of an Ink Supply, an ink pump and an Intermediate Tank that is pressurized with air. The role of the ink pump is to fill the Intermediate Tank from the Supply, while the ink is pushed from the Intermediate Tank to the Print Head using air pressure. When the Supply is being replaced the Intermediate Tank behaves as an ink buffer. As commented before, the necessity of an Intermediate Tank itself is a disadvantage when high production is required. The Intermediate Tank's volume compromises the amount of time available to replace the Supply and it leads to robustness issues since it must cycle between full and empty thousands of times.

4. DESCRIPTION OF THE CONSTRUCTION AND OPERATION OF THE INVENTION

The Continuous Impulsion Ink Delivery System is based on a fluid pump that is working as long as the job is being printed and is surrounded by a mini-recirculation circuit, which contains a mechanic relief valve. This valve limits the pressure in the ink line.

Each line uses two Supplies to enable Hot Swapping - the ability to replace a Supply without stopping printing - avoiding the need of an Intermediate Tank and an Air Pressure System for pressurizing the Intermediate Tank. There is also an electro-valve selecting the Supply being used at any given moment [Figure 1 **and** Figure 2**].**

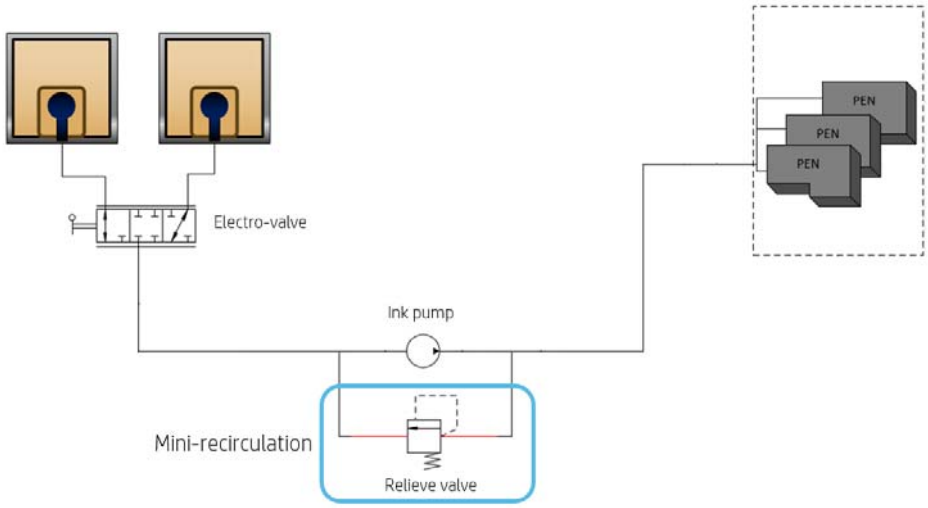

Figure 1: Schematics

Figure 2: Dual Supply

The system works as follows. As soon as a job starts the ink pump is switched on; for the rest of the printing time the ink pump will remain working, independently if that specific fluid is being fired by the Print Heads or not at any given moment. Thus, when there is no ink consumption by the Print Head, the ink pushed by the ink pump increases the pressure in the ink line up to the point when the relief valve is opened. This creates a recirculation path around the ink pump, resulting in the ink flowing around the pump continuously [Figure 3**]. It is important to point out that during this phase no ink is absorbed from the Ink Supply, all the ink being moved is already in the ink line.**

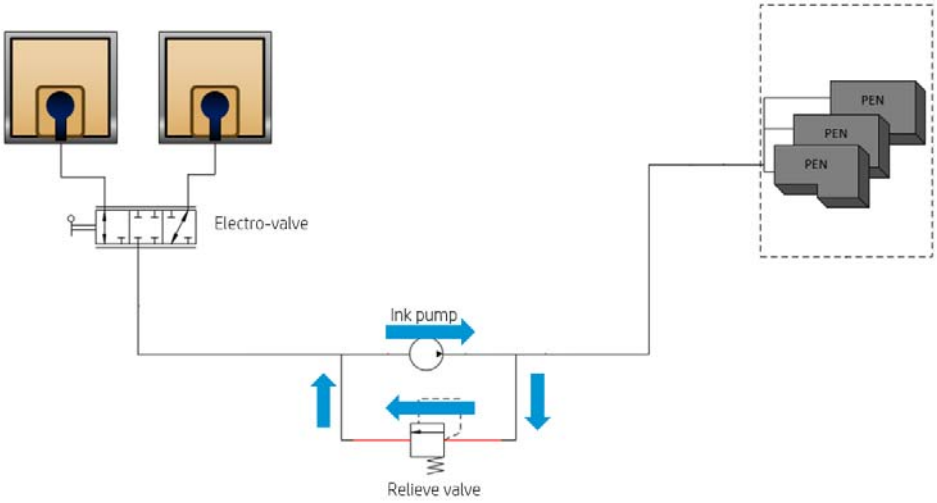

Figure 3: No ink consumption

When the Print Head starts firing ink and requires to be filled by the Ink Delivery System, the pressure in the ink line will drop, causing the relief valve to close. Thus, the ink is now flowing from the Supply to the Print Head by the action of the ink pump [Figure 4**]. The pressures during printing can be observed in** Figure 5**, where Pressure 1 represents the pressure at the entrance of the ink pump and Pressure 4 is the ink pressure at the entrance of the Print Head. As it can be seen, the relief valve works as expected and regulates the ink pressure along the line, ensuring only the necessary ink is flowing to the Print Head, while the rest is kept in the mini-recirculation circuit.**

