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AUTOMATIC DETECTION OF A NON-EFFECTIVE PRIME

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Automatic detection of a non-effective prime

Abstract

Some printheads require some servicing routines during the normal operation in order to keep the printheads in good conditions. Typically, the servicing routines consist of a combination of spitting, where the resistors are activated to spit ink, and blow primes, that consist of applying air pressure on the printhead vent to open the printhead regulator and eject some ink.

Typically, the result of performing a non-effective prime is a defect on the Image Quality, since during the servicing routines, the amount of ink ejected during a prime is lower than the required. This situation could occur if there is an obstruction on the air channel that connects the air pump to the printhead regulator.
Note that even though some primer subsystem includes a pressure sensor, since the volume of the air channel is too small, it may be difficult to detect an obstruction based on the pressurization profile compared to a regular prime.

This invention describes an automatic process to detect a non-effective prime based on monitoring the temperature measured by the TSR (Temperature Sensor Resistance) located in the printhead. Depending on the temperature profile during a blow-prime, a non-effective prime can be detected. Furthermore, the solution allows to detect drooling situations.

Invention

The solution proposed allows to automatically detect a non-effective prime in real time based on the temperature measure by the TSR (Temperature Sensor Resistance) located in the printhead.
During a servicing routine, the printhead perform a series of spitting and primes. The solution takes advantage of the fact during a blow-prime event, the temperature of the TSR is reduced since the ink ejected, which is at a considerable temperature, is replaced by fresh ink.

The following graphs corresponds to an effective prime event: Before performing a blow-prime, the printhead resistors are activated and the steady state temperature is 44ºC (*point 1*). Then, the resistors are deactivated (*point 2*) and the TSR starts decreasing. Then, a blow-prime is triggered for 1 seconds (*point 3*) and the temperature decreases since the ink ejected at a higher temperature is replaced by fresh ink and the temperature decreases. When the blow-prime stops (*point 4*), the temperature starts stabilizing to the room's temperature, approx. 37ºC (*point 5*).

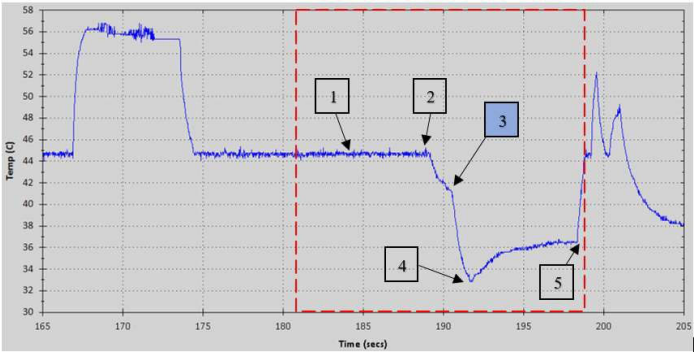

Figure 1. TSR measurements during an effective blow-prime

The following graphs corresponds to a non-effective prime event caused by a misalignment on the rubber tips of the latch respects the printhead vent, not allowing to blow-prime the printhead regulator bag to eject ink. In this case, when the blow-prime starts (point 3), there is not a sudden decrease on the temperature read by the TSR.
If this situation occurs, the printer rises a System Error alerting the customer that a non-effective prime has been performed in order to take the proper actions.

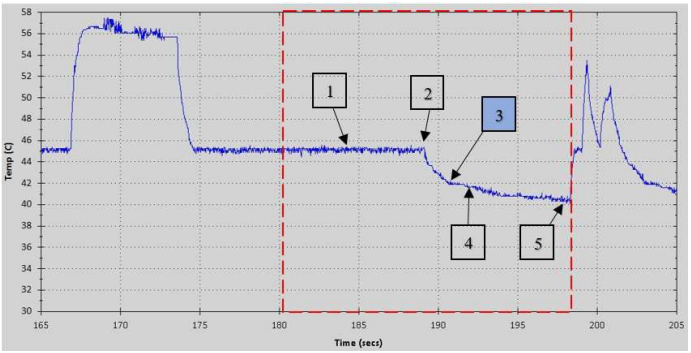

Figure 2. TSR measurements during a non-effective prime

As previously commented, the invention proposed also allows also to detect if the printhead is drooling. For instance, if a particle is in the printhead regulator not allowing the printhead to close the regulator, or if there is an obstruction on the air channel that is increasing the time required by the printhead to recover the backpressure and ink is being ejected until the printhead recovers the backpressure since the Ink Delivery System provides pressurized ink.

The following image corresponds to the case in which there is a partial blockage on the air channel. A blow-prime is performed and the temperature decreases (*point 3*). However, when the blow-prime stops, the temperature continues decreasing (*point 4*) since the regulator is still open while there is pressurized ink provided by the Ink Delivery System.

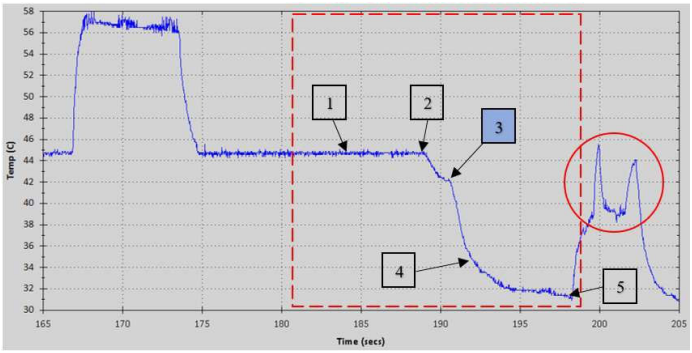

Figure 3. TSR measurements during a prime showing drooling

It is also remarkable that during the Servicing routine, the resistors are not able to increase the printhead temperature to its expected values due to the ink flux (see red cercle temperature profile compared with the other previous cases).

If this situation occurs, the printer automatically depressurizes the Ink Delivery System and rises a System Error to alert the customer. Since the drooling situation could have been detected during the first cycle of spitting and priming, the severity of the drooling observed in the image would be lowered.

The automatic detection will be triggered during the normal operation of the printer, when a servicing routine that includes a series of spitting and primes is triggered, monitoring the TSR. Furthermore, a dedicated Service Engineer diagnostic could be implemented to help during the troubleshooting of the primer subsystem.

The advantages that the invention provides are:

- **Automatic detection of a non-effective prime:** the detection is triggered during the normal operation of the printer, when a servicing routine that includes spitting and primes is performed, such as the Beginning of Job servicing.
- **Detection in real time:** a non-effective prime is detected when it occurs. This improves the diagnostic ability and prevents consequents issues related to performing non-effective primes.
- **Customer experience:** detecting when a non-effective prime is happening, avoids problems such as Image Quality or a severe drooling if the situation is not detected. Improving the overall experience of the customer with the printer.
- **Troubleshooting:** being able to detect when a non-effective prime occurs, improves the troubleshooting of the printer.
- **Robustness:** improves the overall robustness of the printer by detecting when an issue with the primer subsystem is happening, reducing the severity of the droolings that may affect other hardware parts.
- **Repair cost:** reduces the cost of a reparation by replacing only the affected parts, avoiding replacing a part that is performing properly. Furthermore, by detecting a drooling situation and reducing its severity, reduces the cost of replacing affected parts by a massive drooling.
- **Warranty cost:** typically, when an Image Quality defect happen, the first reaction is to install a new printhead. If the issue is related to the primer subsystem not performing an effective prime, the second printhead will fail too. This solution identifies an issue with the primer subsystem and trigger the corrective actions.
- **Printer cost:** does not requires extra sensor, reusing the TSR of the printhead.

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