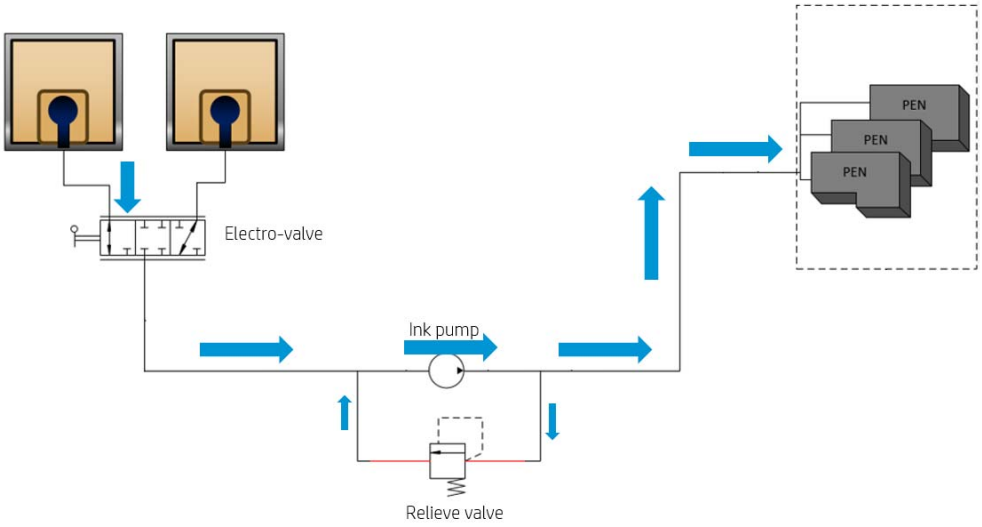

Figure 4: Ink consumption

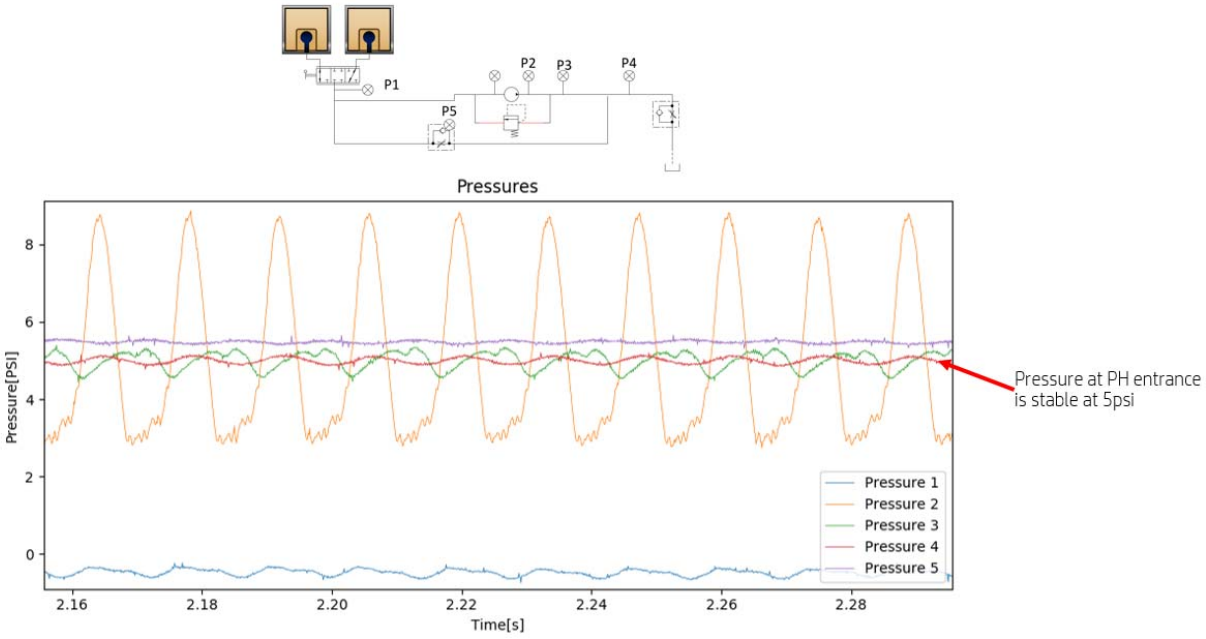

Figure 5: Pressure measures during printing test

5. ADVANTAGES

Simplicity. Compared to previous concepts, the Continuous Impulsion Ink Delivery System requires less components and less algorithms to work, which leads to better ability to self-diagnose problems and lower chances of having a component failing.

Extended Hot Swap time. The removal of the Intermediate Tank as ink buffer, whose buffer functionality is replaced by the second Ink Supply, increases several times the available time for replacing an Ink Supply.

Increased robustness. The more sensitive components of previous solutions are removed e.g. Intermediate Tank; hence the robustness of the new system improves. Furthermore, there is no need to have an Air Pressure System, reducing the number of components susceptible to fail.

Pressure controlled mechanically. The working principle of the ink pressure control is based in the mechanical relief valve, which does not require any active control e.g. Firmware algorithms. This type of components are very reliable and are able to control the Ink Pressure autonomously. For safety, a pressure sensor would be added to the system to monitor the pressure, but it would only be used as a disaster check.

Disclosed by Carlos Chover, and Rodrigo Alvarez, HP Inc.